F & R Cawley Limited

Part B2 – Section 5c
Non-Technical Summary

F & R Cawley Limited are applying to vary permit reference MP3397NF to allow them to treat lithium-ion batteries at their Household, Commercial and Industrial waste transfer station at 1 Covent Garden Close, Luton. The site had historically collected and bulked used single stream industrial used lithium-ion batteries, which were exported without treatment. The site has developed a process to treat lithium-ion batteries with the recovery of materials through mechanical separation. The process has been trialled under a research and development arrangement with the Environment Agency over the past 2 years and is now in a position to be added as a permitted activity.

A flow diagram has been prepared to summarise the overall treatment process and this is provided in Appendix I with the Operations and Procedures Manual provided in Appendix II. In summary, the process includes the following stages:

Stage	Description
Pre acceptance	Only single stream lithium-ion industrial batteries will be accepted for processing. A battery risk assessment form is completed as part of the initial sales enquiry process. Where required, Cawleys undertake further checks, obtain additional information and undertake an inspection prior to transport to site.
Transport / Tracking	Batteries are required to be packed in UN approved cases under the Carriage of Dangerous Goods and use of Transportable Pressure Equipment Regulations 2009 (ADR 2023). The batteries are logged and tracked from acceptance through to which bag of lithium flake they are added to for onward recovery.
Acceptance	Each battery is weighed on receipt, if not already completed, and a thermal scan undertaken with handheld thermal imaging cameras. Any batteries with an elevated temperature are removed and where safe immediately discharged and dismantled. If not safe, the batteries are quarantined and the quench tank utilised. Where batteries pass all initial checks they are temporarily stored.
Storage	Lithium-ion batteries are stored separately from all other batteries on site in two temperature-controlled ISO containers equipped with a fire detection system and are capable of being flooded with water should thermal runway occur. Both shipping containers are surrounded on three sides by a concrete block wall designed to act as a fire break. They are vented and fitted with heating and cooling units that will maintain a constant temperature and thermal imaging cameras designed to identify a significant increase in temperature.
Sorting / Segregation	Visual and temperature checks are undertaken on each battery. Battery packs are then moved into the main workshop where they are dismantled by trained, competent and authorised technicians in accordance with the safe system of work. Once the battery pack has been broken down to modular level, modules are identified for either re-use or end-of-life materials recovery.

Stage	Description
Re-use	Modules identified for re-use are re-packed in accordance with ADR 2021 requirements and stored in the temperature-controlled ISO containers prior to being shipped to a European partner organisation Under Annex 7 under approved Trans Frontier Shipment (TFS) Licences (GB 0001 008850 Van Peperzeel NL & GB 0001 008793 EcarACCU NL).
Pre-treatment	Modules identified for end-of-life materials recovery are full discharged using a bi-directional power supply. When the discharge is complete the unit is checked for compliance by one of the trained and authorised technicians who fits a jumper lead between the positive and negative terminals on each battery to stop any potential chemical recharge. The discharge process eliminates the risk of fire when the batteries are shredded.
Treatment	The shredding of batteries takes place under cover and within an area benefitting from sealed drainage in accordance with the requirements set out in the Waste Batteries and Accumulators Directive. The shredding plant has been specifically designed and commissioned for the mechanical treatment of lithium batteries. It is located in a separate section of the treatment building with fire rated glass and doors. The batteries enter the shredding plant via conveyor belt to ensure no personnel are located next to the shredder plant when in operation. A dust extraction system is in place. All equipment is checked and serviced with routine maintenance. The shredding process creates a lithium flake (approximately 10mm in size), which comprises metal/plastic flock and black mass. No further recovery of metals from the lithium flake is undertaken on site.
Storage for Recovery	Lithium flake that is temporarily stored in UN approved 1 tonne flexible intermediate bulk containers (FIBC). The flake is not combustible and is stored in the yard area on sealed drainage until there is a sufficient quantity to form a single load.
Onward Recovery	The lithium flake is transported off site for further recovery and refining of metals under the TFS.
Emissions Control	Abatement is provided by a carbon filter and vented to a local exhaust vent (LEV) stack. The LEV system is as ATEXON® VR18Z Spark Detection and Ex-tinguishing System, which has been installed and designed to reduce the risk of ignition sources such as embers from reaching protected equipment. Replacement filters are installed by competent operatives under permit to work. Diffuse emissions are minimised by carrying out the activity within a building. The shredder is only operated within separate enclosure.
Emissions Monitoring	A Dust Management Plan is not considered necessary as the shredding process is conducted inside the treatment building and is in a controlled environment with a dust extraction system to a local exhaust vent. Personnel are not allowed to be adjacent to the shredder when in use to reduce direct exposure. Shredding equipment is regularly maintained to prevent build up of explosive dust and use of ATEX certified equipment. DSEAR risk assessment are in place and a copy is provided at Appendix III. Air emissions from the stack are subject to annual monitoring. A specific air emissions risk assessment has been completed and no significant risks have been identified based on emissions to air from the past 2 years of trials. A separate Noise Management Plan is not considered necessary as the shredding process is undertaken inside the battery treatment building and risk assessment has not identified this as a significant issue. Noise levels from the battery treatment process are at or lower than the noise levels associated with the existing HCI waste treatment facility.

Stage	Description
Emergency Control Measures	A Fire Prevention Plan and Lithium Ion Operations Fire Strategy are in place and provided in Appendix IV. In summary, the battery storage containers can be flooded with water in the event of emergency. A quenching tank is also present on site for any batteries exhibiting thermal runaway. The workshop is protected by comprehensive smoke detectors and fire alarms and all working areas are monitored by thermal cameras to alert for increases in temperature. Battery temperatures are checked twice daily. Fire detection is present within the building together with automatic fire suppression measures during the shredding process. The active air extraction also reduces fire risk. Standard fire fighting equipment is also present.

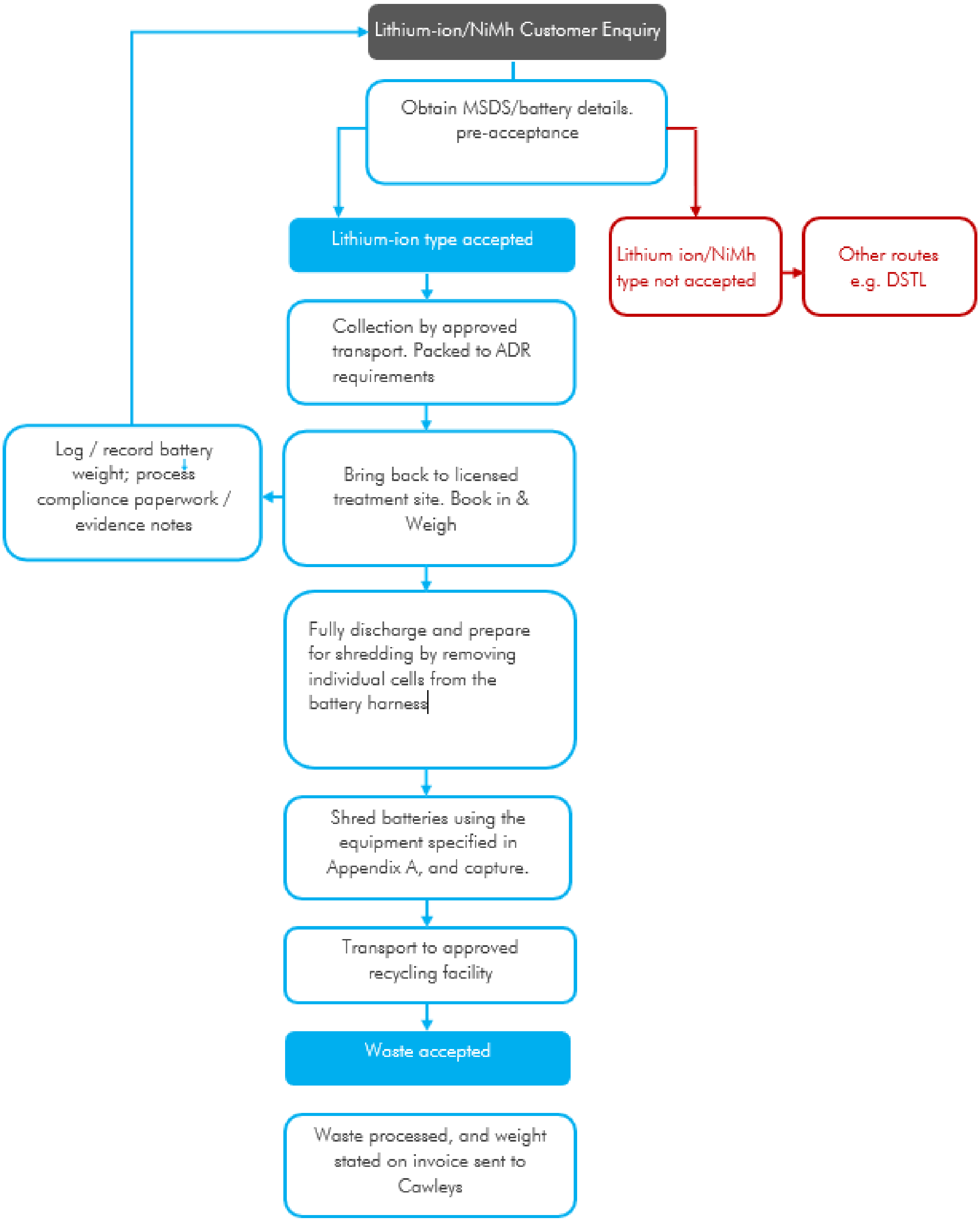
The maximum quantities of waste to be stored on site are as follows:

Waste Type	Waste Code	Maximum Storage Capacity	Location
Lithium Ion Batteries	16 06 05	<20 tonnes	UN approved packaging within ISO Containers
Recovered Materials	19 10 05*	<30 tonnes	UN approved storage in FIBCs

The lithium battery shredding activities will take place approximately 260 weeks of the year with the battery shredder operational for approximately 520 hours i.e. 2 hours per working day.

Appendices

Appendix I – Process Map



Appendix II – Operations and Procedures Manual

LITHIUM BATTERY ACCEPTANCE & TREATMENT, COVENT GARDEN CLOSE LUTON

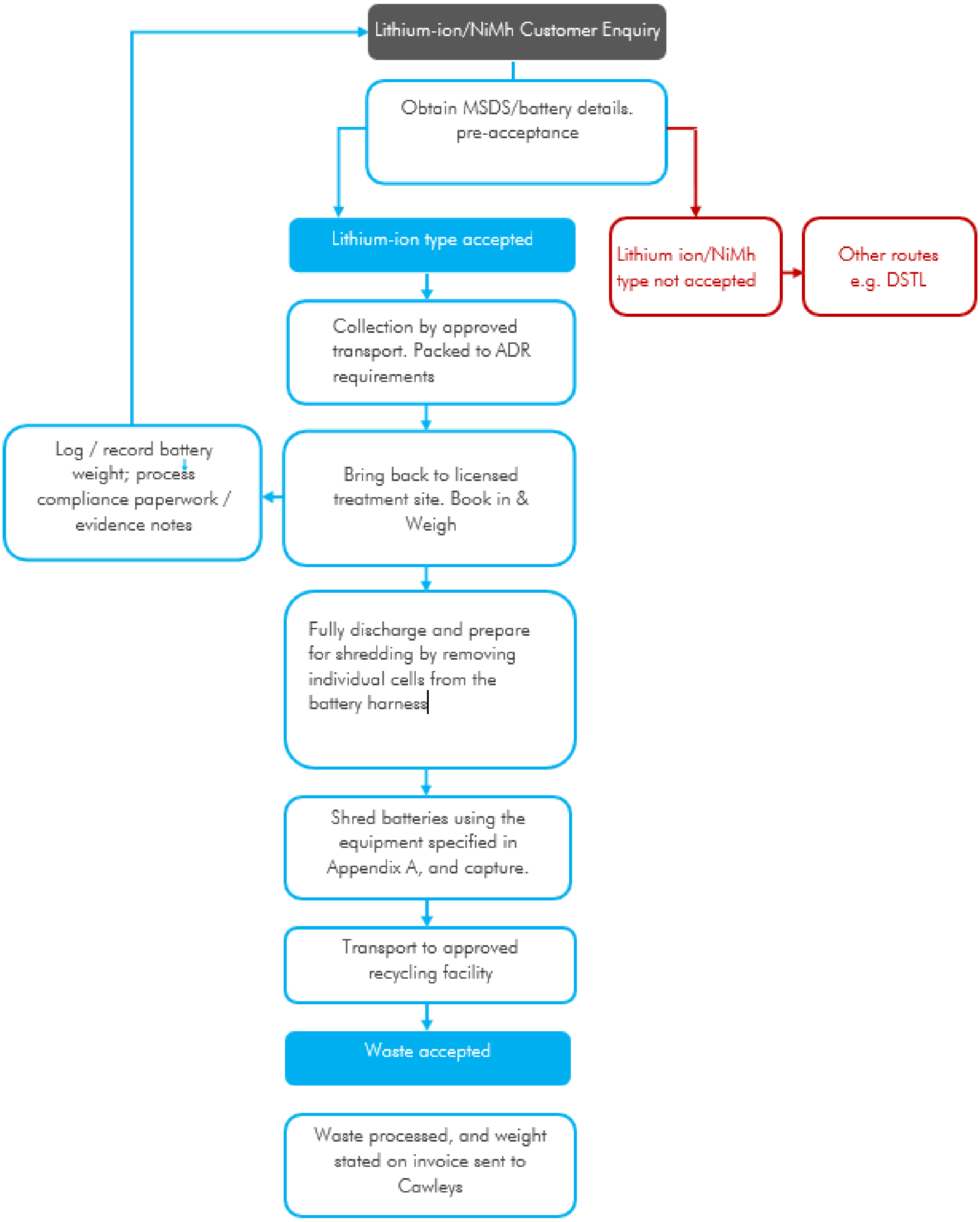
OPERATIONS & PROCEDURES MANUAL

ACCEPTANCE | SAMPLING | DOCUMENTED SYSTEM | INSTRUCTIONS | LICENCES

Cawleys, 1 Covent Garden Close, Luton, Beds LU4 8QB ▶ Tel 0845 260 2000 ▶ Fax 01582 847 453 ▶ Email info@cawleys.co.uk
Company Registration No. 4170234 | Registered Name: F & R Cawley Ltd

PROCESS MAP

LITHIUM ION & BATTERY COLLECTION & TREATMENT



ACCEPTANCE CRITERIA & TREATMENT INFORMATION

LITHIUM ION BATTERY ACCEPTANCE, INSPECTION, STORAGE & MONITORING PLAN

F&R Cawley currently collects, and bulks used single stream industrial, used Lithium-Ion batteries, which are exported without treatment.

These batteries are collected from a number of organisations under contract that create spent or damaged units e.g. The Motor Industry Research Authority who are involved in the testing of these units which are used to provide motive power to electric and hybrid vehicles from various producers – currently these batteries are collected, broken down to modular level and exported without any form of treatment.

The company are permitted to store lithium-ion batteries at 1, Covent Garden Close, Luton, Bedfordshire, LU4 8QB under permit number EPR/MP 3397NF – covering European Waste Codes 16 06 04 and 16 06 05. In addition, the Company has Approved Battery Export Status which it has held since 2018, exporting whole battery packs to a number of European partner organisations under Annex 17 of the Green List and Approved Battery Treatment Operator (ABTO) status was granted in February 2021.

The company would prefer to send batteries for recycling in the UK both in relation to the treatment costs and to reduce the environmental impact of sending batteries to Europe. In order to deliver this the company has developed a treatment option that involves the breaking down of the battery pack to modular level with the resulting modules being triaged and sorted for either onward shipment to second life re-use, or end-of-life materials recovery.

Lithium-Ion second life re-use / end-of-life materials recovery battery pack collection.

The company will only accept single stream lithium-ion industrial batteries for processing – this is communicated to the customer at point of sale or following a customer enquiry.

With any waste battery a Risk Assessment Form is completed as part of the sale / enquiry process in order to ensure the customer fully understands their obligations in full disclosure of all details needed to safely store and collect the batteries. Lithium-Ion batteries are classed as a Dangerous Good and will be consigned and moved in accordance with ADR 2021 (e.g. UN3480 Lithium Ion Batteries, UN3481Lithium Ion Batteries Contained in Equipment, UN3090Lithium Metal Batteries, UN3091Lithium Metal Batteries Contained in Equipment)

With the RA Form the customer confirms this detail via the waste description which is transposed on to the Dangerous Goods Note that accompanies each load collected.

Where damaged batteries are identified for collection the extent and timescale of the damage and potential risks are assessed prior to collection and the appropriate packaging is determined following the options given under ADR 2021. Packaging Instructions P908, P909, P910, P911 or LP903, LP904,LP905,LP906 (4.1.4 ADR2021) are considered and a suitable UN Approved package is used for the collection either under PG1 or PG2 conditions.

On the day of collection, whilst on the customers premises a physical check is made by the vehicle driver to check that the load is as described and is recorded correctly on the Dangerous Goods Note and Waste Transfer Note, and a thermal scan completed using a handheld thermal imaging camera with the results recorded.

In the event that the thermal scan detects elevated temperatures the customer and Cawleys Lithium Battery Recyclgin Solutions DGSA will be informed, with the battery pack isolated and left on the customers premises awaiting further advise.

Lithium ion industrial (vehicle) batteries will be moved as a whole item.

Where sub-contractors are used to make the collections, they will work in accordance with the above as a contractual requirement.

<u>Site acceptance of Lithium-Ion second life re-use / end-of-life materials recovery battery packs at Covent Garden Close.</u>

Upon arrival at 1 Covent Garden Close the load will be subject to another thermal scan completed using a handheld thermal imaging camera prior to unloading, with the results recorded.

In the unlikely event of a battery pack being identified with an elevated temperature this will be removed from the main load, and if safe to do so, immediately dismantled and discharged. If unsafe to dismantle the battery will be submerged in water and placed in the quarantine area to observe.

All battery packs that have not been weighed will be weighed upon receipt at Covent Garden Close using calibrated scales and the weight recorded for each customer will be entered onto the consignment note.

Battery packs are then moved into the main workshop where they are dismantled by trained, competent and authorised technicians in accordance with the safe system of work. The workshop is protected by comprehensive smoke detectors and fire alarms and all working areas are monitored by thermal cameras to alert for increase in temperature.

Breaking the battery pack down into re-use or end of life materials recovery modules.

Once the battery pack has been broken down to modular level, modules are identified for either re-use or end-of-life materials recovery.

Modules identified for re-use are re-packed in accordance with ADR 2021 requirements and stored in 2 x 40 foot designated steel shipping containers that are vented and fitted with heating and cooling units that will maintain a constant temperature and thermal imaging cameras designed to identify and significant increase in temperature. Both shipping containers are surrounded on three sides by a concrete block wall designed to act as a fire break.

These modules are then shipped to a European partner organisation Under Annex 7 with our approved TFS Transfrontier Shipment Licences (GB 0001 008850 Van Peperzeel NL & GB 0001 008793 EcarACCU NL).

All modules being stored have their temperature checked twice per day using a handheld thermal imaging camera with the results recorded in the site log

Modules identified for end-of-life materials recovery are full discharged using a bi-directional power supply. When the discharge is complete the unit is checked for compliance by one of the trained and authorised technicians who fits a jumper lead between the positive and negative terminals on each battery to stop any potential chemical recharge. The discharge process eliminates the risk of fire when the batteries are shredded using the equipment and safe systems of work detailed in Appendix A.

During the shredding process an odour is released which is then masked using a spray injection system with the chemical detailed in Appendix B. The company has completed gas chromatography of the odour generated by the process to confirm that this is not harmful to the environment or health and is using HSE EH40 to review the results of the gas chromatography against. In addition, chemical analysis of the residual material has been undertaken to ensure that this has not changed the waste classification for the material concerned.

The residue of the shredding process, metal/plastic flock and black mass is then packed in a UN approved FIBC ready to transport to our approved recycling partner in Sheffield for onward treatment.

Appendix III – DSEAR Risk Assessment

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DSEAR Assessment for Lithium Battery Shredder

Client	F & R Cawley Ltd. Maidenhall, Bedfordshire.
Contact	Amanda Clark SHEQ Manager
Report issue date	20 March 2023
Report number	R3016012936R1ak




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1. PROJECT DETAILS

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Peer Reviewer	Simon Gakhar, Associate Process Safety Specialist

This report has been issued in digital format. In order to maintain the integrity of the data, the secure digital copy held in the DEKRA archive will be considered the source document; all other versions will be considered uncontrolled copies.

1.1 Revision History

Table 1: Report revision history

Version №	Date	Reason for Revision	Author	Reviewer
R1	20/03/2023	First report with Recommendations	AK	SG

2. EXECUTIVE SUMMARY

DEKRA conducted an explosion safety assessment under the requirements of DSEAR [1] for Cawleys Lithium Battery Shredding Plant located in Maidenhall, Bedfordshire.

The purposes of the study were to conduct an Explosion Risk Assessment and Hazardous Area Classification of the Lithium Battery Shredding Plant, and to assess compliance against the requirements of DSEAR [1].

The main finding of the assessment is that there are gaps in the measures in place for the management of the risks of harm from fires and explosion. These gaps will require additional actions to be taken and these actions have been summarised as recommendations throughout this DSEAR assessment.

The Basis of Safety for the Lithium Battery Shredding Plant is based on:

- The Avoidance of Explosive Dust Atmosphere inside the battery shredder via the application of dust extraction system.
- The Avoidance of Ignition Sources at the dust collection unit through the use of ATEX-certified work equipment.
- The Application of Organisational Measures (battery discharging and testing, compliance with manufacturer's instruction, operator training, etc) for fire prevention inside the shredder.
- The Application of Technical Measures for fire detection and control via fire-resisting materials of construction, spark detection and extinguishment system.

For the Basis of Safety to hold, the recommendations summarised in Section 8 on page 29 should be implemented / actioned so far as is reasonably.

3. ACRONYMS

ATEX: ATmosphères EXplosives

BoS: Basis of Safety

CCTV: Closed Circuit Television

DSEAR: Dangerous Substances and Explosive Atmospheres Regulation

FIBC: Flexible Intermediate Bulk Container

HAC: Hazardous Area Classification

HEDB: High Energy Density Battery

LEV: Local Exhaust Ventilation

MEC: Minimum Explosive Concentration

MIE: Minimum Ignition Energy

NFPA: National Fire Protection Association

PBD: Propagating Brush Discharge

PtW: Permit to Work

SDS: Safety Data Sheet

STEL: Short Term Exposure Limit

WEL: Workplace Exposure Limit

4. DEFINITIONS

ATEX-certified: Equipment certified to the requirements of EU Directive 2014/34/EU and suitable for the hazardous area.

Equipment: machines, apparatus, fixed or mobile devices, control components and instrumentation which are capable of causing an explosion through their own potential sources of ignition.

Explosion: a release of energy that causes a rapid pressure rise.

Flash fire: the term for a slow deflagration of a premixed, truly unconfined, unobstructed fuel-air cloud producing negligible overpressure. Thermal effects are the main hazard.

Fire: a slow combustion where the fuel and air are not premixed. Thermal effects are the main hazard.

Grade of release:

> **Continuous Grade of Release:** release which is continuous or is expected to occur frequently or for long periods.
>
> **Primary Grade of Release:** release which can be expected to occur periodically or occasionally during normal operation.
>
> **Secondary Grade of Release:** release which is not expected to occur in normal operation and, if it does occur, is likely to do so only infrequently and for short periods.

Hot Work: welding, cutting, grinding, brazing, drilling and similar activities which results in sparks, fire, molten slag, or hot surfaces.

Zone 20: an area in which an explosive atmosphere in the form of a cloud of combustible dust in air is present continuously, or for long periods or frequently.

Zone 21: a place in which an explosive atmosphere in the form of a cloud of combustible dust in air is likely to occur in normal operation occasionally.

Zone 22: an area in which an explosive atmosphere in the form of a cloud of combustible dust in air is not likely to occur in normal operation but, if it does occur, will persist for a short period only.

5. INTRODUCTION

F&R Cawley Ltd (Cawleys) have designed and installed a Lithium Battery Shredding Plant at their Recycling Facility in Maidenhall, Bedfordshire. The shredding plant is used for shredding Lithium ion high energy density batteries (HEDB). A significant hazard of the process is dust explosion due to ignition of an explosive dust cloud of the product from the shredding operation.

Cawleys has requested DEKRA Organisational & Process Safety (DEKRA) to conduct an explosion safety assessment as required by the Dangerous Substances and Explosive Atmospheres Regulations (DSEAR) [1].

The project scope is outlined in the DEKRA quotation 3016012936. In summary, the scope of the project is to conduct an Explosion Risk Assessment and Hazardous Area Classification of the Lithium Battery Shredder.

This report does not include assessment of chemical reaction hazards if found on site, although anecdotal comments may be made if appropriate. Also, a fire risk assessment required by the Regulatory Reform (Fire Safety) Order 2005 [9] is outside the scope of this assessment. It is important that such risk assessment is carried out if not done already.

Ade Kalejaiye of DEKRA visited Cawleys Recycling Facility on 16 February 2023 to undertake the assessment. Alan Colledge (Technical Director - Lithium), for Cawleys was present during the assessment and provided valuable information for the exercise.

If a 'Unit Operation' is identified as not being an issue as far as this assessment is concerned, it must be understood that this is only valid as long as the process and circumstance of operation are the same as when the assessment was carried out. If there is any alternation to the Unit Operation in the future e.g., flammable materials are introduced where initially, there were none, then the assessment should be carried out again.

Throughout this report, recommendations are given to either improve safety or fulfil a legal requirement. These recommendations are prioritised using the following principles:

- **Priority H** - High **(H)** recommendations address high-risk issues. This is because the combination of likelihood and severity of the fire/explosion is currently too high. These should be addressed first particularly where the action is easy to implement and / or of low cost.
- **Priority M -** Medium **(M)** recommendations address issues presenting a lower but still moderate risk to personnel. Moreover, recommendation(s) which fulfil a legal duty but are not necessarily addressing a high-risk problem are also marked as M. These items should be addressed in the short term, particularly where the action is easy to implement and / or of low cost.
- **Priority L** - Low **(L)** recommendations address issues presenting low risk issues. Other smaller suggestion to improve safety also fall under this category.

The recommendations given in this report are intended to be a means of ensuring safety for personnel in accordance with the intent of DSEAR. These have all been compiled in Section 8 on page 29. If, however, there is an equally effective way of attaining the same aim, then the two are deemed interchangeable.

It is a legal requirement to review the risk assessment so as to keep it up to date and particularly if significant changes occur in the future. Therefore, the recommendation below is made.

R1. **General -** DSEAR (Regulation 5) requires this assessment to be reviewed at regular intervals. Based on the risks and changes foreseen, it is recommended to review this assessment whenever changes are made but even without changes at no later than 4 years from the date of this report. This should be captured in the site's action tracker or equivalent system. **(M)**

The brief overview of the assessment methodology used in this report is discussed in Appendix B. In summary, it follows the hierarchical 'Three Rules of DSEAR' approach:

1. Do not have a flammable atmosphere, but if you can't and you do…
2. Do not ignite it, but if you can't and you do…
3. Do not hurt anyone.

5.1 Site Overview

Cawleys Recycling Facility in Maidenhall is a multi-purpose waste handling and recycling facility located in a densely populated industrial estate. The Lithium Battery Shredding Plant is located in a warehouse-style building at the southwest corner of the facility (see illustration in Figure 1).

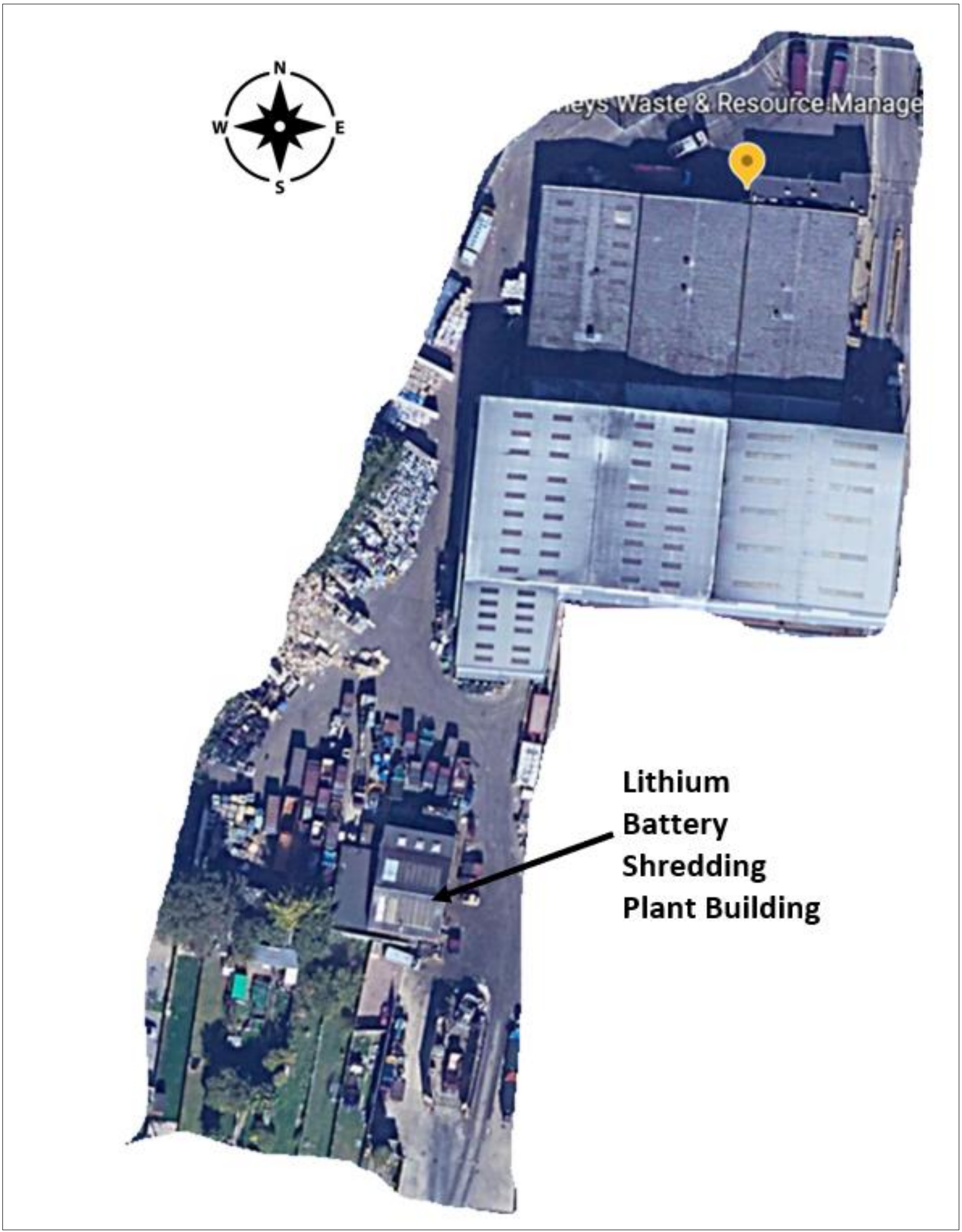

Figure 1: Recycling Facility Layout

6. LITHIUM BATTERY SHREDDING PLANT - HOUSEKEEPING

Good housekeeping is vital in preventing dust explosions in the workplace. Dust layers are extremely dangerous and are known as a major source of secondary dust explosions. Also, layers of dust on items of equipment act as insulators which can cause an item of equipment to overheat which leads to smouldering of the dust layer in contact with the surface of the equipment. Smouldering dust layers are potential ignition sources of explosive dust atmospheres.

At the time of the site visit, there was no discernible dust layers inside the battery shredding plant and it was stated that cleaning of the work area is carried out at the end of the work day. On that basis, it is assumed that dust layers are controlled, and the level of housekeeping was considered to be good.

7. LITHIUM BATTERY SHREDDING PLANT

7.1 Overview of Process

The Lithium Battery Shredding Plant is a warehouse-style building with a roller shutter door located at the east wall of the building and personnel entrance / exit doors located in various areas across the building. Most of the building is open plan but with dividing brick block walls separating offices and the Lithium Battery Shredder from the open plan area.

The primary uses of the open plan area are:

- Storage of batteries waiting to be shredded.
- Storage of 1-ton flexible intermediate bulk containers (FIBC) of battery flakes pending transfer to outdoor storage area.
- Battery discharger and discharging station.
- Battery shredder control panel and video display, and battery loading gravity (roller) conveyor.

The main process steps associated with the battery shredding plant are:

- Battery packs received at the facility are manually dis-assembled into individual batteries.

- The individual batteries are connected to a proprietary battery discharger which ensures that the battery is deep discharged to 0%. The discharger is connected to the power grid and transmits the energy removed from the battery to the grid.

- The discharged battery is kept in a holding area inside the building pending the time they can be loaded into the shredder. A red wire is connected between the positive and the negative terminal of each battery to prevent a build-up of potential difference across the battery terminals.

- The discharged batteries are loaded on to the gravity conveyor, the red wires are removed, and the operator performs a final voltage test to confirm that each battery is fully discharged before starting the battery shredder.

- The battery shredder crushes the batteries to produce flakes of about 10mm particle size which are stored in a 1-ton FIBC. It is understood that the standard practice is to keep the FIBC at less than ¾ of its safe working load so as to limit material losses to the dust extraction unit.

<u>Lithium Battery Shredder</u>

The lithium battery shredder is an assembled equipment comprising of an in-feed belt conveyor, a charging hopper for the shredder element, product (enclosed) belt conveyor [Photograph 1], and a 1-ton FIBC filling station [Photograph 2].

The hopper, product (enclosed) conveyor and FIBC station are fitted with dedicated local extract ventilation (LEV) ducting which is connected to a dust extraction unit that maintains a negative pressure around the shredder unit. It is understood that the battery shredder cannot be started if the dust extraction unit is not working.

There is live closed-circuit television (CCTV) monitoring of the shredder element installed inside the hopper, this allows the operator to have a real time view of the shredding operation inside the hopper.

A spark detection and fire extinguishing (water deluge) system is provided at the inlet side of the shredder element (top of the hopper) and at the outlet side of the shredder element (hopper discharge). It is understood that the drive system for the shredder element has reverse rotation features for managing process upsets.

Whenever a spark or ember is detected inside the hopper, a short (intermittent) burst of water mist is automatically activated to extinguish the fire and an audio alarm is generated at the same time to alert the operator. The spark detection and extinguishing system automatically stops the intermittent burst of water mist when the fire has been extinguished, hence, a manual reset is not required every time the system is activated. This ensures uninterrupted operation of the shredder. It is understood the conveyors are stopped until the fire is extinguished.

The material of construction of the shredder is carbon steel except for the belts on the conveyors. The marking plate on the battery shredder indicated that it was fabricated in August 2020.

Dust Extraction System

Nuisance dust extracted from the battery shredder is passed through a dust collection unit located outside of the building [Photograph 3]. The unit is a two-compartment design that allows automatic cleaning of the filters in one compartment while the filters in the other compartment are in use. The air mover is a centrifugal fan installed at ground level adjacent to the pressurised water reservoir for the spark detection and extinguishing system.

Cleaning of the filters is via a mechanical (pneumatic) shaker. Dust and lithium ion battery flakes collected inside the dust collector hopper are discharged – at timed interval - into an FIBC station at the bottom of the hopper. It is understood that the mechanical shaker is provided to aid the removal of dust and battery flakes from inside the hopper during discharge into the FIBC.

It was stated that the dust collector hopper has an open top for explosion venting. It is unlikely that it will be a permanently open top. There are normally open explosion vents but there is usually a lightweight shield without any fasteners or similar cover arrangements for the vent. Therefore, the following recommendation is made.

R2. **Dust Extraction Unit -** Confirm the details of the explosion vent design with the manufacturer and obtain the technical file for the dust collector. **(M)**

Spark detection and extinguishing system like that installed on the battery shredder is provided at the inlet ducting to the dust extraction unit [Photograph 3].

The dust extraction unit is fabricated from galvanised steel, and it was stated that the unit was installed in 2022.

The ATEX marking plate on the unit provides the certification “Ex II 2D c T80^{o}C”. In the absence of technical documentation for the dust extraction unit, the following recommendation is made.

R3. **Dust Extraction Unit –** Confirm the full details of the ATEX certification from the manufacturer. **(L)**

Photograph 1: Shredder hopper, enclosed product (belt) conveyor and LEV ducting.

Photograph 2: FIBC Filling Station comprising of product conveyor discharge spout, FIBC support frame and FIBC LEV ducting.

Photograph 3: Dust Extraction Unit including spark detection system (red colour, top left) on inlet piping.

7.2 Hazardous Area Classification (HAC)

7.2.1 Flammable Atmospheres

At the time of the visit, there was no information on the explosion characteristics of the flakes produced from the battery shredding process.

Safety Data Sheet (SDS) [2] provided for the battery pack indicates that typical ingredients for the cathode is an oxide of lithium and one or more metals such as Cobalt, Nickel, Manganese, etc. It is understood that the electrolyte is a paste comprising of a Lithium salt and an organic carbonate (e.g., ethylene or propylene carbonate) as the electrolyte solvent.

The anode is stated to be usually carbon powder or graphite which could be up to 20% weight of the battery. Carbon powder is a carbonaceous dust, and it is classed as dust group IIIB (non-conductive dust) according to NFPA 499 [3]. The shredding process is expected to release the carbon powder or pulverise the graphite such that they can pose a dust fire or explosion hazard.

A key step in any dust hazard analysis is a detailed knowledge of explosive characteristics of the powder and/or particulate solid being handled. Such detailed information is often not included in an SDS and would require testing to determine the explosive characteristics. Testing should always be carried out on the finest and driest sample likely to be found in the process. In this case it is likely to be the material entering the FIBC at the base of the dust collector. Testing should also be performed from material collected just prior to the shredder blades being changed as this is usually when the finest particles will be produced. Therefore, the following recommendation is made.

R4. **General –** Conduct explosive characteristics testing of the flakes produced from the battery shredder. The requirements of the test should be discussed with DEKRA. **(H)**

However, for the purposes of this assessment it is assumed that dust produced from the shredding process is capable of dust explosion in the form of a dust cloud and dust fire in the form of a dust layer.

7.2.2 Hazardous Area Classification

The following summarises the sources and grades of release for the purposes of HAC:

Identified Primary Grades of release:

1. Dust collector hopper and dirty side of filter media – this is based on short self-cleaning intervals of the filters which could produce explosive dust cloud periodically during normal operation.

Identified Secondary Grades of Release:

2. Clean-side of the dust filter, inside of fan casing and outlet ducting – due to a filter element failure.
3. Exhaust fan outlet – due to a filter element failure.
4. Hopper discharge spout – due to potential for a short duration dust cloud when the hopper is discharging into the FIBC and when a full FIBC is being replaced.

5. Dust extraction inlet ducting – due to a blunt shredding blade.

Non-Hazardous Area

It is understood that the dust extraction system is designed to control health hazards of dust. Such units will be adequately sized to have sufficient volumetric air throughput to ensure the dust concentration in the workplace is below the workplace exposure limit (WEL) and hence, the dust / air entering the dust collector will be below the minimum explosive concentration (MEC). For example, carbon black has a short term exposure limit (STEL) of 0.007 g/m^3 [4] and its MEC is > 50 g/m^3 [3], the MEC is almost a thousand times the STEL. Based on this design parameter, the following sections of the plant are classed as non-hazardous.

1. Internals of the shredder hopper.
2. The enclosed product conveyor.
3. Internals of the product FIBC.

Filter changing task would generate dust cloud, but a hazardous zone is not required because such a task would be done according to the specialist contractor safe systems of work. However, the following recommendation is made.

R5. **Dust Extraction Unit** - Ensure filter replacement task is completed under a permit to work system which mandates that control of ignition sources. **(L)**

7.2.3 HAC Table

The table below shows the HAC schedule for the Lithium battery shredding plant in accordance with the BS EN IEC 60079-10-2 [5].

Table 2: HAC Schedule for Lithium Battery Shredding Plant

	Source of release			Hazardous Area Classification			Comments
No.	Description	Location	Grade of release (C, P, S)	Zone Type (20/21/22)	Zone extent (m)		
					Horizontal	Vertical	
1.	Dust Collector Hopper & dirty side of filter	Dust Extraction System	P	21	Internal volume of the hopper including dirty side of filter.		
2.	Clean side of filter, inside of fan casing and outlet ducting	Dust Extraction System	S	22	Internal volume of clean side of filter including outlet ducting and inside of fan casing.		
3.	Exhaust Fan Outlet	Dust Extraction Unit	S	22	1m radius around fan exhaust outlet.		
4.	Dust Collector Hopper Discharge Spout	Dust Extraction Unit	S	22	1m radius around the hooper spout.		
5.	Dust extraction inlet ducting	Dust Extraction Unit	S	22	Internal volume of inlet ducting		

7.3 Ignition Assessment

The following ignition categories are listed in BS EN 1127-1 [6], but those in bold are the relevant ignition sources applicable to the explosive dust atmospheres identified for the Lithium battery shredder plant.

1. **Hot surfaces.**
2. **Flames and hot gases (including hot particles).**
3. **Mechanically generated sparks.**
4. Unsuitable or malfunctioning electrical equipment.
5. Stray electrical currents, cathodic corrosion protection.
6. **Static electricity.**
7. Lightning.
8. Radio frequency (RF) electromagnetic waves.
9. Visible light electromagnetic waves.
10. Ionising radiation.
11. Ultrasonics.
12. Adiabatic compression and shock waves.
13. Exothermic reactions, including self-ignition of dusts.

The ignition sources assessment is governed by the following two considerations:

1) The probability that the ignition source is present. This depends on the severity of the hazardous area.
    a. For a Zone 22, the only ignition sources considered are those which are present in normal operation.
    b. For Zone 21, ignition sources in normal and expected abnormal situations are considered.
    c. For Zone 20, ignition sources in normal, expected abnormal and rare abnormal situations are considered.
2) The probability that the identified ignition source is effective enough to ignite the explosive dust. The answer to this query depends on two sub-aspects, these are:
    i. The strength of the ignition source can deliver, which is either indicated by the temperature produced or an amount of energy dissipated. This will be judged on a case-by-case basis for each identified ignition source.
    ii. The ignition sensitivity of the explosive dust.

The following sub-sections assesses the relevant ignition sources in this process.

7.3.1 Hot Surfaces

The only location where a hot surface could exist is at the electric motor for the dust extraction fan, but the electric motor is not within an explosive dust atmosphere. Therefore, normal equipment protection is sufficient for the electric motor.

7.3.2 Mechanical Sparks

An obvious source of mechanical sparks will be from dust extraction fan blades if the blades come in contact with the fan casing. This can only occur due to a misalignment of the fan shaft if the casing is not properly supported, or it is installed on shifting ground or it is not installed on level ground. Such issues would have been identified during commissioning and it is not considered further. Regular inspection and maintenance is required to identify issues with the fan if any occur over the life of the unit.

Mechanical sparks may be encountered during maintenance / repair work at or near the dust extraction unit. Examples of sources of mechanical sparks that may be encountered during maintenance / repair work include the use of hand tools such as portable grinder, drills, etc.

Protection against mechanical sparks from such tools will be by control of the use of such tools in areas where explosive dust atmosphere may be present. BS EN 1127-1 [6] allows the use of steel tools (e.g., screwdrivers, spanners, etc.) which can only cause single sparks when they are used in Zones 21 and 22 only.

Tools such as portable grinders, which generate showers of sparks are only permitted if no explosive dust atmosphere is present in the workplace. That is, the use of such tools must be under a permit to work, which ensures that the work area has been adequately made dust-free.

7.3.3 Flames and Hot Gases (including hot particles)

Hot particles could occur due to fires from crushing of a battery that is not fully discharged. The hot particles can be carried to the dust collector. But there are spark detection and extinguishing system provided in the shredder hopper, product conveyor and at the inlet ducting before the dust collector.

Flames or hot particle could occur from hot work associated with repairs / maintenance. Hot work entails welding, cutting, grinding, brazing, drilling and similar activities which results in sparks, fire, molten slag, or hot surfaces. Hot work is automatically assumed to be strong enough to ignite explosive dust atmospheres and initiate smouldering of dust layers.

The principal prevention is to separate out the fuel (flammables / combustibles) and the hot work. Hot work should be managed by a permit to work (PtW) system. The following guidance should be followed as a minimum (not exhaustive):

- Where possible, hot work is not carried out where an explosive dust atmosphere may be present, e.g., it is carried out in workshops under appropriate controls.
- Where hot work has to be carried out inside the dust collector, all combustibles / flammables are removed, and the dust collector is thoroughly de-dusted to ensure there is no potential for explosive dust atmosphere.
- The work is contained, e.g., through the usage of fire blankets and shields.
- A fire watch present during the work independent from the person using the equipment.

- There is provision for an emergency response plan (e.g., fire extinguishers), and this should consider the unique hazards posed by the hot work activity for which existing firefighting provisions may be insufficient.
- There is adequate detection and monitoring prior to and during the hot work.
- A fire watch is present after the work is completed to observe for any developing fires and smoulders and to monitor the temperature of surfaces affected by the work. This is to ensure surface temperatures are sufficiently low before reintroducing a flammable material into the booth.
- Persons issuing hot work permits are competent to do so, familiar with the area in question and suitably trained.

The PtW system was not examined at the time of the site visit. Therefore, the following recommendation is made.

R6. **Dust Extraction Unit –** Ensure there is a permit to work system in place for managing hot work activities. **(L)**

7.3.4 Static Electricity

Static Electricity and use of FIBCs

Static charges can be generated whenever the dust collector is emptied into the FIBC, the charge can accumulate on the deposited material as well as on the fabric from which a FIBC is constructed or any parts of it. An ignition could occur if the accumulated charge is released in the form of an incendiary discharge in the presence of an explosive dust atmosphere. Spark, brush, cone, and propagating brush discharges are all possible when FIBCs are used.

The requirements and specifications which FIBCs should meet depend on the nature and sensitivity of the explosive dust atmosphere present during filling and emptying. The final goal for the construction of FIBC is to exclude incendive discharges from the FIBC fabric during their intended use.

Since discharges of different incendivity (i.e., different types of discharges, such as spark, brush, or propagating brush discharges) may be generated, the necessity of their exclusion and thus the requirements for construction of the FIBC depends on the intended use of the FIBC. For this reason, different types of FIBC have been developed, which are defined as Type A, B, C or D.

- Type A FIBCs are made from fabric or plastic sheet without any measures against the build-up of static electricity.
- Type B FIBCs are made from fabric or plastic sheet designed to prevent the occurrence of propagating brush discharges.
- Type C FIBCs are made from fabric interwoven with connected conductive threads or filaments and designed to prevent the occurrence of incendiary sparks, brush discharges and propagating brush discharges. Type C FIBCs are fitted with dedicated earthing connections and must be connected to earth during filling and emptying operations.
- Type D FIBCs are made from static dissipative fabric with discontinuous conductive threads designed to prevent the occurrence of incendiary sparks, brush discharges

and propagating brush discharges, without the need for a connection from the FIBC to earth.

The four different types of FIBC should be used according to the minimum ignition energy (MIE) of the powder and/or particulate solid as shown in Table 3 below. Other types of FIBC or FIBC of unknown type should only be used in the presence of flammable atmospheres after detailed evaluation by an expert.

Table 3: Use of the different types of FIBC [7]

Material in FIBC	Surroundings	
MIE of material	**Non-flammable atmosphere**	**Dust Zones 21 & 22**
MIE > 1000 mJ	A, B, C, D	B, C, D
3 mJ < MIE ≤ 1000 mJ	B, C, D	B, C, D
MIE ≤ 3 mJ	C, D	C, D

The ability to use an FIBC safely in hazardous explosive dust atmospheres may change if an inner liner is installed in the FIBC. Combinations of FIBC and inner liner that can be used safely in hazardous atmospheres are shown in Table 4.

Table 4: Use of the different types of FIBC [7]

FIBC	Inner Liner		
	Type L1	**Type L2**	**Type L3**
Type B	Not permissible	Permissible	Permissible
Type C	Permissible	Permissible	Not permissible
Type D	Not permissible	Permissible	Not permissible

The three types of inner liners are based on surface resistivity as follows.

- Type L1 inner liners are made from materials with surface resistivity on at least one surface of less than 10 mega-ohms (MΩ) and, where necessary, a breakdown voltage through the material of less than 4 kV.
- Type L2 inner liners are made from materials with surface resistivity on at least one surface of between 1 giga-ohms (GΩ) and 1 tera-ohms (TΩ), and a breakdown voltage through the material of less than 4 kV.
- Type L3 inner liners are made from materials with surface resistivity of greater than 1TΩ and a breakdown voltage through the material of less than 4 kV.

At the time of the site visit, information on an FIBC label indicates that it is 'multi-trip[1]', with a safe working load of 1000 kg and a safety factor of 6. There was no information on the FIBC

[1] FIBCs are classed as either single trip or multi-trip.

type or the inner liner type (if any). This certainly means the FIBCs are not Type C or D as such FIBCs are clearly labelled as such. Therefore, the following recommendation is made.

R7. **General –** Based on the MIE provided by the test in recommendation R4, ensure that the FIBC type and any associated inner liner complies with the requirements presented in Table 3 and Table 4. **(M).**

Spark Discharges

Spark discharges occur from charged isolated conductors i.e., when charge is allowed to accumulate. This can occur for example on unearthed metal and other conductive or static dissipative items of equipment. Spark discharges can ignite explosive dust atmospheres (dependent upon MIE) and should be avoided by effective earthing and bonding of conductors.

A key source of isolated conductors in the explosive dust atmosphere identified in the HAC schedule (Table 2) is damaged earth cable connections in cartridge filters sleeves or clamps, and bag filter supports. During filter cleaning, the self-cleaning (shaker) mechanism may jostle the filter (now an isolated conductor) closer to the grounded dust collector hopper thereby leading to a spark discharge in the presence of an explosive dust atmosphere.

It is nearly impossible to guarantee that all small parts of a dust collector are bonded and earthed by cable connections. Hence, the primary protection measures for such a scenario is by the design and construction of the dust collector unit along with explosion protection. It is understood that explosion venting is provided at the top of the dust collector hopper. ATEX certification indicates that the ignition protection (construction safety) concept for the dust collector unit minimises the likelihood that an ignition source will arise from the unit provided that the equipment is inspected and maintained.

Another source of isolated conductors is charged hand tools that are stored on an FIBC during maintenance work around the dust collector. Whilst not likely to be high energy sparks, if the MIE of the powder is suitably low (not verified as yet), spark discharges even from low capacitance hand tools could be incendive for the dust atmosphere at the discharge of the dust collector hopper or inside the FIBC.

R8. **Dust Extraction Unit -** Until MIE data is available and a better risk judgement can be made, the practice of storing hand tools on top of the FIBC should be prevented as part of the risk assessment process under the permit to work for the maintenance task. **(L)**

Brush Discharges

Brush discharges occur from insulating materials e.g., plastic items or insulating powders. The maximum spark equivalent energy associated with brush discharges is 3 to 4 mJ [**Error! Reference source not found.**7]. Brush discharges can arise from the charging effect that occurs when dust is captured on the surface of a filter medium or from the charge powder itself or from the surface of the FIBC if insulating.

PD CLC/TR 60079-32-1: 2018 [7] states that current knowledge does not provide any indication that brush discharges can cause incendive ignition of combustible dusts independent of their MIE. Therefore, this ignition source can be disregarded.

Propagating Brush Discharges (PBD)

The principal precondition for a PBD is a high electrical charging regime on a thin (less than 10 mm) insulating material. They are more likely to occur if the insulator is in contact with an earthed conductor although this is not a prerequisite for a PBD. They do not occur in all metal plant.

Pneumatic conveying of dusts and particulate solids generates static charges on the materials being conveyed. PBD can occur inside the multi-compartment dust collector if there is a deflection plate used to direct the incoming gas-solid stream to the online filter compartment, and the surface of this deflection plate is coated with an insulating material.

The protection measure for this scenario is avoidance of the use of insulating deflection plates and provision for explosion protection. It is understood that explosion venting is provided at the top of the dust collector hopper. ATEX certification also indicates that the ignition protection (constructional safety) concept for the dust collector unit (based on its Type non-electrical 'c' certification) along with recommended maintenance minimises the likelihood that an ignition source will arise from the unit.

R9. **Dust Extraction Unit** – Verify with the equipment manufacturer if an insulating deflector plate is used inside the dust collector. **(L)**

Cone Discharge

Cone discharges occur from a heap of highly charged non-conductive powder after entering hoppers or silos. These are possible in FIBCs. Whilst unlikely to be incendive to the dust cloud in question, this cannot be completely discounted until MIE data is available.

7.4 Discussion

Discussion at the site visit indicates that there is experience of fires inside the shredder hopper. It was stated that this is due to release of energy from batteries that have not been deep discharged to 0%. The site identified that such an event occurs when batteries received from suppliers are damaged and one or more cells inside a battery are isolated from the charge/discharge circuit. For such batteries, the discharger and test equipment at the site will not identify such faults. The energy released from the charged cell(s) is incendive to combustible particles from the shredding process. Hence, the site installed the spark detection and extinguishing system at the hopper inlet and outlet, and at the inlet to the dust collection unit. It is understood that there is a maintenance service plan for the spark detection and extinguishing system. However, the following recommendation is made.

R10. **General –** Ensure that the tasks associated with the maintenance service plan for the spark detection and extinguishing system includes a performance test of the system. **(L)**

BS EN IEC 62485-6:2021 [8] indicates that lithium-ion batteries do not contain lithium metal. Therefore, the use of water as a fire extinguishing agent does not pose reactive and hydrogen generation hazards associated with the interaction between water and lithium metal.

Concerns were raised about the potential for smouldering fires under a pile of battery flakes inside the product FIBC because it was thought that the battery flakes may still be hot from the frictional heating by the shredder element. However, thermal imaging conducted during the site visit at the discharge of the hopper, along the product conveyor and across the content inside the FIBC indicated no hot spots and showed that the flakes are at ambient temperature. This indicated that the shredder mechanism uses very low force of attrition and would not lead to frictional heating. However, the following recommendation is made.

R11. **Battery Shredder –** Ensure there is a system in place for regular inspection and replacement of the shredder blades if this has not been specified by the shredder manufacturer. **(L)**

R12. **Battery Shredder -** Consider carrying out periodic thermal imaging of the shredded product from the shredder discharge through to the FIBC discharge spout. **(L)**

Dust explosion inside the dust collector is a known hazard to the site. Hence, the site has made provision for explosion protection and installed the dust collector outdoors. It is apparent that there are gaps in the explosion protection design basis and sufficient information of the dust extraction unit. These gaps have been captured by relevant recommendations.

7.5 Basis of Safety

The Basis of Safety for the Lithium battery shredding plant is based on:

- The Avoidance of Explosive Dust Atmosphere inside the battery shredder, enclosed conveyor and product FIBC via the application of dust containment and extraction system.

- The Avoidance of Ignition Sources at the dust collection unit through the use of ATEX-certified work equipment, spark detection and appropriate maintenance of the equipment and earthing and bonding. Explosion venting and isolation is present as a secondary basis of safety.

- The Avoidance of Ignition Sources during FIBC filling by ensuring correct choice of FIBC and liner, and appropriate measures to ensure the FIBC is used correctly.

- The Application of Organisational Measures (battery discharging and testing, compliance with manufacturer's instruction, operator training, etc.) for fire prevention inside the shredder.

- The Application of Technical Measures for fire detection and control via fire-resisting materials of construction, spark detection and extinguishment system.

For the Basis of Safety to hold, the recommendations summarised below should be implemented / actioned as far as is reasonably practicable.

7.6 Recommendations

R2. **Dust Extraction Unit -** Confirm the details of the explosion vent design with the manufacturer and obtain the technical file for the dust collector. **(M)**

R3. **Dust Extraction Unit –** Confirm the full details of the ATEX certification from the manufacturer. **(L)**

R4. **General –** Conduct explosive characteristics testing of the flakes produced from the battery shredder. The requirements of the test should be discussed with DEKRA. **(H)**

R5. **Dust Extraction Unit** - Ensure filter replacement task is completed under a permit to work system which mandates that control of ignition sources. **(L)**

R6. **Dust Extraction Unit –** Ensure there is a permit to work system in place for managing hot work activities. **(L)**

R7. **General –** Based on the MIE provided by the test in recommendation R4, ensure that the FIBC type and any associated inner liner complies with the requirements presented in Table 3 and Table 4. **(M).**

R8. **Dust Extraction Unit -** Until MIE data is available and a better risk judgement can be made, the practice of storing hand tools on top of the FIBC should be prevented as part of the risk assessment process under the permit to work for the maintenance task. **(L)**

R9. **Dust Extraction Unit –** Verify with the equipment manufacturer if an insulating deflector plate is used inside the dust collector. **(L)**

R10. **General –** Ensure that the tasks associated with the maintenance service plan for the spark detection and extinguishing system includes a performance test of the system. **(L)**

R11. **Battery Shredder –** Ensure there is a system in place for regular inspection and replacement of the shredder blades if this has not been specified by the shredder manufacturer. **(L)**

R12. **Battery Shredder -** Consider carrying out periodic thermal imaging of the shredded product from the shredder discharge through to the FIBC discharge spout. **(L)**

8. CONCLUSION AND RECOMMENDATION SUMMARY

A DSEAR assessment has been undertaken for F&R Cawley Ltd for the activities undertaken at the Lithium Battery Shredding Plant in Maidenhall, Bedfordshire.

The main finding of the assessment is that there are gaps in the measures in place for the management of the risks of harm from fires and explosion. These gaps will require additional actions to be taken and these actions have been summarised as recommendations throughout this DSEAR assessment.

The Basis of Safety for the Lithium Battery Shredding Plant is based on:

- The Avoidance of Explosive Dust Atmosphere inside the battery shredder via the application of dust extraction system.
- The Avoidance of Ignition Sources at the dust collection unit through the use of ATEX-certified work equipment.
- The Application of Organisational Measures (battery discharging and testing, compliance with manufacturer's instruction, operator training, etc) for fire prevention inside the shredder.
- The Application of Technical Measures for fire detection and control via fire-resisting materials of construction, spark detection and extinguishment system.

For the Basis of Safety to hold, the recommendations summarised below should be implemented / actioned so far as is reasonably practicable.

Recommendation	Page No.
R1. **General -** DSEAR (Regulation 5) requires this assessment to be reviewed at regular intervals. Based on the risks and changes foreseen, it is recommended to review this assessment whenever changes are made but even without changes at no later than 4 years from the date of this report. This should be captured in the site's action tracker or equivalent system. **(M)**	9
R2. **Dust Extraction Unit -** Confirm the details of the explosion vent design with the manufacturer and obtain the technical file for the dust collector. **(M)**	13
R3. **Dust Extraction Unit –** Confirm the full details of the ATEX certification from the manufacturer. **(L)**	13
R4. **General –** Conduct explosive characteristics testing of the flakes produced from the battery shredder. The requirements of the test should be discussed with DEKRA. **(H)**	17
R5. **Dust Extraction Unit** - Ensure filter replacement task is completed under a permit to work system which mandates that control of ignition sources. **(L)**	18
R6. **Dust Extraction Unit –** Ensure there is a permit to work system in place for managing hot work activities. **(L)**	22
R7. **General –** Based on the MIE provided by the test in recommendation R3, ensure that the FIBC type and any associated inner liner complies with the requirements presented in Table 3 and Table 4. **(M).**	24

9. FLAMMABILITY DATA

The following table gives the flammability data for typical ingredients in the HEDBs handled on site. The information was sourced from NFPA 499 [3].

Table 5: Flammability data for powders

Classification of Data	Ignition Sensitivity			Explosion Severity		Electrostatic Properties		Thermal Decomposition	Burning Behaviour	Limits	
Test Parameter	Layer Ignition Temp. (LIT)	Cloud Ignition Temp. (CIT)	Minimum Ignition Energy (MIE)	20 litre Sphere		Resistivity (Low RH)	Charge Relaxation Time (Low RH)	Onset Temp.	BZ Number	Minimum Explosible Conc. (MEC)	Limiting Oxygen Conc. (LOC)
Units	°C	°C	mJ	P_{max} barg	K_{st} bar m/s	Ohm m	hours	°C	-	g/m³	% $^v/_v$
Carbon Powder										> 50	

Key:

- Blank fields mean no data are available from the information sources used.

10. REFERENCES

1. "*Dangerous Substances and Explosive Atmospheres Regulations 2002*", S.I.2002 No.2776 (DSEAR 2002).
2. *"High Energy Density Battery – Safety Data Sheet*", Assembly 0754A12-002, Rev. A1, Issue Date: 01/04/2018, UEC Electronics.
3. NFPA 499:2021, "*Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas"*, NFPA.
4. *"EH40/2005 Workplace Exposure Limits"*, 4th Edition, HSE.
5. BS EN IEC 60079-10-2:2015, "*Explosive atmospheres. Classification of areas. Explosive dust atmospheres*", BSI
6. BS EN 1127-1:2019, "*Explosive atmospheres. Explosion prevention and protection. Basic concepts and methodology*", BSI.
7. *PD* CLC/TR 60079-32-1:2018, "*Explosive atmospheres. Electrostatic hazards, guidance. British Standards Institution*", BSI.
8. BS EN IEC 62485-6:2021, *"Safety requirements for secondary batteries and battery installations. Safe operation of lithium-ion batteries in traction applications"*, BSI.
9. "*Regulatory Reform (Fire Safety) Order 2005*", S.I. 2005 No. 1541

APPENDIX A DSEAR 2002

The following is a summary of the regulations of DSEAR:

- **Regulations 1 to 4** deal with preliminary issues, i.e., the date of entry into force of the Regulations, scope and definitions.
- **Regulation 5** requires employers and the self-employed to assess risks to employees and others whose safety may be affected by the use or presence of dangerous substances at work.
- **Regulation 6** sets out how the risk to safety from dangerous substances should be eliminated or reduced.
- **Regulation 7** contains specific requirements to be applied where an explosive atmosphere may be present (in addition to the requirements in regulation 6).
- **Regulation 8** requires the provision of arrangements to deal with accidents, incidents and emergencies.
- **Regulation 9** requires the provision of information, training and instruction on dangerous substances.
- **Regulation 10** requires the identification of pipes and containers where these contain dangerous substances.
- **Regulation 11** addresses the need to coordinate explosion protection measures where employers share the same workplace.

A.1 When does DSEAR Apply?

DSEAR applies whenever:

- There is work being carried out by an employer (or self-employed person), and
- A *dangerous substance* is present (or is liable to be present) at the workplace, and
- The dangerous substance could be a risk to the safety of people as a result of fires, explosions or similar energetic events or through corrosion to metal.

Fires and explosions create harmful physical effects such as thermal radiation, overpressure effects and oxygen depletion. These effects can also be caused by other energetic events such as runaway exothermic reactions involving chemicals or decomposition of unstable substances such as peroxides. These events are also covered by DSEAR.

Gases under pressure can also cause explosions creating harmful effects. Substances that are corrosive to metal may cause damage to metal/metal containing structures which could result in reduced structural integrity.

A.2 Definition of Dangerous Substances?

Dangerous substances include:

- A substance or mixture which meets the criteria for classification as hazardous within any physical hazard class laid down in the CLP Regulation whether or not the substance is classified under that regulation.
- Any kind of dust that when spread in air to form a cloud (ie form an explosive atmosphere), can explode.

- Any other substances, or mixtures of substances, which because of their physical properties and the way in which they are present in the workplace create a risk to safety from fires and explosions, but which may not be covered by CLP Regulation. For example high flashpoint liquids present in the workplace at elevated temperatures.

A.3 Main Requirements of DSEAR

In summary, DSEAR places duties on employers (and the self-employed, who are considered employers for the purposes of the Regulations) to assess and eliminate or reduce risks from dangerous substances. Specific requirements are discussed below.

A.3.1 Assessing Risks

Before work is carried out, employers must assess the risks that may be caused by dangerous substances. The purpose is to help employers to decide what they need to do to eliminate or reduce the risks from dangerous substances. If there is no risk to safety, or the risk is trivial, no further action is needed. If there are risks then employers must consider what else needs to be done to comply fully with the requirements of DSEAR.

As part of the risk assessment, employers must classify areas where hazardous explosive atmospheres may occur into zones. The classification given to a particular zone, and its size and location, depends on the likelihood of an explosive atmosphere occurring and its persistence if it does.

DSEAR defines a place where an explosive atmosphere may occur in quantities that require special precautions to protect the health and safety of workers as **hazardous**. A place where an explosive atmosphere is not expected to occur in quantities that require such special precautions is deemed to be **non-hazardous**. For these purposes "**special precautions**" means precautions to control potential ignition sources within a hazardous area, particularly in relation to the construction, installation and use of equipment.

Identifying hazardous or non-hazardous areas should be carried out in a systematic way. Risk assessment should be used to determine if hazardous areas exist and to then assign zones to those areas. The assessment should consider such matters as:

a) The hazardous properties of the dangerous substances involved;

b) The amount of dangerous substances involved;

c) The work processes, and their interactions, including any cleaning, repair or maintenance activities that will be carried out;

d) The temperatures and pressures at which the dangerous substances will be handled;

e) The containment system and controls provided to prevent liquids, gases, vapours or dusts escaping into the general atmosphere of the workplace;

f) Any explosive atmosphere formed within an enclosed plant or storage vessel; and,

g) Any measures provided to ensure that any explosive atmosphere does not persist for an extended time, e.g. ventilation.

Before a workplace containing zoned areas comes into operation for the first time, the employer must ensure that the overall explosion safety measures are confirmed (verified) as being safe. This must be done by a person or organisation competent to consider the particular risks in the workplace, and the adequacy of the explosion control and other measures put in place.

If an employer has five or more employees, the employer must record the significant findings of the risk assessment.

A.3.2 Preventing or Controlling Risks

Employers must put control measures in place to eliminate risks from dangerous substances, or reduce them as far as is reasonably practicable. Where it is not possible to eliminate the risk completely employers must take measures to control risks and reduce the severity (mitigate) the effects of any harmful event.

The best solution is to eliminate the risk completely by replacing the dangerous substance with another substance, or using a different work process. This is called substitution in the Regulations.

In practice this may be difficult to achieve, but it may be possible to reduce the risk by using a less dangerous substance. For example, replacing a low flashpoint liquid with a high flashpoint one. In other situations it may not be possible to replace the dangerous substance at all. For example, it would not be practical to replace petrol with another substance at a filling station.

A.3.3 Control Measures

Where the risk cannot be eliminated, DSEAR requires control measures to be applied in the following priority order:

- Reduce the quantity of dangerous substances to a minimum.
- Avoid or minimise releases of dangerous substances.
- Control releases of dangerous substances at source.
- Prevent the formation of a dangerous atmosphere.
- Collect, contain and remove any releases to a safe place (for example, through ventilation).
- Avoid ignition sources. Areas classified into zones must be protected from sources of ignition. Equipment and protective systems intended to be used in zoned areas should be selected to meet the requirements of the *Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 1996*. Equipment already in use before July 2003 can continue to be used indefinitely provided a risk assessment shows it is safe to do so.
- Avoid adverse processing conditions (for example, exceeding the limits of temperature or control settings) that could lead to danger.
- Keep incompatible substances apart.

These control measures should be consistent with the risk assessment and appropriate to the nature of the activity or operation.

A.3.4 Mitigation

In addition to control measures DSEAR requires employers to put mitigation measures in place. These measures should be consistent with the risk assessment and appropriate to the nature of the activity or operation and include:

- Reducing the number of employees exposed to the risk.

- Providing plant that is explosion resistant.
- Providing plant that is corrosion resistant.
- Providing explosion suppression or explosion relief equipment.
- Taking measures to control or minimise the spread of fires or explosions.
- Providing suitable personal protective equipment.

A.3.5 Preparing Emergency Plans and Procedures

Arrangements must be made to deal with emergencies. These plans and procedures should cover safety drills and suitable communication and warning systems and should be in proportion to the risks. If an emergency occurs, workers tasked with carrying out repairs or other necessary work must be provided with the appropriate equipment to allow them to carry out this work safely.

The information in the emergency plans and procedures must be made available to the emergency services to allow them to develop their own plans if necessary.

A.3.6 Providing Information, Instruction and Training for Employees

Employees must be provided with relevant information, instructions and training. This includes:

- The dangerous substances present in the workplace and the risks they present including access to any relevant safety data sheets and information on any other legislation that applies to the dangerous substance.
- The findings of the risk assessment and the control measures put in place as a result (including their purpose and how to follow and use them).
- Emergency procedures.

Information, instruction and training need only be provided to other people (non-employees) where it is required to ensure their safety. It should be in proportion to the level and type of risk.

The contents of pipes, containers, etc must be identifiable to alert employees and others to the presence of dangerous substances. If the contents have already been identified in order to meet the requirements of other law, this does not need to be done again under DSEAR.

APPENDIX B HAZARD AND RISK ASSESSMENT METHODOLOGY

This section gives a brief overview of the methodology used to assess the fire and explosion hazards and risks (where possible).

1. Firstly, the flammability properties, quantities involved, circumstances or work and the process is assessed to determine whether a flammable atmosphere is or could be present under credible abnormal situations. If not, the unit operation can be concluded to being non-hazardous and the assessment can be regarded as being completed. The supporting justification is documented so there is a record that it has been formally assessed.
2. If there is a potential flammable atmosphere present, then the next sub-section discusses how it can be prevented from forming, or how it can be reduced in size or duration – this is the Hazardous Area Classification (HAC) part of the assessment.
3. Once hazardous areas have been identified, the ignition sources present and capable of igniting the hazardous areas are assessed. The objective here is to identify the relevant ignition sources and assess whether they are adequately controlled when examined a built facility. Where appropriate, guidance would be given on how ignition sources can be adequately controlled.
4. Once the ignition sources have been assessed, the fire and explosion hazard scenarios are identified. Where possible and required, the hazard likelihood and consequence(s) are assessed, and this allows a view to be formed about the risk of the process unit. By this stage, a Basis of Safety (strategy for keeping personnel safe from the hazards of fires and explosions) can be identified or proposed.
5. Following all of this, or throughout the above steps: recommendations are made. The recommendations are then accumulated in Section 8, page 29, as a 'check off' list

The following subsections give a more detail about the methodology employed to assess the fire and explosion hazards.

B.1 Plant Overview and Process Description

This section provides an overview of the relevant information about the process and plant to enable the assessment to be carried out. The process description should give consideration:

- Material(s), quantities or flow rates involved.
- Relevant process conditions e.g., temperature, pressure, or any parameter that can affect the explosion hazards and risks.
- Major plant items and statement or indication on sizes and materials of construction.
- Any procedural aspects of the process which have ramifications on the fire/explosion hazard e.g. sampling, or line breaking etc.
- Facility siting.
- Risk control systems such as safeguards, citation to existing protection against any aspect of explosion safety may be given.

B.2 Hazardous Area Classification (HAC)

A relevant standard e.g., BS EN IEC 60079-10-2 [5] for dusts is first identified and then used as the method to identify the sources and grades of release and assign the hazardous area(s) taking into account the various factors which influence the overall zones.

In order to determine whether a *hazardous* flammable atmosphere (*hazardous area* for short) is present, the properties of the material(s), quantities involved, circumstances or work and the process is assessed to check whether ignition of the flammable atmosphere could cause harm to personnel.

If ignition of the flammable atmosphere could harm personnel, then a formal hazardous area may need to be assigned and ignition sources rigorously controlled. If not, then assigning a formal hazardous area is unnecessary e.g., spray cleaning using a low flash point, high boiling point liquid from a small (less than 1 litres) bottle would release very little flammable vapours that even if ignition occurred, serious harm to personnel would not occur. As such special precautions such a ATEX certified equipment is not required.

The conclusions of the HAC are typically given in a tabulated form, from which plan and elevated drawings can be derived. NB: HAC plan and elevation drawings are not part of the standard delivery of an explosion safety assessment.

B.3 Ignition Sources

Next, ignition source(s) present in the identified hazardous areas that is/are capable of igniting the flammable atmosphere are assessed. If none are present, or they can be adequately controlled, then safety can be based on *Avoidance of Ignition Sources*. Possible sources of ignition that should be considered for a process are listed in full in BS EN 1127 [6]:

1. Hot surfaces
2. Flames and hot gases (including hot particles)
3. Mechanically generated sparks
4. Unsuitable or malfunctioning electrical apparatus
5. Stray electrical currents, cathodic corrosion protection
6. Static electricity
7. Lightning
8. Radio Frequency (RF) electromagnetic waves
9. Visible light electromagnetic waves
10. Ionising radiation
11. Ultrasonics
12. Adiabatic compression and shock waves
13. Exothermic reactions, including self-ignition of dusts

The ignition sources assessment is directed by the following two considerations:

1. The likelihood of the ignition source being present. This is guided by the following principles (as detailed in BS EN 1127 [6]):
    i. For Zone 22 areas, ignition sources during normal operation shall be considered.
    ii. For Zone 21 areas, ignition sources during normal operation and expected malfunctions shall be considered.
    iii. For Zone 20 areas, ignition sources during normal operation, expected malfunctions and rare malfunctions shall be considered.

2. The likelihood of the identified ignition source being effective enough to ignite the material(s) of concern. The answer to this query depends on two sub-aspects:
   i. The strength that the ignition source can deliver, which is typically either indicated by a temperature or an energy dissipated. This will be judged on a case-by-case basis for each identified ignition source.
   ii. The ignition sensitivity of the flammable material(s).

If an effective ignition source has been identified, control measures to either being stop its occurrence or neutralise its effectiveness is explored.

B.4 Discussion on Hazards and Risks

This section identifies the fire and explosion hazards of the process. If possible, a view about the associated risks is also given. Once the hazard scenarios have been identified, their likelihood is assessed by taking into consideration the conclusions from the HAC i.e., likelihood of flammable atmosphere, and the ignition assessment.

The scale of the anticipated effects and extent of harm (i.e., consequences of the event), and occupancy patterns of personnel in the affected area are also considered when appropriate. The above factors are combined with any other relevant conditional modifiers and safeguards to give a view about the risk.

Where a view has been expressed about the acceptability of a risk, this is normally a qualitative judgement based on what would typically be expected by industry norms for that process or operation. It is assumed this would correspond to a tolerability criterion acceptable under the law.

- Where a risk has been deemed to be acceptable, it means it exceeds or is at least aligned with good engineering practice, industry norms or demonstrably of no significant concern. As such, the process can run although minor improvement may still be recommended.
- Where a risk has been deemed to be ALARP (as low as reasonably practicable), this will invariably entail a cost-benefit analysis showing the cost to achieve further risk reduction to bring the risk into the tolerable region is grossly disproportionate to the benefit achieved.
- Where a risk has been deemed to be unacceptable or intolerable, this process would ideally cease from operation until the major improvement have been made.

B.5 Basis of Safety

A summary of the Basis (or Bases) of Safety is given in this section taking into consideration the hierarchy of risk management under the law.

B.6 Recommendations

This section lists the recommendations for the process being assessed. The objective is to identify all necessary recommendations to make the risk(s) acceptable or ALARP. At time, there could be in an information gap that needs to be addressed first, and that too is often captured in the recommendations list.

Appendix IV – Fire Prevention Plan

Cawleys

FIRE PREVENTION PLAN

Luton | Covent Garden Close | March 2023

TABLE OF CONTENTS

1. Introduction

1.1. Fire Prevention Plan

1.1.1. This Fire Prevention Plan (FPP) is written using the Environment Agency's (EA) 'Fire Prevention Plan Guidance – updated 11th January 2021. The FPP will form part of the Environmental Management System for the overall site. It is the objective of this plan to:

- Minimise the likelihood of a fire happening
- Aim for a fire to be extinguished within 4 hours, and
- Minimise the spread of fire within the site and to neighbouring sites.

1.1.2. The FPP details the fire risks and the controls put in place to ensure so far as is reasonably practicable that fires do not occur or, if they do occur, there are adequate precautions in place to minimise the environmental impact by minimising the amount of polluting material released into the atmosphere and ensuring that polluting materials do not enter water courses or significantly affect adjacent sensitive receptors.

1.1.3. The FPP master copy is stored digitally on a shared computer drive, a read-only copy is available to view / download from the company intranet (Smartlog) and hard copies are available on site in each operation area e.g. MRF office, Lithium workshop office, etc.

1.1.4. The primary control measures in this plan will be tested at least twice a year and the plan will be reviewed annually. Planned fire drills are completed at least twice a year. Fire warden provision is continually kept under review and refresher training is undertaken as and when required but no more than 3 years apart.

1.2. Permit holder details

1.2.1. Permit holder: F&R Cawley Ltd. t/a Cawleys
1.2.2. Site address: 1 Covent Garden Close, Luton, Bedfordshire, LU4 8QB
1.2.3. Telephone: 0845 260 2000
1.2.4. Company reg. no.: 4170234
1.2.5. EA environmental permit no.: MP3397NF
1.2.6. EA Exemption (T11): NC2/061729/2020
1.2.7. EA ABE / ABTO licence no.: BE2210516BE / BS2210608BS
1.2.8. OS grid reference: TL 069 231

2. The Site

2.1. Site plans / site setting

2.1.1. Drawing no. GPP/C/L/22/03 v1 details the layout of the buildings, any area where hazardous materials are stored, the main access routes for fire engines and any alternative access, access points around the perimeter to assist fire-fighting, hydrants and water supplies, the location of mobile and fixed plant and the quarantine area. (Appendix 1)
2.1.2. Drawing no. GPP-C-L-15-06 v7 details the site surface water drainage plan. (Appendix 2)
2.1.3. Drawing no. GPP-C-L-15-07 v2 details the foul drainage plan. (Appendix 3)
2.1.4. Drawing no. GPP-C-L-15-04 v2 outlines the site boundaries. (Appendix 4)

2.2. Sensitive receptors in the area:

Receptor	Distance	Image reference
Residential properties	150 m	
Industrial premises	Various within <100 m	
Petrol stations	290 m	
Railway line	200 m NE	
Watercourses	River Lea >1 km North	
Schools	Nursery 240 m	
Hospitals / Surgeries	<2 km West & East / <1 km	

Nursing and care homes	>500 m
Airports	5 km

2.3. Building structures

2.3.1. All buildings have been constructed in accordance with building control regulations applicable at the time of construction.
2.3.2. The offices (main building) and the warehouse where the process machinery is housed are of a traditional brick build construction.
2.3.3. The MRF waste tipping hall is the most recent construction and is made from profile fire safe cladding affixed to a steel portal framed structure. The roof above the processing machinery is composed of chrysotile bonded asbestos sheeting with the roof of the office building being felt and tar.
2.3.4. In relation to the other buildings shown on the site layout plan (drawing reference GPP/C/L/22/03 version 1 Appendix 1) these are traditional brick structures with chrysotile bonded asbestos cement roofs.
2.3.5. The Lithium Workshop is a traditional brick structure with a fire-retardant composite board roof.

2.4. Permitted wastes

2.4.1. The facility has the capacity and is permitted to accept 550 tonnes of mixed waste per day which equates to 2,750 tonnes per week or 143,000 tonnes per annum as allowed by the licence / permit. The MRF facility only accepts the materials as defined within the site permit MP3397NF.

2.5. Recycling operations

2.5.1. All waste being brought onto the facility is weighed in using calibrated weighbridges and scales. There are three weighbridges at the site; two at the waste reception area (in and out) and one located at the rear of building (for weighing on/off wood/refuse derived fuel, recycled commodity and general waste loads going for onward treatment or disposal).
2.5.2. The majority of the waste entering the facility is mixed general waste or dry mixed recyclables. Through a manual/mechanical sorting process, approximately 75% of the material entering the facility will either be recycled or re-purposed with residual material being disposed of via energy from waste facilities or as a last resort, sent to landfill.
2.5.3. Unprocessed waste held in the tipping hall is loaded into a hopper by a 360° material re-handler; the waste then enters a trommel which sorts the waste by size. Smaller sized items fall onto conveyors and then to the automatic separation system which incorporates an optical sorting system, ballistic separator, and over-band magnets. Finally, there is a manual picking line to further extract any recyclable / recoverable elements. The medium / larger items fall onto a conveyor that passes through a manual sorting process.

2.6. Lithium workshop operations (R&D)

2.6.1. All lithium batteries arriving on site are to be weighed in on the main weighbridge starting 01/10/2022. Once weighed, the waste is sent to the Lithium Workshop.
2.6.2. The Lithium Workshop contains thermal imagining cameras and has a fire alarm system which is wired and connected into the wider part of the site.
2.6.3. Loads are temperature checked on arrival before they are processed/stored.
2.6.4. If elevated temperatures are discovered on receipt, a dynamic risk assessment will be undertaken by a competent member of staff based on the battery packaging type:

Cawleys, 1 Covent Garden Close, Luton, Beds LU4 8QB ▶ Tel 0845 260 2000 ▶ Fax 01582 847 453 ▶ Email info@cawleys.co.uk
Company Registration No. 4170234 | Registered Name: F & R Cawley Ltd

2.6.4.1. PG1 Crate (metal – UN approved for the carriage of Lithium batteries) – a battery may be left in the container if deemed safer to control and the container placed in a designated quarantine area.

2.6.4.2. PG2 Crate (wood – UN approved for the carriage of Lithium batteries) – if a battery cannot safely be separated from its packaging, the whole crate must be placed in the quenching container located beside the Lithium workshop (submerged in water) or covered with a fire blanket.

2.6.4.3. Emergency services will be notified as soon as reasonably practicable should a fire occur.

2.6.5. Thermal imagining cameras are fitted in all storage containers and operational areas which monitor any elevations in temperature. The storage containers temperature is controlled using air conditioning units.

2.6.6. There is an independent Fire Safety Strategy to cover the Lithium workshop operations. (Appendix 5).

2.7. Vehicle workshop operations

2.7.1. The vehicle workshop is situated on Arundel Road (see site plan) circa 50 meters from the main transfer operations.

2.7.2. Maintenance and inspection of the Cawleys HGV fleet – all vehicles are empty when undergoing work.

2.7.3. All works are carried out by trained and authorised Cawleys employees.

2.7.4. All activities have been fully risk assessed with supporting safe systems of work which are reviewed on an annual basis.

2.7.5. All hot works are carried out under a Hot Works permit with a fire watch in place – hot works are stopped 2 hours before the workshop shuts.

2.7.6. All third-party contractors undergo a full site induction, with works completed under a permit to work and a hot works permit if required

2.7.7. All 240v power tools are inspected for damage prior to use and are pat tested annually – damaged tools are made inoperable and removed from service.

2.7.8. Housekeeping standards are monitored and recorded by the Maintenance Manager on a daily basis.

2.7.9. All liquids (various engine oils of different grades, hydraulic oil and waste oils) are stored in double skinned tanks clearly signed above a bund capable of holding 110% of the total volume with overspill removed on a regular basis.

2.7.10. All flammable materials are stored in a locked COSHH cabinet when not in use.

2.7.11. Waste is removed on a daily basis and stored in appropriate bins outside of the workshop emptied by Cawleys on a regular basis.

2.7.12. Hazardous wastes are stored separately from GW and other flammable materials in UN approved containers, emptied as and when required by the Cawleys Hazardous Services.

2.7.13. Smoking is only permitted in the smoking zone.

2.8. Fabrication workshop operations

2.8.1. The Fabrication workshop is situated on Arundel Road (see site plan) circa 30 meters from the main transport operations.

2.8.2. Repair and maintenance of Cawleys metal containers and the manufacture of specialist parts for off site contracts and the Materials Recovery Facility.

2.8.3. All works are carried out by trained and authorised Cawleys employees.

2.8.4. All activities have been fully risk assessed with supporting safe systems of work which as reviewed on an annual basis.

2.8.5. All hot works are carried out under a Hot Works permit with a fire watch in place – hot works are stopped 2 hours before the workshop shuts.
2.8.6. All third-party contractors undergo a full site induction, with works completed under a permit to work and a hot works permit if required.
2.8.7. Oxygen and acetylene are used within the Fabrication workshop, stored within a locked cage as per applicable legislation when not in use.
2.8.8. All 240v power tools are inspected for damage prior to use and are pat tested annually – damaged tools are made inoperable and removed from service.
2.8.9. Housekeeping standards are monitored and recorded by the Fabrication Manager on a daily basis.
2.8.10. All liquids are stored in double skinned tanks clearly signed above a bund capable of holding 110% of the total volume with overspill removed on a regular basis.
2.8.11. All flammable materials are stored in a locked COSHH cabinet when not in use.
2.8.12. Waste is removed on a daily basis and stored in appropriate bins outside of the workshop emptied by Cawleys on a regular basis.
2.8.13. Hazardous wastes are stored separately from GW and other flammable materials in UN approved containers, emptied as and when required by the Cawleys Hazardous Services.
2.8.14. Smoking is only permitted in the smoking zone.

3. Types of combustible materials

3.1. Combustible waste(s)

- Paper
- Cardboard
- Hard and soft plastics – 80/20, 90/10, 98/2 and Jazz
- Rags/textiles
- Scrap metals
- Refuse derived fuel (RDF) and solid recovered fuel (SRF)
- Compost and plant material
- Mixed waste containing any combustible wastes
- WEEE
- Rubber
- Wood

3.2. Persistent organic pollutants

3.2.1. Waste domestic items that fall under the classification of PoP's are segregated at point of tipping to a designated area within the tipping hall.
3.2.2. All items are recorded, and photographic evidence is taken.
3.2.3. The items are then recoded by the weighbridge operators using the contamination report.
3.2.4. PoP items are then relocated using the loading shovel to a segregated designated bay located at the rear of the yard.
3.2.5. Transportation is then organised for further disposal.

3.3. Other combustible materials

3.3.1. Diesel used for the site plant is stored in one above ground double skinned tank located near the Lithium Battery R&D. There are no water courses within 1km of the site boundary.
3.3.2. Acetylene is stored on site near the fabrication workshop in a lockable steel cage.

3.3.3. There is also a small quantity of flammable aerosols held in the fabrication and vehicle workshops which are stored in steel lockable containers however the quantities held are not considered significant.

3.3.4. Empty gas cylinders storage at the front of the MRF. COSHH store located within the MRF.

3.3.5. The dust generated by the MRF process is explosive if mixed with air at the correct ratio but analysis of the dust in air concentrations have shown that the volume of dust in air is so low that an explosion could not occur during normal operating conditions. The tipping area is cleared, swept, and cleaned as necessary during operations in order to limit dust and potential nuisance. The tipping and waste handling apron are checked as part of a daily site inspection for damage or degradation. All waste is cleared from the site on a rotational basis, front end, and back end once a month. Cleaning of mobile plant is carried out using a high-pressure jet wash system with the water captured in an interceptor. Dust monitoring / DSEAR tests are periodically undertaken.

4. Management of common causes of fire

4.1. Arson

4.1.1. The site is manned daily Mon- Fri from 6:00am to 01:00am. Sat 6:00am to 12:00pm.

4.1.2. The site is securely fenced with lockable gates.

4.1.3. Recorded CCTV – cameras installed inside and outside the facility.

4.1.4. The main office building has an intruder alarm that is monitored by a watch station out of hours.

4.2. Plant and equipment

4.2.1. **Static plant:** MRF maintenance work is carried out by our on-site Maintenance Department or by approved contractors when specialist expertise is required. There is a preventative maintenance plan for the main processing plant and all mobile plant is maintained in accordance with the manufacturer's recommendations by authorised and competent personnel. All equipment is subject to daily pre use checks. There is strict procedural documentation in relation to the maintenance carried out within the MRF. The MRF process control system (Scada) incorporates a monitoring system that measures the electrical load on each motor in the system. This allows the Plant Controller to detect if there is a blockage which could cause a motor to overheat and is therefore able to shut that part of the plant down before such an event could take place.

4.2.2. **Lithium workshop shredding system:** shredding system maintenance works will be carried out as and when required by a trained, authorised, and competent member of staff and as per the producer's instructions.

4.2.3. **Mobile plant:** mobile plant that is not being used is kept away from combustible waste. Mobile plant is serviced and maintained periodically by competent, authorised personnel in accordance with the manufacturer's schedules/guidelines. Heavy plant is fitted with an automatic fire suppression system.

4.3. Electrical faults including damaged or exposed electrical cables

4.3.1. Electrical equipment / installations on site are fully certified by a suitably qualified person.

4.3.2. Periodic electrical installation condition assessments are carried out every 3 years.

4.3.3. Portable appliances are tested on an annual basis.

4.3.4. Electrical faults are investigated and repaired by authorised and competent persons in line with manufacturers guidelines

4.4. Discarded smoking materials

4.4.1. Smoking is only permitted in the designated smoking areas across the site which are equipped with suitable metal receptacles for the disposal of discarded smoking materials.

4.5. Hot works safe working practices

4.5.1. A hot works permit is used across the site by trained and authorised internal and external engineers supported by suitably trained staff members who act as fire wardens / fire watch throughout the works and for 3 hours after completion. All hot works permits are issued / checked and signed off by a trained and authorised member of the MRF management team.

4.6. Use of industrial heaters

4.6.1. All workshops are fitted with oil-fired industrial heaters / coolers fitted in accordance with all applicable legislation – serviced and maintained in accordance with manufacturers guidelines by an authorised and competent third party contractor.

4.7. Hot exhausts and engine parts

4.7.1. All plant and equipment are visually inspected at the beginning of each shift with the check recorded in R2C, and at the end of the working day by site operatives to ensure that there has been no build-up of dust on hot exhausts or engine parts. Any dust is cleaned off once the vehicle has cooled down.

4.7.2. Mobile plant is parked in the location shown on the site layout plan when not in use; all exhaust systems on the mobile plant have adequate covers. A rubber blade is used on the loading shovel to prevent sparks.

4.7.3. All heavy mobile plant is fitted with automatic fire suppression systems.

4.8. Fire watch procedures

4.8.1. Prior to works commencing the work area is fully cleaned. isolated and inspected by a member of the MRF management team, who will then issue the hot works permit. During the full duration of works and for 3 hours after completion of the works a fully trained member of the MRF team acts as fire watch. The fire watch is in mobile communication with the MRF management team at all times with access to firefighting equipment should the need arise.

4.8.2. Any hot works required on mobile plant is completed outside of the MRF in a cordoned off work area away from any combustible materials stored in the yard.

4.9. Ignition sources

4.9.1. There are no uncontrolled ignition sources within 6 metres of the stored waste materials.

4.9.2. The smoking shelter is located by the canteen and is well distanced (more than 6m) from any combustible waste.

4.10. Batteries

4.10.1. Batteries in end-of-life vehicles (ELVs) – ELV batteries are only accepted at the Lithium workshop in UN approved shipping containers. Prior to collection all batteries are checked for damage and elevated temperatures – units that pass inspection are then packaged in UN approved shipping containers and where necessary within vermiculite (fire retardant packaging material) to protect them during transit. Units that are damaged or displaying elevated temperatures are left on customers premises. Upon arrival at the Lithium workshop all batteries are checked for signs of elevated temperatures by the supervisor, and then stored in a temperature controlled shipping container fitted with a fire alarm surrounded by a fire wall made of concrete legato blocks that hold an A1 fire-resistant classification in accordance with REI 240 (the shipping containers are located away from all combustible materials stored on site) – the containers are checked at regular intervals throughout the day with a hand held temperature gauge. In the event that a battery is identified with an elevated temperature upon arrival at site it is removed from the UN approved packaging if safe to do so and placed in a water bath or covered with a fire retardant blanket – if it is not safe to remove from the packaging the whole box is placed in the water bath – once safe to do so emergency services are notified.

4.10.2. Battery storage – when tipped all loads are checked for non-conforming waste types and EWC compliance. When batteries are identified in a load, all work in the tipping hall is suspended while the batteries are removed and placed in UN approved storage containers by battery type. In the case of damaged batteries being found these are stored in UN approved containers away from the other batteries or if deemed unstable by the TCM or a member of the MRF management team they are placed in a water bath.

4.11. Leaks and spillages of oils and fuels

4.11.1. Emergency spillage procedure in place (WI009-06).
4.11.2. Spill kits are kept on site in key locations e.g. oil storage area, COSHH cupboard, etc.
4.11.3. Staff are briefed and trained on their function and can be used in the event of a spill or leak from any plant or equipment on site.
4.11.4. Spillage drills undertaken periodically.

4.12. Build-up of loose combustible waste, dust, and fluff

4.12.1. There is a continuous cleaning regime within the plant on a low level, with dedicated staff continually cleaning throughout the shift to keep areas clear and dust levels down.
4.12.2. Bi-annually there is a deep clean of the MRF including a high level clean, of which specialist contractors are brought in to carry out these works. This will involve all roofs / tops of cabins / high level equipment that cannot be reached during normal operations.
4.12.3. Daily end of shift clean-up regime in place for the Lithium Workshop.

4.13. Reactions between wastes

4.13.1. Visual checks are carried out whenever waste is being tipped. Only the waste allowed under the permit is accepted at the site. The waste streams are quickly sorted, separated, and stored within fireproof concrete block bays. Therefore, it is very unlikely that adverse reactions between different waste streams will occur on the site.

4.14. Waste acceptance and deposited hot loads

4.14.1. The site and tipping hall reception area is always staffed when tipping takes place. Both General Waste and Dry Mixed Recycling Waste is tipped in this area. The tipping hall staff inspect all waste entering the tipping hall to ensure that it is as described and so that any contamination / non-conforming waste types can be removed and quarantined. In addition, they will visually check for any burning or smouldering waste. Waste can be brought to site by third parties or on the Company's own vehicles. The Company's own vehicle drivers inspect the waste at the point of collection prior to its arrival at the transfer station and will deal with any problems of unacceptable/ non-conforming waste at source so that the appropriate disposal route is adopted.
4.14.2. If contamination is persistently found in loads or a load has an unacceptable level of contamination this will initiate an investigation which may result in the load being rejected and taken to an alternative approved disposal point. Persistent offenders will be banned from site.
4.14.3. Designated incoming wood loads are tipped in front of the wood bays marked on the site layout plan (reference GPP/C/L/22/03 version 1). These loads are stockpiled using 360° material re-handler. Contamination is logged and dealt with at the time of tipping. Rainwater from the wood storage area is directed to the underground storage tank.

4.14.4. Third parties delivering wastes and recycled materials to the site will report to the Weighbridge office and new visitors are given a copy of the site rules. Failure to comply with the site rules may result in access being denied on subsequent occasions.

4.14.5. Hot loads are not accepted at the site. In the unlikely event that a hot load is inadvertently accepted, the quarantine area will be used to allow the waste to cool before being taken off-site to a suitably licensed facility for disposal.

4.14.6. The standard quarantine area is to the left of the entrance in the tipping hall. The quarantine area for hot loads is to the rear of the premises.

4.15. Hot and dry weather

4.15.1. All waste types are stored in accordance with the site working plan, with waste /commodity removed from site on a first in first out basis. Forklift & mobile operators are instructed to rotate the waste / commodity in order that the older waste / commodity can be loaded first.

4.15.2. Both tipping halls (front and rear) are covered by an automated fire suppression system that thermal cameras which monitor waste piles 24/7 for elevated temperatures which are displayed in the MRF control room and monitored by the SCADA operator.

5. Prevent self-combustion

5.1. General self-combustion measures

5.1.1. Storage time management / Stock rotation policy: all bales are removed from site on a rotational basis with loads being booked daily for removal and the older bales removed / loaded first. This process is managed via daily stock control completed by the yard supervisor and MRF Manager who arrange for the various materials to be removed- bays are emptied at the end of each week.

5.2. Monitor and control temperature

5.2.1. The MRF has been designated into two levels of risk (high and low) in relation to the storage of waste.

5.2.2. The pile of unprocessed mixed waste (high risk area) inside the building is monitored using a thermal imaging system.

5.2.3. Fire watch (out of hours) – the plant stops at 01:00 hours, the maintenance team will be on site until 02:00 carrying out preventative maintenance. The maintenance team are trained Fire Marshalls who will carry out a visual check on the plant before they finish their shift to ensure that there are no hot spots etc.

5.2.4. No materials are stored on site for more than 3 months, stock is rotated on a daily basis with the older wastes / commodities being loaded first, all bays are cleared on a weekly basis.

6. Manage Waste Piles

6.1.1 The waste pile in the tipping hall shall be no higher than 4 metres with a length of 15 metres and the depth 10 metres; this equates to a maximum volume for the tipping hall of 600m^3.

6.1.2 The waste in the tipping hall is dealt with on a daily continual basis; the waste is constantly turned via the loading shovel / 360° material re-handler. The tipping hall supervisor monitors the movements of the waste to ensure that the earliest waste is processed first. The rear push wall on the tipping floor is of concrete construction.

6.1.3 Maximum tonnage storage material and the storage location area:

Recovered materials / Waste Type	m^2 / Height/Volume M3	Location
Landfill (unrecoverable bulky material-loose)	42/3/126	Transfer Waste Out
RDF Transfer (unwrapped, awaiting baling-	210/2/420	Transfer Waste Out
RDF Bales Wrapped	50/2/100	Transfer Waste Out
Recyclate Bales (Mid-grade paper)	30/2/60	Recycling Baler Area (internal)
Recyclate bales (LDPE)	35/2/70	Recycling Baler Area (internal)
Recyclate Bales (Mixed Paper, Rigid Plastics,	120/3/360	Concrete Block Bays (external)
Wood x2	100/3/300	Concrete Block Bays (external)
Tyre skips x 2 (commercial / domestic)	12/2/24	Yard Area (contained in skips)
Mixed Metal Roll-ons x2	32 /2.5/ 80	Yard Area (contained in roll-

6.1.4 **Permissible storage times for unprocessed material:**

Combustible material – waste in tipping floor	Received into facility (average)	% unprocessed primary internally	Maximum storage time
Card/Paper	5.6 tonnes per day	1.88%	24-48 Hrs.
Plastics (rigid/film)	1.45 tonnes per day	0.48%	24 -48 Hrs
Rubber	0.064 tonnes per day	0.021%	24 -48 Hrs
Wood	7.02 tonnes per day total Direct tipping to bay – 5.02 tonnes Tipping floor – 2.02 tonnes	2.35%	24 -48 Hrs
General commercial	205.37 tonnes per day	68.81%	24 -48 Hrs
Mixed Recycling	55.7 tonnes per day	18.66%	24 -48 Hrs
Scrap metals	0.46 tonnes per day	0.15%	24 -48 Hrs
Refuse derived fuel (RDF)	0.085 tonnes per day	0.028%	24 -48 Hrs
Compost and plant material	8.23 tonnes per day	2.76%	24 -48 Hrs
General Construction Waste / Hardcore	13.80 tonnes per day	4.62%	24 -48 Hrs
Quarantined waste (WEEE/gas cylinders)	0.21 tonnes per day	0.07%	24 -48 Hrs
Waste Batteries* estimated (R&D)	0.5 tonnes per day		

6.1.5 Waste stored in containers: Car, HGV tyres found in the incoming waste streams and scrap metals (both ferrous and nonferrous) recovered by the MRF are stored in containers in the yard.

6.1.6 Types of containers used: metal 40-yard rollonoff containers.

6.1.7 Accessibility of containers: the containers are stored along the permitter of the site with the loading hook / assembly facing into the yard. Containers are kept clear of obstructions and in the case of emergency can be moved by either a rollonoff vehicle or any of the mobile plant used on site.

6.1.8 Moving containers in a fire: containers are kept clear of obstructions at all times, in the event of a fire the waste is contained within the container and will not spread, a fire hose can be directed at / in the container - containers have wheels at the rear and can be moved by either a rollonoff vehicle or any of the mobile plant on site. If required a container on fire would be moved to the centre of the yard awaiting the arrival of the emergency services.

7. Fire Spread Prevention

7.1. Separation distances

7.1.1. All processed waste piles will have a separation distance of 6 metres or be contained by an appropriate fire wall in a storage bay.

7.1.2. The storage areas for plastics / mixed papers inside the building are more than six metres apart.

7.1.3. The loose RDF storage area is located separately from any other flammable waste storage area.

7.1.4. All WEEE waste loads arriving on site are weighed in on the main weighbridge and stored in the WEEE storage shed as marked on the plan (T11 – Exemption Area).

7.1.5. Hardcore is stored in a segregated area within the building at the rear of the RDF Baler, an external covered conveyor belt fills the bay via hand-picked hardcore from the picking cabin along with direct tipped vehicles into the bay. A local service provider collects direct from the bay two to three times per week.

7.2. Waste storage bays

7.2.1. The storage areas for plastics / mixed papers inside the building are more than six metres apart.

7.2.2. Wood is stored externally and is contained within concrete blocked bays with an A1 fire retardant rating, 10 metres away from the MRF building.

7.2.3. Processed baled material is stored in concrete bays with an A1 fire retardant rating at least 10 metres from the building.

7.2.4. External, the baled recyclable materials and RDF is stored no more than three bales high within concrete blocks with an A1 fire retardant rating which provide adequate fire break protection.

7.2.5. The bays are ten metres away from the building. This ensures that there is always a 0.5m high free space between the top of the stored bales and the block wall.

7.3. Fire walls construction

7.3.1. All external storage bays are formed from concrete interlocking blocks. The construction of the concrete block system prevent fire spreading to neighbouring compartments / areas. The fire prevention plans guidance has been considered when selecting the concrete interlocking blocks and using them on site. They are constructed to a height of four metres height and enclosed on three sides.

7.3.2. They have an A1 class fire resistant (EN 13501 – 1 standard) providing up to four hours fire resistance.

7.4. Quarantine Area

7.4.1. A quarantined area of 400m2 will be made available by undertaking a dynamic risk assessment and will be sited as far as possible from any stockpiles or building.
7.4.2. The closest combustible waste stockpile will be at least 10m from any quarantines area.
7.4.3. The quarantines area will be used in the unlikely event of a hot load arriving on site or any fire within a stockpile.

8. Detection/Suppression Systems

8.1.1. All processed waste piles will have a separation distance of 6 metres or be contained by an appropriate fire wall in a storage bay.
8.1.2. The storage areas for plastics / mixed papers inside the building are more than six metres apart.
8.1.3. The loose RDF storage area is located separately from any other flammable waste storage area.
8.1.4. All WEEE waste loads arriving on site are weighed in on the main weighbridge and stored in the WEEE storage shed as marked on the plan (T11 – Exemption Area).
8.1.5. Hardcore is stored in a segregated area within the building at the rear of the RDF Baler, an external covered conveyor belt fills the bay via hand-picked hardcore from the picking cabin along with direct tipped vehicles into the bay. A local service provider collects direct from the bay two to three times per week.
8.1.6. The entire site has an integrated fire alarm system (except for the Vehicle Workshop – in scope to be integrated at a later date).
8.1.7. The pile of 600m3 (95% of the total pile is combustible) of the unprocessed mixed waste inside the building is monitored using a thermal imaging system. Fire suppression is achieved using foam cannons which are targeted by the detection system. The foam additive is AFFF. The system has a 48,000-litre water holding tank with 400 litres of foam stored in a separate tank. If suppression is demanded there is an automatic start-up of the system. If one cannon is activated the system is capable of delivering suppression material for 40 minutes. If both are activated the running time would be 20 minutes. The rate of discharge is 1,200 litres per minute per cannon. In the event that this proves inadequate water is available from one of the three fire hydrants stated above and the water and foam systems can both be re-charged with the system running. Automatic suppression takes place once the thermal imaging system has detected a fire mass greater than 0.5m2 with a core temperature greater than 300oC. More conventional fire detection systems are employed throughout the rest of the MRF in the form of smoke and heat detectors. There is an addressable integrated fire alarm system with manual call points. Alarm activation is monitored by a watch station through using a secure red care line. The system is fully maintained and tested periodically. The site has additional firefighting equipment in the form of hose reels and portable extinguishers. All heavy mobile plant is fitted with automatic fire suppression systems.
8.1.8. A fire suppression system is fitted to the Lithium Workshop conveyor belt and shredder. The Lithium shredder is purpose built and has an automated 'Helios' fire suppression system fitted. To minimise fire risk from fine particles, the Lithium shredding process with the workshop has an active air extraction system which is fitted with a carbon filter. Air is positively extracted from the workshop through the carbon filter and vented via a small exhaust stack (Local Exhaust Vent [LEV]) as shown on drawing reference GPP/C/L/22/03 version 1. Appropriate fire extinguishers and fire blankets are available to use.
8.1.9. The site has an adequately trained number of fire wardens on site who are re-trained re-train every three years. All other employees are to exit the building. The fire wardens are instructed not to take any risks that would put their or others' lives at risk. Monitoring of waste temperatures is carried out using the thermal imaging system.

8.1.10. Certification for the systems:

- The Fire detection and alarm system has been properly designed, installed, and will be maintained in line with BS 5839: 2017. 'Fire Detection and Alarm Systems for Buildings' Testing & Maintenance.
- Fire Fighting Equipment is provided and correctly positioned and maintained in accordance with BS 5306: Part 8, 2012 'Fire Extinguishing Installations and Equipment on Premises'
- Emergency lights are installed and maintained in accordance with BS 5266: Part 1: 2016 'Emergency Lighting'
- HELIOS PYROsmart fire detection and suppression system.
- The LEV system within the Lithium Building, is an 'ATEXON® VR18Z Spark Detection and Extinguishing System' and has been installed and designed to reduce the risk of ignition sources such as burning embers from reaching protected equipment.

9. Firefighting Techniques

9.1. The nearest Fire Station to the site is 1.8 miles away: Luton Fire Station, Studley Rd, Luton LU3 1BB.

9.2. The site is readily accessible from either Covent Garden Close or Wingate Road. There is access to the MRF through 4 doorways (all sized to allow for a LGV fire appliance vehicle to enter), three facing Covent Garden Close and one facing Wingate Road.

9.3. The MRF has been designated into two levels of risk (high and low) in relation to the storage of waste. The high-risk area is where the loose waste which will be monitored by the thermal detection system. The low risk area is for baled material, the bales are stored within two areas indicated on the plan as mixed paper and plastics bale storage area.

9.4. The Fire Brigade have access to both areas easily by way of two fast action shutter doors, the first door closest to the plastics bale storage area is 5m high and 3m wide which is a suitable size for the fire and rescue service to have their appliance within the building. The second door is 2.5m high and 2m wide, which is not sufficient for the appliance to enter the building, however the mixed plastic bale storage is within 1 metre of the door-way.

9.5. Fire watch (out of hours) – the plant stops at 17:00 hours, the maintenance team will be on site until 01:15 carrying out preventative maintenance. The maintenance team are trained Fire Marshalls who will carry out a visual check on the plant before they finish their shift to ensure that there are no hot spots etc.

10. Water Supplies

10.1. There are fire hydrants at the gateway from both access points, plus an additional fire hydrant located in Arundel Road.

10.2. The sizing of the water mains pipe servicing the fire hydrants are as follows: Covent Garden close 75mm, Wingate Road 150mm, Arundel Road 100mm.

10.3. The three main hydrants that would be utilised in the event of a fire in the outside yard have the correct sizing of pipe work which should deploy 20 litre/second (2100 litre/minute). This falls in line with the recommendations of the Fire Plans (based on 300m3 of combustible material to 2,000l/minute is required), which is the maximum volume of storage in any of the outside waste bays.

11. Fire water management

11.1. In the event of a fire, firefighting water from within the North part of the building and Northern yard area will drain to the underground storage tank (shown on the surface water drainage plan). This has an overflow pipe installed underground, to link it to the culvert holding tank. In the event of a fire in one of the external recyclable material bays, firefighting water will drain to the culvert holding tank.

11.2. The Southern part of the building and yard will drain to the Culvert holding tank. This existing culvert holding tank has the capacity to contain firefighting water from 50 minutes at 2,000 litres/minute. The tank is fitted with a manually controlled shut off valve, which is tested quarterly, testing is recorded in the site diary; our company tanker fleet clean out the culvert holding tank on a half yearly schedule. This tank can be emptied whilst a fire was in progress by one of our own vehicles or a third- party vehicle. The underground storage provided by the tank and the culvert holding tank with the shut off valve together with the ability to empty the tank with a fire in progress or damping down is sufficient to ensure that firewater will not leave the site.

11.3. In respect of a fire with the Tipping Area the firefighting medium is "Cold Fire" which would not create water runoff and would soak into the waste material which has been proven in a number of tests that we have undertaken of the system.

11.4. The closest borehole is 260 m West of site.

12. During and following an incident

12.1.1. In the event of a fire, unprocessed primary waste material will be diverted to our Wellingborough transfer station. This decision will be taken by one of the Management team and the decision will be based upon the maximum waste storage limits for the site. If Wellingborough site is near its storage capacity, then the additional tipping facilities that can be utilised e.g. FCC Newton Longville.

12.1.2. All significant incidents shall be notified to the Environment Agency as soon as reasonably practicable on 0800 80 70 60 (must be within 24 Hours).

12.1.3. When a fire has been successfully dealt with and the fire brigade are starting to damp down, site management will identify a safe and suitable area for the material to be moved into using the site mobile plant in order to allow the Fire Brigade to apply more water to any hot spots. Once the Fire Brigade is satisfied that all hot spots and potential sources of ignition have been dealt with, site management to arrange bulk haulage for onward disposal.

12.1.4. Small amounts of burned material from a small fire can be loaded directly once fully extinguished into a Roll On/Off for disposal.

12.1.5. The waste is comprised of the products of combustion or partial combustion. The waste would not be ordinarily classified as hazardous even after the application of the 'Cold Fire' fire-fighting medium.

12.1.6. Part of the roof structure is bonded chrysotile asbestos. In an intense fire it is possible that the panels could start to delaminate. Reassurance air testing would need to take place and if it was suspected that the panels had delaminated, specialist approved contractors will be appointed to make the area safe in accordance with all applicable legislation.

12.1.7. The main pollutant identified, should a fire occur, would be air pollution.

12.1.8. In the event of a fire in the Lithium Workshop, the clean-up procedure would be subcontracted to a third party external provider.

12.1.9. Silencing of the fire alarm system should never be taken as an indication that it is safe to re-enter the building.

12.1.10. Re-entry of the building is strictly prohibited until the fire brigade officer in charge declares it is safe to do so.

FPP reviewed by:	Nigel Ingram	Signed:	Nigel In	Date:	March 2023
FPP reviewed by:	Terry Swaby	Signed:	TSwaby	Date:	March 2023

The FPP will be reviewed annually or in the event of significant changes to the premises or personnel, changes to work activities or equipment, changes or increase in the storage of combustible waste on the site or changes to legislation.

KEY

S/Term QA	Short Term Quarantine Area
QC	Quarantine Container - Gas Bottles
Tank for F/S/S	Proposed Site for Tank for Fire Suppression System
QA	Quarantine Area in the event of a Fire
SS	Smoking Shelters
D	MRF Door
↗	Access Points
F	Fuel Storage
OS	Oil Storage
MP	Mixed Paper Bales
LRDF	Loose RDF
PS	Paint Store

No areas of made ground. Total site surfaced with concrete.

Rev	Description	Initial	Date
1	Amendment to bay uses, QA, fabrication workshop, Lithium battery relocated. Text updated.	KD	18/07/22

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iCon Environmental Innovation Centre, Eastern Way, Daventry, Northamptonshire, NN11 0QB
Registered in England No. 6019666

TITLE:	Luton Waste Facility Covent Garden Close, Luton Permit - Site Layout Plan		
CLIENT:	CAWLEYS		
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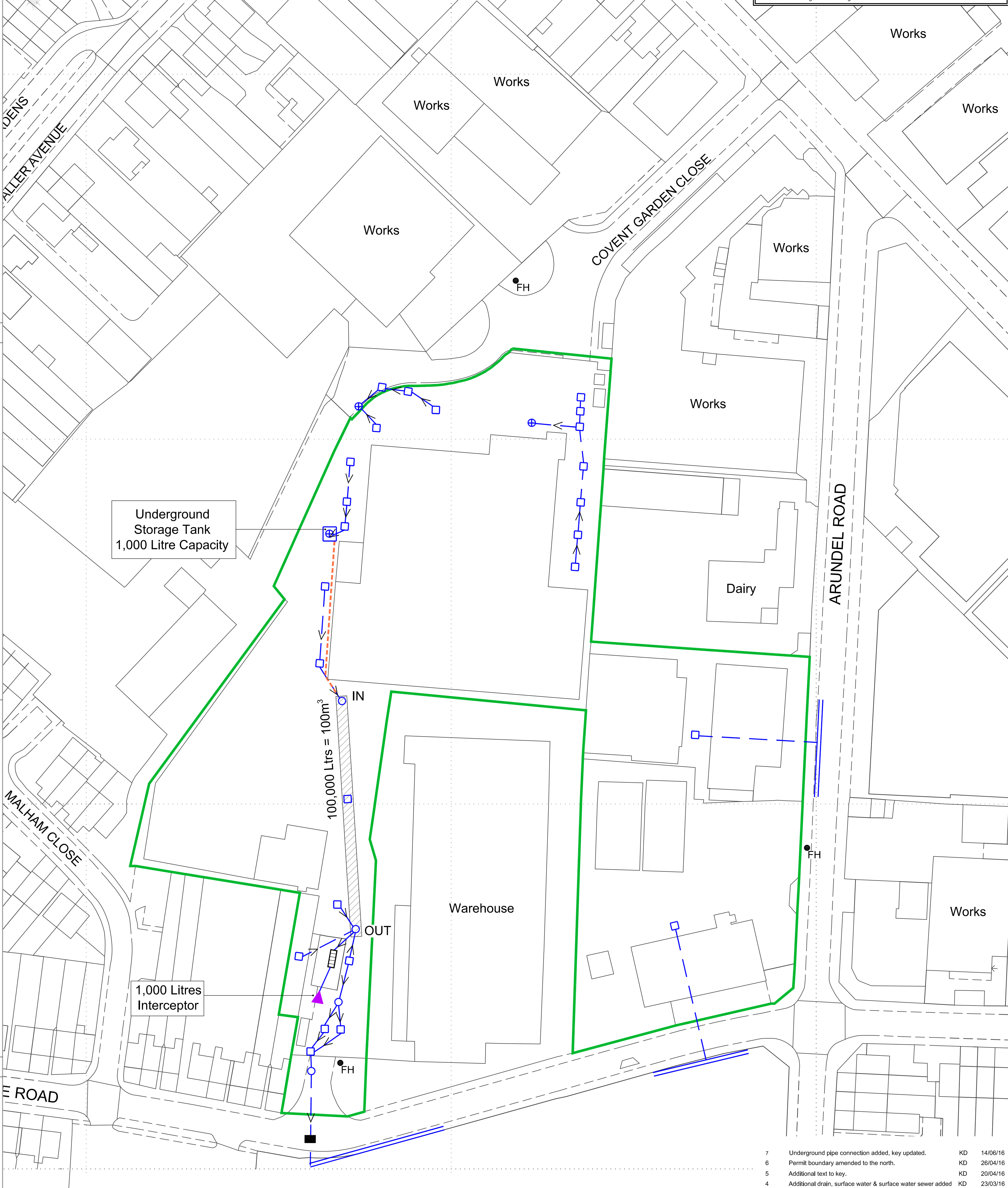
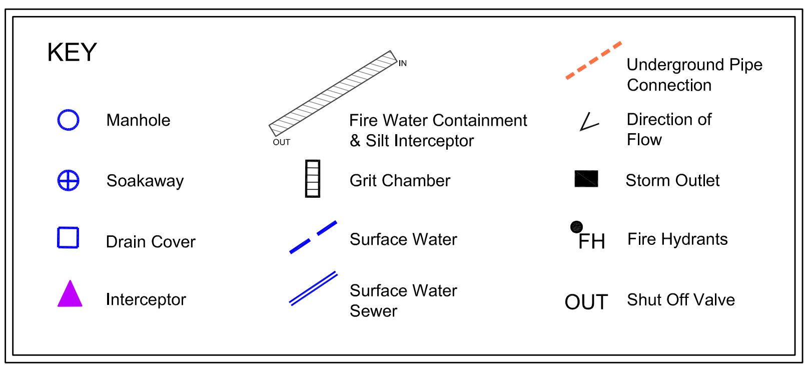
DRAWN BY:	KD	CHECKED BY:	CS
DRAWING NO.:	GPP/C/L/22/03	REV NO.:	1
SCALE:	1:1000 at A3	DATE:	11 July 2022
SCALE BAR:	0 5 10 20 30 50		

ORIGINAL A3 SIZE SHEET





Rev	Description	Initial	Date
7	Underground pipe connection added, key updated.	KD	14/06/16
6	Permit boundary amended to the north.	KD	26/04/16
5	Additional text to key.	KD	20/04/16
4	Additional drain, surface water & surface water sewer added to Arundel Road. 3 x Fire Hydrants added.	KD	23/03/16
3	Slight amendments and additional text added.	KD	17/03/16
2	Slight amendment to direction of flow, following a discussion with Alan Colledge.	KD	11/06/15

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TITLE:	**Luton Waste Facility, Covent Garden Close, Luton Surface Water Drainage Plan**		
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SCALE:	1:1000 at A3	DATE:	09 June 2015
SCALE BAR:	0 5 10 20 30 50		

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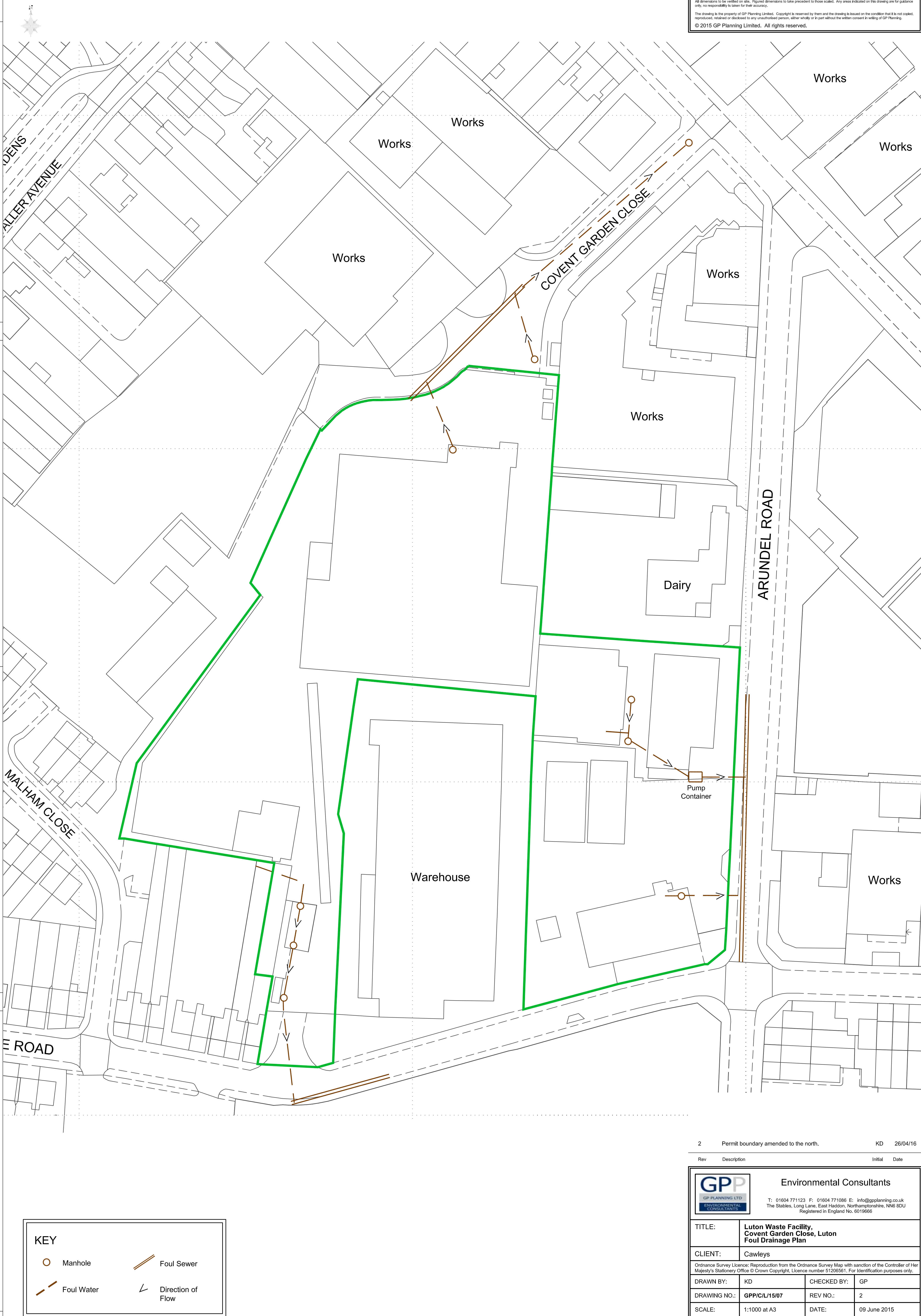

Rev	Description	Initial	Date
2	Permit boundary amended to the north.	KD	26/04/16

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DRAWING NO.:	**GPP/C/L/15/07**	REV NO.:	2
SCALE:	1:1000 at A3	DATE:	09 June 2015
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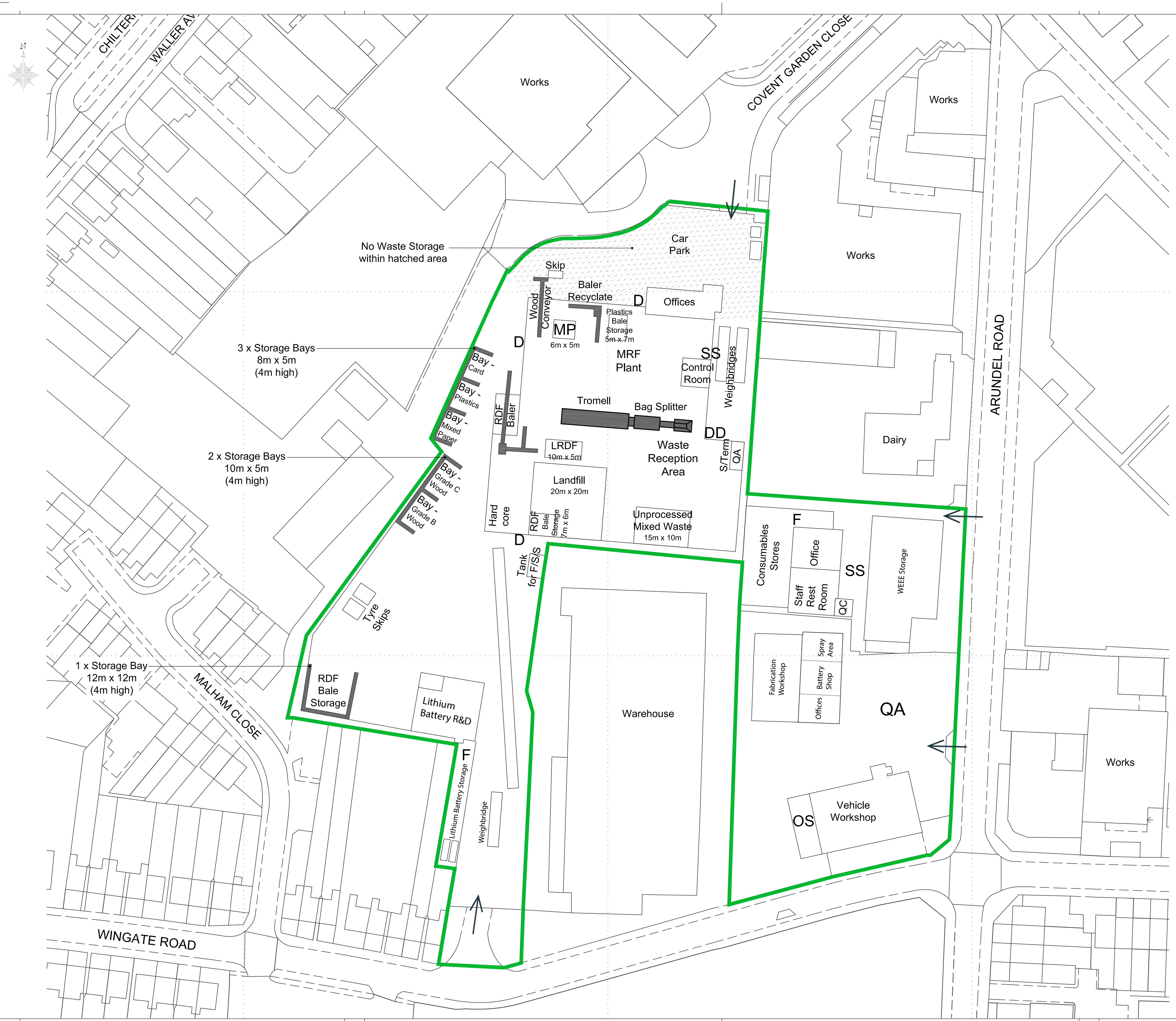
ORIGINAL A3 SIZE SHEET



KEY

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OS	Oil Storage
PS	Paint Store
MP	Mixed Paper Bales
LRDF	Loose RDF

No areas of made ground.
Total site surfaced with concrete.

Rev	Description	Initial	Date
7	Measurements added.	KD	14/06/16
6	Permit boundary amended to the north.	KD	26/04/16
5	Additional labeling to site layout & key up dated.	KD	20/04/16
4	Additional amendments to layout and labels.	KD	23/03/16
3	Additional labeling of buildings/layout	KD	15/03/16
2	Additional labeling of buildings/layout	KD	13/10/15

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SCALE:	1:1000 at A3	DATE:	30 September 2015
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ORIGINAL A3 SIZE SHEET

Local Recycling | Global Responsibility

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Lithium-ion Operations
Fire Strategy
Luton | Covent Garden Close | July 2023

Lithium-ion Operations
Fire Strategy Plan
(Luton - Covent Garden Close)

TABLE OF CONTENTS

Lithium-ion Operations
Fire Strategy Plan
(Luton - Covent Garden Close)
1. Introduction

On its site located on Covent Garden Close, Luton, Cawley's Waste Management & Recycling run a Lithium Battery recycling operation. This strategy and associated procedures, specifically applies to the Lithium Battery recycling building, located at its site at Covent Garden Close, Luton. All other buildings and operations on site, are covered by separate strategies and procedures.

The lithium recycling operation is dedicated to; the recovery of the lithium battery materials and also giving an alternative second life recycling route. Cawleys have been dealing with lithium batteries for over 12 years and in the last 6 years have operated a dedicated workshop for the dismantling of batteries prior to export. We hold all applicable licences which include; Approved Battery Exporter (ABE), Approved Battery Treatment Operator (ABTO) and also multiple Transfrontier Shipment Notifications (TFS) as per requirements set out by the Environment Agency (EA).

The purpose of the operations is not purely in regard to shredding, but it is also in relation to the repurposing of the lithium batteries which equates to approx. 50% of tonnage handled.

We have a dedicated team who have previously pioneered the safe transportation, dismantling, discharging, shredding, and onward export logistics into Europe for waste batteries. In the event of a serious incident, we have control measures in place to ensure minimum business interruption and to ensure business continuity and that all operations can be business as usual within 24hrs of the incident arising, please review appendix 6 for further information.

Cawleys are leading the way and are one of a handful of companies that have a dedicated resource and facility to recycle lithium batteries. We have over 500 tonnes experience in dealing with lithium batteries both at our own site and whilst assisting with third-parties battery producers and emergency services.

Existing customers include waste battery producers from the following industries; Motorsport, Automotive Testing Companies, (MIRA, Millbrook Proving Ground UTAC) numerous OEM's battery manufacturers etc……

Alan Colledge the Technical Director of Lithium Battery Recycling Solutions is a 4th term Dangerous Goods Safety Advisor (DGSA) and has just under 30 years' experience in the waste industry. Having spent the previous 18 years specialising in Hazardous and dangerous Waste, heading up Cawleys Hazardous Division, Lithium Batteries from cars were introduced to Alan 10 years ago and since then he has pioneered the options and management of waste batteries for the company which has led to European partners and setting up one of the first UK dedicated workshops in 2017 to decommission waste EV batteries based in Luton. Alan has also established relationships for legitimate 2nd Life Reuse to divert waste batteries into power supplies. Since the launch of Lithium Battery Recycling Solutions in October 2021 Alan has moved the capabilities even further by setting up one of the first UK waste Battery plants to recover materials through mechanical separation. This is a big step for the UK allowing the batteries to become a mixed shredded material for onward recovery and refining and leading to starting a new value chain for Lithium batteries which is sorely missing domestically.

Cawley's, are committed to their statutory obligations to comply with the Regulatory Reform (Fire Safety) Order 2005 and will:

- Where necessary maintain and carry out structural improvements, maintain & update fire detection and warning systems, and carry out scheduled maintenance of all fire related equipment.

- Regularly review this strategy and procedure, the standards of the Lithium Building and it will, as far as is reasonably practicable, carry out all necessary remedial works.
- As part of its strategy and procedural reviews, Cawley's will keep up to date with any information pertinent to lithium batteries and also any legislative changes that may effect its operations.
- Maintain its commitment to training its staff and promoting the awareness of fire safety, in this way endeavouring to create a fire safe environment and ensuring safe and suitable premises for the well-being of staff, visitors, contractors and any other persons having access to the building and process.

1.1. Scope

This Fire Strategy applies to all staff, visitors, contractors, and any other persons visiting the building.

The aim of this document is to:

- Explain the structure of the organisation and how fire safety will be managed and communicated.
- Identify those staff with specific duties and responsibilities.
- Identify fire precautions and fire safety measures that are required to be complied with, to meet regulatory and best practice safety standards.
- To minimise business disruption.

1.2. Site plans / site setting

1.2.1. Drawing no. GPP/C/L/22/03 v1 details the layout of the buildings, any area where hazardous materials are stored, the main access routes for fire engines and any alternative access, access points around the perimeter to assist firefighting, hydrants and water supplies, the location of mobile and fixed plant and the quarantine area. (Appendix 1)

1.2.2. Drawing no. GPP-C-L-15-06 v7 details the site surface water drainage plan. (Appendix 2)

1.2.3. Drawing no. GPP-C-L-15-07 v2 details the foul drainage plan. (Appendix 3)

1.2.4. Drawing no. GPP-C-L-15-04 v2 outlines the site boundaries. (Appendix 4)

1.3. Building structures – Lithium Building

1.3.1. The Lithium Building is of brick-built construction, with a metal corrugated roof that has clear window lights within it make up. The internal design of the building is split in to 2 main areas:

- The workshop and shredding facility
- A meeting room, kitchenette, and small office.

1.4. Building Compartmentalisation

1.4.1. Separating the two areas is wall to wall compartmentation that consists of fire rated glass and FD30s rated fire doors. The Fire doors a provide a fire barrier between the 2 compartments, delaying the spread of fire and smoke.

2. Lithium-ion Operations – RAMS 09-24 (Appendix 5)

2.1. Feedstock Reception Handling

2.1.1. The organisation will only receive lithium batteries in accordance with our acceptance criteria aligned to this strategy. We do not accept any unsolicited waste consignments from third parties.

2.1.2. All batteries arriving on site will be transported in accordance with the Carriage of Dangerous Goods and use of Transportable Pressure Equipment Regulations 2009 (ADR 2023).

2.1.3. All batteries are assessed for electrical status and will be treated as 'live' until they have been through our discharge process.

2.1.4. All lithium batteries arriving on site will then be weighed in on the main weighbridge once weighed, the batteries will be transported to the Lithium Workshop.

2.1.5. Loads are then temperature checked on arrival before they are processed/stored.

2.1.6. If elevated temperatures are discovered on receipt, a dynamic risk assessment will be conducted by the high voltage engineers and specific actions will be undertaken as previously assessed and rehearsed. This could include for example, removing the battery/pack to the sterile/quarantine area or placing the affected pack/battery into the quenching tank situated outside the building or utilisation of the fire-fighting media such as the fire blanket/Lith-EX extinguishers. Potential specific scenarios are detailed in appendix 6.

2.1.7. In the event of discharge not being completed, batteries will remain connected, but discharge units will be isolated. A 60 min fire watch will be conducted prior to weekday end with no more than 500kilos being left at any one time.

2.1.8. All batteries are cleared from the lithium workshop prior every weekend.

2.2. Decommissioning of 'Live' Battery Packs in accordance with manufacturing guidelines/Safe System of Works (SSW)

2.2.1. Check battery visually and with thermal camera, voltage check from Orange Main Plug, check case voltage.

2.2.2. Decommission the outer shell using insulated tools, air tools and power tools.

2.2.3. Once the outer casing is removed check temperature and voltage across internal modules to find appropriate busbar connection positioned at halfway voltage point to be removed in order to reduce voltage to safer levels.

2.2.4. Remove remaining busbars to continue reducing pack voltage until all modules have been isolated.

2.2.5. Remove ancillary wiring and fixings around Modules.

2.2.6. Place Modules destined for second life reuse into insulated bags and into UN approved packaging in preparation for shipping to final destination. These modules are recorded in a shipping manifest and forwarded on accordingly.

2.2.7. Once packaged the modules are moved to the temperature-controlled ISO containers equipped with a fire detection (heat) system, surrounded by fire retardant concrete blocks and bespoke inlet valves to allow the ISO containers to be flooded with water by either the fire services or trained and competent site staff using fire hoses and hydrant, in the unlikely event of an emergency.

2.2.8. Storage units are checked twice per day with temperature / thermal camera with the results recorded.

2.2.9. If elevated temperatures are recorded, the affected batteries / modules are removed from the ISO containers and placed in the quenching tank or covered by a fire blanket and then placed in the quarantine area.

2.2.10. No 'live' part decommissioned batteries are left in the building overnight. The high voltage engineers will not start to decommission any battery if the decommissioning cannot be completed fully that day.

2.3. Decommissioning of Battery Packs - Damaged/ Burnt Batteries.

2.3.1. Open case and check battery for elevated temperature, smoking/vapour release/noises.

2.3.2. In the event of signs of potential thermal runaway, a dynamic risk assessment will be conducted to either quarantine the affected pack/battery in the designated quarantine area outside the building covered with a fire blanket or placed into the quenching tank situated outside the building.

2.3.3. Check case for any voltage.

2.3.4. Move battery onto insulated table which is monitored by a thermal camera.

2.3.5. Damaged batteries may need additional cutting tools to safely remove outer casing.

2.3.6. Check voltage across all busbars visible. Conduct temperature checks.

2.3.7. Assess any batteries/components that may be live.

2.3.8. Assess and make plans to choose correct tooling and method before decommissioning starts. Consider Air tools, insulated tools, chisel, prybar. If no voltage present and safe to do so a large handling machine and skip can be used to shake battery components/ash away.

2.3.9. Burnt components to be placed into bags/drums awaiting shredding.

2.3.10. Larger Cases stored and palletised awaiting offtake.

2.4. Decommissioning of Battery Packs – Unpacked Modules/cells

2.4.1. Remove Batteries from packaging and check visually and for temperature.

2.4.2. Determine Batteries for 2nd Life or End of Life.

2.4.3. Discharge/Shred or repackage where appropriate.

2.5. Discharge Operations

2.5.1. Check Voltage on all Modules ready for discharge.

2.5.2. Connect/arrange modules with the same voltage, observing correct polarity, for Parallel or Series connections to not overload discharge unit voltage/amperage rating.

2.5.3. Make sure Discharge Unit is TURNED OFF.

2.5.4. Plug battery array into Discharge unit.

2.5.5. Turn on Discharge Unit and programme to discharge to 0.2 volts.

2.5.6. Record and refer to max AMP limit list per battery type if history present.

2.5.7. Regularly monitor batteries and state of discharged – no discharging is to be undertaken over-night, or when there are no Lithium Workshop operatives in the building.
2.5.8. Discharge Unit to only operate under vision of Thermal Camera system.
2.5.9. Discharge Unit alerts user after completion of battery discharge, battery to be installed with a short circuit jumper cable immediately, fixed between the positive and negative terminals to stop potential voltage creep (batteries now inert).
2.5.10. If battery is left for any sustained period after discharge, battery will need a voltage check first and if voltage present the battery must be discharged back down to 0.2 volts at which point jumper cable is fitted between positive and negative terminals.
2.5.11. All fully discharged batteries must be placed in quarantine for a minimum of 1 hour before shredding.
2.5.12. Check offtake FIBC bag is in place.
2.5.13. Check jumper short circuit wire is in place on batteries whilst on the height adjustable work platform – any batteries without a jumper cable to be returned to discharge.
2.5.14. Check battery is at zero volts using a digital multi meter – and batteries that show voltage must have jumper wire removed and taken back to discharge.
2.5.15. Check temperature of battery before placing onto feed conveyor – any batteries with elevated temperatures to be removed to quarantine area situated outside the building.
2.5.16. Turn on Shredder and allow self-start procedure to finish.
2.5.17. Turn on Conveyor.
2.5.18. Turn on LEV Extraction system.
2.5.19. Check Helios fire suppression system is fully operational.
2.5.20. Send Battery for shredding using the feed conveyor.
2.5.21. Monitor Process visually using CCTV system fitted in the hopper and with thermal cameras positioned within the shredding room.
2.5.22. Monitor offtake bag and stop process when full, as necessary.

3. Fire Strategy – Prevention

3.1. Arson

3.1.1. The site is manned daily Mon- Fri from 6:00am to 01:00am. Sat 6:00am to 12:00pm.
3.1.2. The site is securely fenced with lockable gates.
3.1.3. Recorded CCTV – cameras installed inside and outside the facility.
3.1.4. The main office building has an intruder alarm that is monitored by a watch station out of hours.

3.2. Plant and equipment

3.2.1. **Lithium workshop shredding system:** shredding system maintenance works will be carried out as and when required by a trained, authorised, and competent member of staff and as per the producer's instructions.
3.2.2. **Mobile plant:** mobile plant that is not being used is kept away from combustible waste. Mobile plant is serviced and maintained periodically by competent, authorised personnel in

accordance with the manufacturer's schedules/guidelines. Heavy plant is fitted with an automatic fire suppression system.

3.2.3. All plant and equipment are visually inspected at the beginning of each shift with the check recorded in R2C, and at the end of the working day by site operatives to ensure that there has been no build-up of dust on hot exhausts or engine parts. Any dust is cleaned off once the vehicle has cooled down.

3.2.4. All heavy mobile plant is fitted with automatic fire suppression systems.

3.3. Electrical Safety

3.3.1. Electrical equipment / installations on site are fully certified by a suitably qualified person.

3.3.2. Periodic electrical installation condition assessments are carried out every 3 years.

3.3.3. Portable appliances are tested on an annual basis.

3.3.4. Electrical faults are investigated and repaired by authorised and competent persons in line with manufacturers guidelines.

3.4. Smoking

3.4.1. Smoking is only permitted in the designated smoking areas across the site which are equipped with suitable metal receptacles for the disposal of discarded smoking materials.

3.5. Hot works

3.5.1. A hot works permit is used across the site by trained and authorised internal and external engineers supported by suitably trained staff members who act as fire wardens / fire watch throughout the works and for 3 hours after completion.

3.6. Use of industrial heaters

3.6.1. All workshops are fitted with oil-fired industrial heaters / coolers fitted in accordance with all applicable legislation – serviced and maintained in accordance with manufacturers guidelines by an authorised and competent third-party contractor.

3.7. Leaks and spillages of oils and fuels

3.7.1. Emergency spillage procedure in place (WI009-06). (Appendix 6)

3.7.2. Spill kits are kept on site in key locations e.g., outside Lithium Building.

3.7.3. Staff are briefed and trained on their function and can be used in the event of a spill or leak from any plant or equipment on site.

3.7.4. Spillage drills undertaken periodically.

3.8. Build-up of loose combustible materials

3.8.1. Daily end of shift clean-up regime in place for the Lithium Workshop.

3.9. Storage

3.9.1. Upon arrival at the Lithium workshop all batteries are checked for signs of elevated temperatures by the supervisor, and then stored in a temperature-controlled shipping container fitted with a fire alarm surrounded by a fire wall made of concrete legato blocks that hold an A1 fire-resistant classification in accordance with REI 240 (the shipping containers are located away from all combustible materials stored on site).

3.9.2. The containers are checked at regular intervals throughout the day with a handheld temperature gauge.

3.9.3. In the event that a battery is identified with an elevated temperature upon arrival at site it is removed from the UN approved packaging if safe to do so and placed in a water bath or covered with a fire-retardant blanket – if it is not safe to remove from the packaging the whole box is placed in quenching tank – once safe to do so emergency services are notified. (detailed in Appendix 6).

3.9.4. Maximum tonnage storage material and the storage location area:

Waste Type	m^2 / Height/Volume M3	Location
Lithium-ion Batteries	<20 tonnes	UN approved packaging within ISO Containers
Recovered Materials (shredded flake)	<30 tonnes	UN approved (FIBC's)

3.10. The Dangerous Substance and Explosive Atmosphere Regulations 2002 (DSEAR)

3.10.1. DEKRA were commissioned and have conducted an explosion safety assessment under the requirements of DSEAR [1] for Cawleys Lithium Battery Shredding Plant Operations. As part of the assessment in considered both dust and gaseous vapours.

3.10.2. The purpose of the study was to conduct an Explosion Risk Assessment and Hazardous Area Classification of the Lithium Battery Shredding Plant, and to assess compliance against the requirements of DSEAR [1]. (Appendix 7)

3.10.3. The main finding of the assessment is that there were gaps in the measures in place for the management of the risks of harm from fires and explosion. These gaps required additional actions to be taken and these actions have been summarised throughout the DSEAR Action Plan. (Appendix 8)

4. Fire Strategy – Detection/Suppression

4.1. Fire Alarm System

4.1.1. The Lithium building fire detection and alarm system has been properly designed, installed, and will be maintained in line with BS 5839: 2017. 'Fire Detection and Alarm Systems for Buildings' Testing & Maintenance.

4.2. Fire Suppression System.

4.2.1. A fire suppression system is fitted to the Lithium Workshop conveyor belt and shredder. The Lithium shredder is purpose built and has an automated 'Helios' fire suppression system fitted.

4.2.2. To minimise fire risk from fine particles, the Lithium shredding process within the workshop has an active air extraction system which is fitted with a carbon filter. Air is positively extracted from the workshop through the carbon filter and vented via a small exhaust stack (Local Exhaust Vent [LEV]) as shown on drawing reference GPP/C/L/22/03 version 1.

4.2.3. The LEV system within the Lithium Building, is an 'ATEXON® VR18Z Spark Detection and Extinguishing System' and has been installed and designed to reduce the risk of ignition sources such as embers from reaching protected equipment.

4.2.4. Fire Fighting Equipment is provided and correctly positioned and maintained in accordance with BS 5306: Part 8, 2012 'Fire Extinguishing Installations and Equipment on Premises'

4.2.5. In the event of signs of battery thermal runaway, a dynamic risk assessment will be conducted to either quarantine or place the pack/battery into a quenching tank that is located directly outside the Lithium Building.

4.2.6. The tank is supplied by a mains water supply to ensure that is always readily available for use. The quenching tank is inspected on a regular basis to ensure that water levels are adequate and that no foreign objects have contaminated it.

4.2.7. There are fire hydrants at the gateway from both access points, plus an additional fire hydrant located in Arundel Road.

4.2.8. The sizing of the water mains pipe servicing the fire hydrants are as follows: Covent Garden close 75mm, Wingate Road 150mm, Arundel Road 100mm.

5. Fire Strategy – Emergency Response Procedures

5.1. Evacuation on discovering a fire.

5.1.1. Sound the Fire Alarm by operating the nearest break glass call point.

5.1.2. Activate the Conveyor and LEV E-Stops.

5.1.3. Activate the Helios Quench System.

5.1.4. If safe to do so attempt to tackle the fire using the correct type of fire extinguisher. N.B Only Trained persons to tackle any fire.

- Fire involving Lithium – LithEX extinguisher.
- Electrical – Co2 Extinguisher
- Any other combustible solid – Foam
- Fire Blanket

5.1.5. Evacuate the building and go to the Assembly Point.

5.1.6. If you are 'hosting' a visitor or a contractor, you are responsible to ensure that they are escorted to the Fire Assembly Point. If this is not possible report their presence and location to the Fire Warden.

5.1.7. Do not return to the building unless authorised to do so by the Fire Warden or in the case of a fire, the OIC (Officer in Charge) of the attending Fire Service.

5.1.8. Silencing of the fire alarm system should never be taken as an indication that it is safe to re-enter the building.

5.1.9. Re-entry of the building is strictly prohibited until the fire brigade officer in charge declares it is safe to do so.

5.2. Fire Loss/Business Interruption

5.2.1. In the very unlikely event of a fire that makes the Lithium Workshop unusable, batteries would be taken directly to supply chain partners based in the UK and Europe who either have the ability to safely discharge and package batteries for onwards compliant disposal in the EU or discharge and shred to a Lithium flake under a tolling arrangement with Lithium Recycling Services.

5.3. Notifications

5.3.1. All significant incidents shall be notified to the Environment Agency as soon as reasonably practicable on 0800 80 70 60 (must be within 24 Hours).

5.4. Clearing and decontamination after a fire

5.4.1. The main pollutant identified, should a fire occur, would be air pollution.
In the event of a fire in the Lithium Workshop, the clean-up procedure would be subcontracted to a third-party external provider.

Lithium-ion Operations
Fire Strategy Plan

(Luton - Covent Garden Close)

Reviewed by:	Matt Smith MIFSM, CFRAR
Reviewed by:	Nigel Ingram Operations Director
Reviewed by:	Alan College Technical Director DGSA WAMITAB holder, CPC holder
FPP reviewed by:	Amanda Clark Compliance Manger DipNEBOSH ENVDIP

The Lithium-ion Operations Fire Strategy will be reviewed annually or in the event of significant changes to the premises or personnel, changes to work activities or equipment, or changes to legislation.

APPENDICES

- Appendix 1 – GPP-C-L-22-03 Luton Site Layout Plan.
- Appendix 2 – GPP-C-L-15-06 Luton Surface Water Drainage Plan.
- Appendix 3 – GPP-C-L-15-07 Luton Foul Drainage Plan.
- Appendix 4 – GPP-C-L-15-04 v2 outlines the site boundaries.
- Appendix 5 – Lithium-ion Operations – RAMS 09-24
- Appendix 6 – Emergency spillage procedure in place (WI009-06).
- Appendix 7 – DEKRA DSEAR Survey.
- Appendix 8 – DSEAR Survey Action Plan.
- Appendix 9 – Declaration of Conformity.
- Appendix 10 – EU Certificate of Conformities (Explosion isolation flap valves VIGILEX).
- Appendix 11 – EU Certificate of Conformities (VIGILEX Vent Panel).
- Appendix 11A –VIGILEX Vent Panel Diagram.
- Appendix 11B – Explosion Panel Detail.
- Appendix 12 – Lithium Building Site Plan
- Appendix 13 – Incident Management Plan

KEY

S/Term QA	Short Term Quarantine Area
QC	Quarantine Container - Gas Bottles
Tank for F/S/S	Proposed Site for Tank for Fire Suppression System
QA	Quarantine Area in the event of a Fire
SS	Smoking Shelters
D	MRF Door
↗	Access Points
F	Fuel Storage
OS	Oil Storage
MP	Mixed Paper Bales
LRDF	Loose RDF
PS	Paint Store

No areas of made ground.
Total site surfaced with concrete.

Rev	Description	Initial	Date
1	Amendment to bay uses, QA, fabrication workshop, Lithium battery relocated. Text updated.	KD	18/07/22

Planning Consultants

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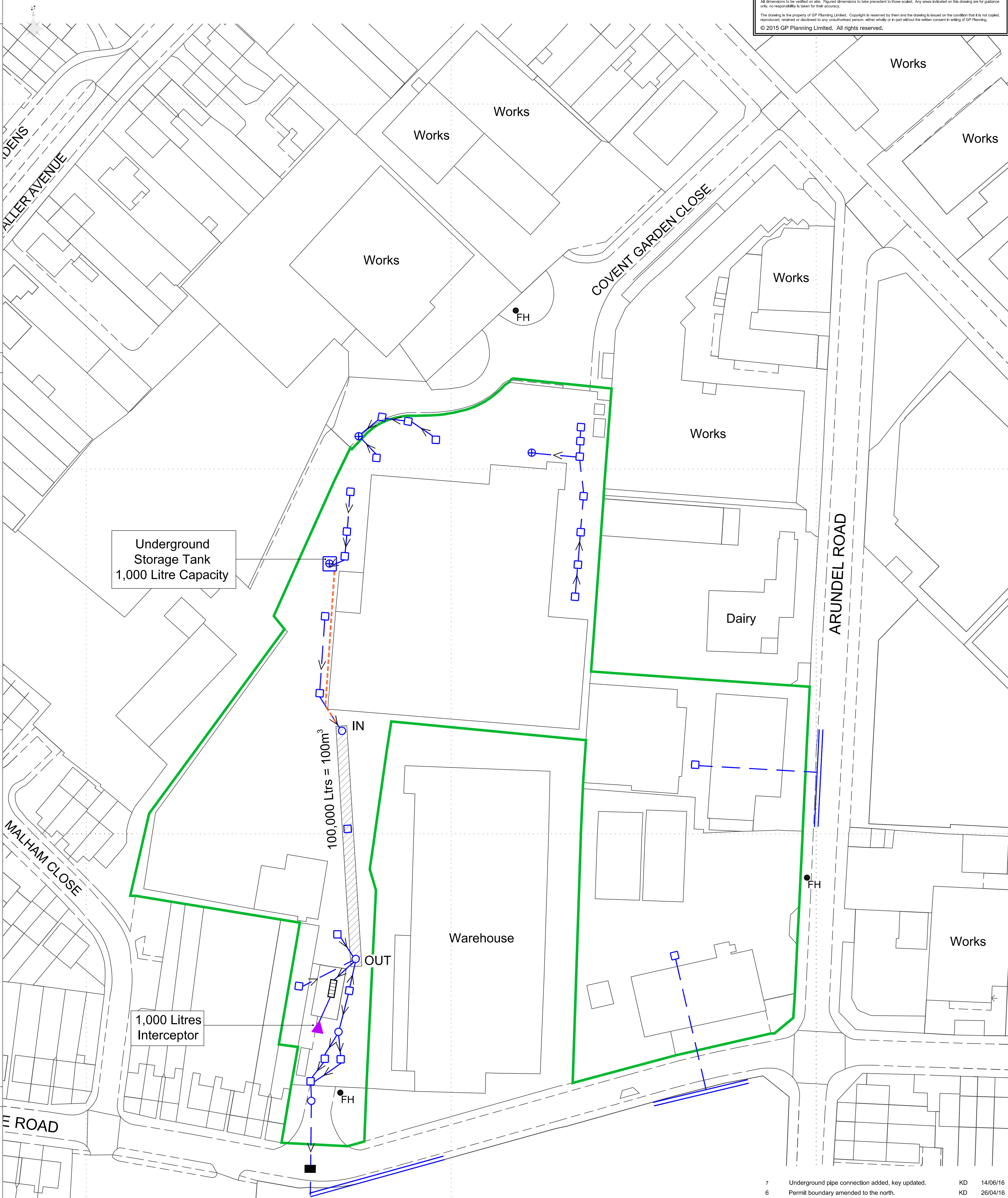
iCon Environmental Innovation Centre, Eastern Way,
Daventry, Northamptonshire. NN11 0QB
Registered in England No. 6019666

TITLE:	Luton Waste Facility Covent Garden Close, Luton Permit - Site Layout Plan		
CLIENT:	CAWLEYS		
DRAWN BY:	KD	CHECKED BY:	CS
DRAWING NO.:	GPP/C/L/22/03	REV NO.:	1
SCALE:	1:1000 at A3	DATE:	11 July 2022
SCALE BAR:	0 5 10 20 30 50		

ORIGINAL A3 SIZE SHEET



KEY

Manhole	Fire Water Containment & Silt Interceptor	Underground Pipe Connection
Soakaway	Grit Chamber	Direction of Flow
Drain Cover	Surface Water	Storm Outlet
Interceptor	Surface Water Sewer	FH Fire Hydrants
		OUT Shut Off Valve

Rev	Description	Initial	Date
7	Underground pipe connection added, key updated.	KD	14/06/16
6	Permit boundary amended to the north.	KD	26/04/16
5	Additional text to key.	KD	20/04/16
4	Additional drain, surface water & surface water sewer added to Arundel Road. 3 x Fire Hydrants added.	KD	23/03/16
3	Slight amendments and additional text added.	KD	17/03/16
2	Slight amendment to direction of flow, following a discussion with Alan Colledge.	KD	11/06/15

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The Stables, Long Lane, East Haddon, Northamptonshire, NN6 8DU
Registered in England No. 6019666

TITLE:	**Luton Waste Facility, Covent Garden Close, Luton Surface Water Drainage Plan**		
CLIENT:	Cawleys		
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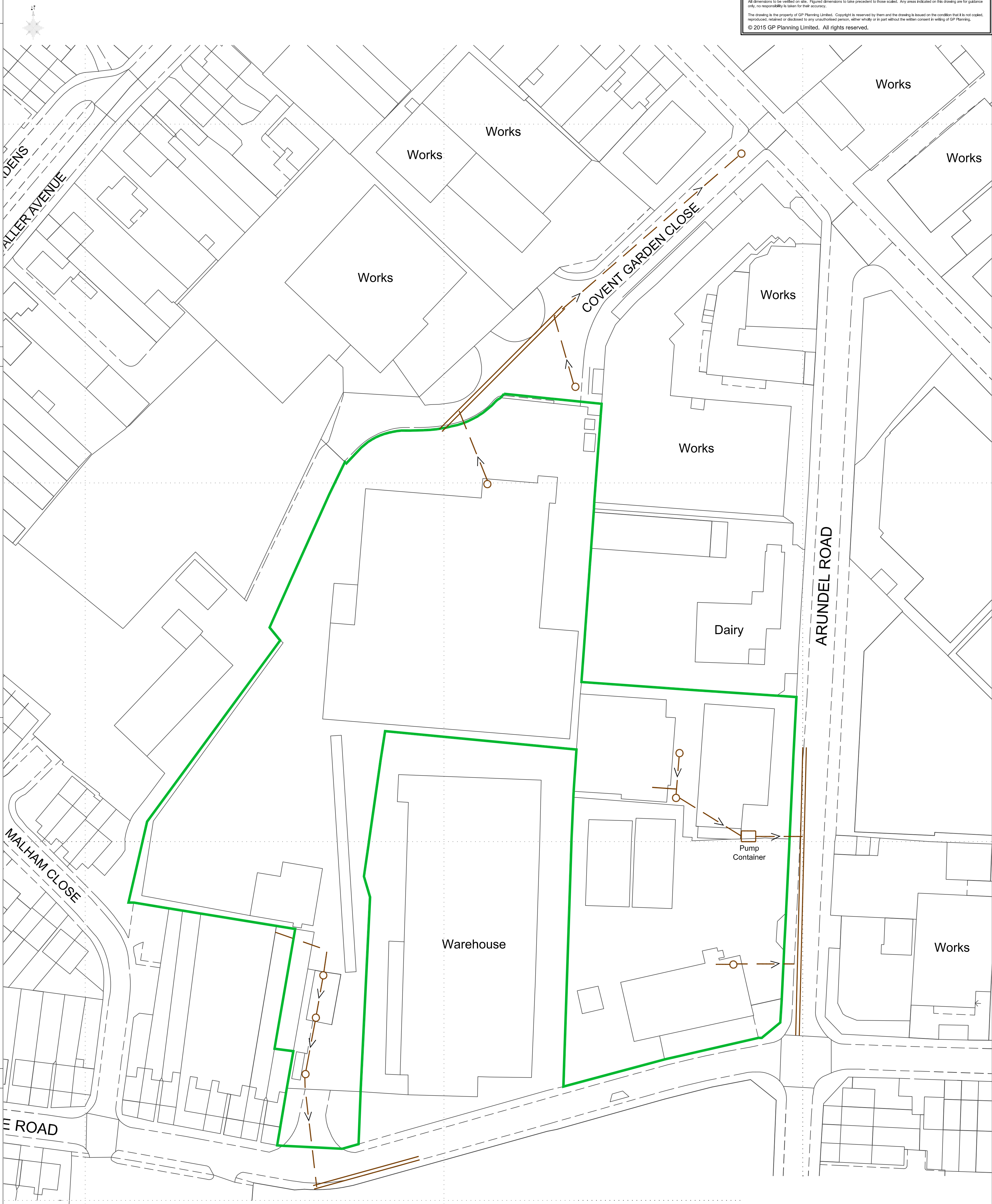
DRAWN BY:	KD	CHECKED BY:	GP
DRAWING NO.:	**GPP/C/L/15/06**	REV NO.:	7
SCALE:	1:1000 at A3	DATE:	09 June 2015
SCALE BAR:	0 5 10 20 30 50		

ORIGINAL A3 SIZE SHEET



KEY

- Manhole
- Foul Sewer
- Foul Water
- Direction of Flow

Rev	Description	Initial	Date
2	Permit boundary amended to the north.	KD	26/04/16

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TITLE:	**Luton Waste Facility, Covent Garden Close, Luton Foul Drainage Plan**		
CLIENT:	Cawleys		
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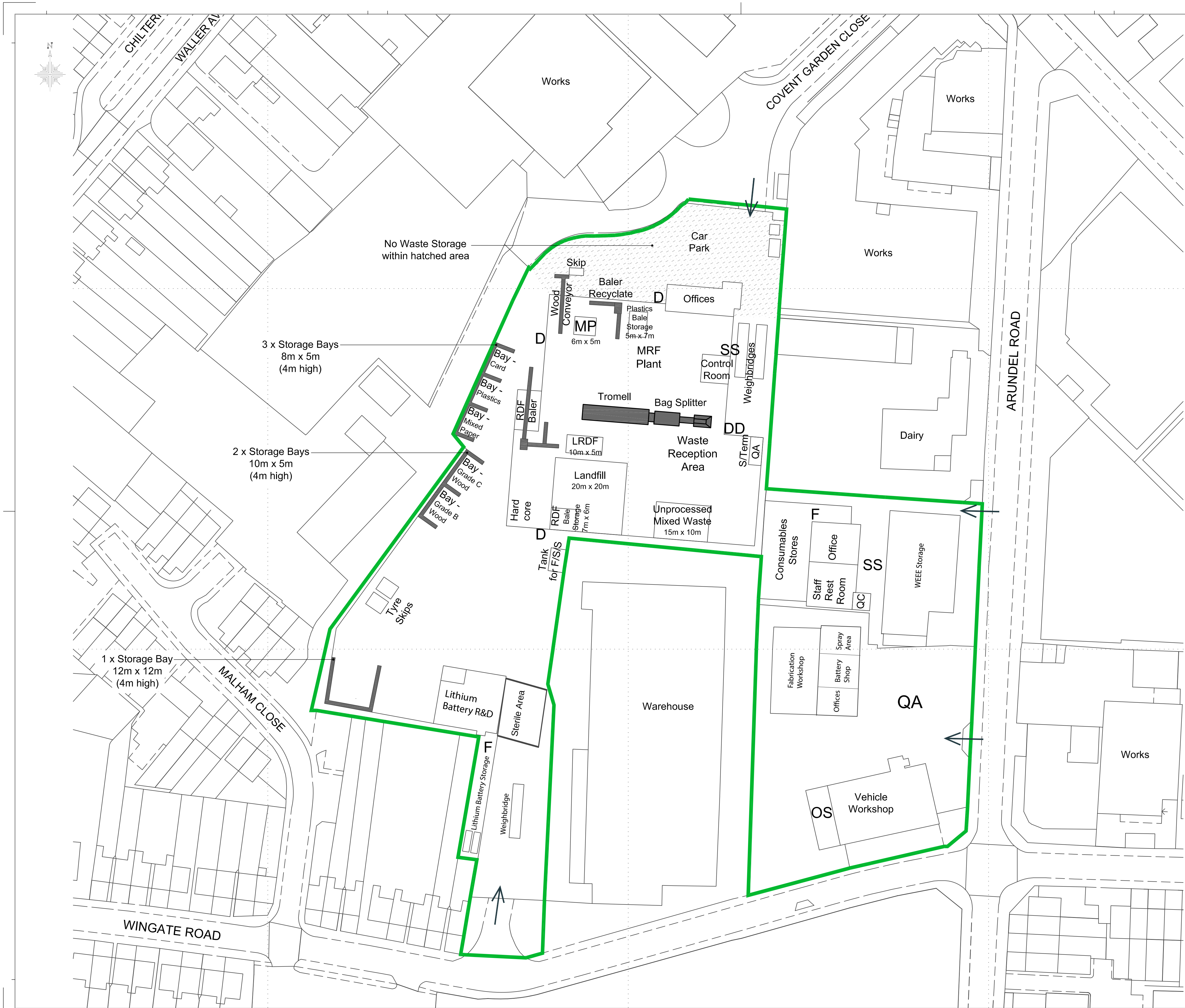
DRAWN BY:	KD	CHECKED BY:	GP
DRAWING NO.:	**GPP/C/L/15/07**	REV NO.:	2
SCALE:	1:1000 at A3	DATE:	09 June 2015
SCALE BAR:	0 5 10 20 30 50		

ORIGINAL A3 SIZE SHEET



KEY

S/Term QA	Short Term Quarantine Area
QC	Quarantine Container - Gas Bottles
Tank for F/S/S	Proposed Site for Tank for Fire Suppression System
QA	Quarantine Area in the event of a Fire
SS	Smoking Shelters
D	MRF Doors
↗	Access Points
F	Fuel Storage
OS	Oil Storage
PS	Paint Store
MP	Mixed Paper Bales
Sterile Area	Sterile Area

No areas of made ground.
Total site surfaced with concrete.

Rev	Description	Initial	Date
7	Measurements added.	KD	14/06/16
6	Permit boundary amended to the north.	KD	26/04/16
5	Additional labelling to site layout & key up dated.	KD	20/04/16
4	Additional amendments to layout and labels.	KD	23/03/16
3	Additional labeling of buildings/layout	KD	15/03/16
2	Additional labeling of buildings/layout	KD	13/10/15

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Registered in England No. 6019666

TITLE:	Luton Waste Facility Covent Garden Close, Luton Permit - Site Layout Plan		
CLIENT:	Cawleys		
DRAWN BY:	KD	CHECKED BY:	GP
DRAWING NO.:	GPP/C/L/15/03	REV NO.:	7
SCALE:	1:1000 at A3	DATE:	30 September 2015
SCALE BAR:	0 5 10 20 30 50		

ORIGINAL A3 SIZE SHEET

Risk Assessment / Method Statement

(Vehicle Operations) RAMS 09-24

Section 1 | Details of Activity / Task / Process

Site:	All Sites including Customer Sites	Revised By:	Amanda Clark (SHEQ Manager), Nigel Ingram (Director of Operations) Alan College (Technical Director) Joe Chester (Lithium Workshop Supervisor), Gerry Robinson (Lithium Worksop Technician)
Department:	Lithium Battery Recycling Solutions	Issue No.:	4
Activities:	Operation of Lithium-Ion Battery Dismantling Area	Date Revised:	April 2023
		Next Rev. Due:	August 2023

Section 2 | Risk Assessment

Task or process description	Identified Associated Hazard/Risk	Person(s) at Risk	Risk Rating L x S =	Existing Control measures	Risk rating following control measures L x S =	Further Control Measure Required	Risk Assessment review Date(s).
Movement of batteries into the Lithium Workshop – from delivery vehicles or from	Struck by moving machinery (FLT/HGV). Struck by falling object. Overturning FLT.	Lithium workshop operatives or other person in working area.	3 x 5=15 High	Trained, licenced, and authorised FLT /mobile plant / HGV operatives only.	2 x 5=5 Medium	FLT refreshers undertaken as required.	April 23

Task or process description	Identified Associated Hazard/Risk	Person(s) at Risk	Risk Rating L x S =	Existing Control measures	Risk rating following control measures L x S =	Further Control Measure Required	Risk Assessment review Date(s).
the storage containers	Manual Handling. Slip/trip/fall.			FLT maintained in accordance with manufacturers requirements by authorised and competent persons Site speed limit always observed. Never exceed the SWL of the FLT. Suitable safety footwear worn. Good housekeeping.		FLT LOLER'98 thorough examination. Pre-use checks completed and recorded. Manual handling training undertaken as part of mandatory training. Adjustable table to be sourced and trialled. Daily site inspections completed and documented by site manager	April 23 March 23
Packing / unpacking batteries (metal / wood cases).	Manual Handling. Slip/trip/fall. Struck by falling object.	Lithium workshop operatives or other person in working area.	3 x 5=15 High	To be completed by trained, authorised and competent persons only. Fixed gib hoist / crane to be used for moving heavy items.	2 x 5=5 Medium	Manual handling training undertaken as part of mandatory training. Ancillary lifting equipment LOLER'98 thorough examination.	April 23

Task or process description	Identified Associated Hazard/Risk	Person(s) at Risk	Risk Rating L x S =	Existing Control measures	Risk rating following control measures L x S =	Further Control Measure Required	Risk Assessment review Date(s).
				Adjustable working platform for battery dismantling. Good housekeeping. Appropriate PPE always worn		Storing hand tools on top of the FIBC should be prevented.	
Positioning batteries on adjustable work platform for dismantling or repacking of modules for onward transport.	Struck by falling object. Slip/trip/fall Manual handling Contact with electricity	Lithium workshop operatives or other person in working area.	3 x 5=15 High	Fixed gib hoist / crane to be used for moving heavy items. Adjustable working platform to be used as and when required. High voltage battery dismantling training undertaken WAMITAB approved. Appropriate PPE always worn. Good housekeeping. Shepherds crook in place. First aiders in place	2 x 5=5 Medium	Manual handling training undertaken as part of mandatory training. Ancillary lifting equipment LOLER'98 thorough examination. Periodic refresher training completed as and when required.	April 23

Task or process description	Identified Associated Hazard/Risk	Person(s) at Risk	Risk Rating L x S =	Existing Control measures	Risk rating following control measures L x S =	Further Control Measure Required	Risk Assessment review Date(s).
Preparation of EV Batteries for processing.	Contact with electricity; Manual Handling; Fire; Electrical flash over.	Lithium workshop operatives or other persons within the local vicinity	3 x 5=15 High	Trained/ competent and authorised technicians. High voltage battery dismantling training undertaken (WAMITAB approved. Method statement + SOP in place, for the safe discharging of batteries (below). Insulated and height adjustable working platform. Insulated tools and gloves always worn. Flash overprotective clothing always worn.	2 x 5=5 Medium	Fire safety management programme of maintenance and testing in place. Periodic refresher training completed as and when required.	April 23

Task or process description	Identified Associated Hazard/Risk	Person(s) at Risk	Risk Rating L x S =	Existing Control measures	Risk rating following control measures L x S =	Further Control Measure Required	Risk Assessment review Date(s).
				Firefighting equipment available – L2 powder extinguishers, Bridgehill fire blankets. Shepherds Crook available. First Aider on site always. Thermal imaging system and integrated fire alarm system installed in building. . Fire blankets available. Fire wardens available on site. Quenching tank on site.			

Task or process description	Identified Associated Hazard/Risk	Person(s) at Risk	Risk Rating L x S =	Existing Control measures	Risk rating following control measures L x S =	Further Control Measure Required	Risk Assessment review Date(s).
Storage of batteries pre-processing.	Fire Thermal runaway Gas release Security Theft	Lithium workshop operatives or other person in working area.	3 x 5=15 High	Batteries to be packed in accordance with the ADR 2023 regulations. Units that have not been discharged to be stored in a 40ft temperature-controlled ISO container fitted with a fire alarm system surrounded by concrete fire-retardant blocks. All batteries discharged prior to Shredding. Re-use batteries to be stored in appropriate ADR packaging in a 40ft temperature-controlled ISO container fitted with a fire alarm system contained in a concrete fire-retardant concrete block wall.	2 x 5=5 Medium	Fire safety management programme of maintenance and testing in place. Periodic refresher training completed as and when required. Aircon servicing programme in place as per manufacturers guidelines. ISO containers always locked. Temperatures checked and recorded daily. Fire alarm servicing program in place as per manufacturers / statutory requirements.	April 23

Task or process description	Identified Associated Hazard/Risk	Person(s) at Risk	Risk Rating L x S =	Existing Control measures	Risk rating following control measures L x S =	Further Control Measure Required	Risk Assessment review Date(s).
				Shredded battery Lithium flake to be stored in 205l clipped top containers or 1000ltr FIBC bags (no significant risk of fire as the battery cells have been destroyed). All battery decommissioning and shredding to be completed within daily shift. Method statement to be always followed (see below)			
Loading packages for onward shipping / processing	Struck by moving machinery (FLT / mobile plant / HGV Struck by falling object. Manual handling	Lithium workshop operatives or other person in working area.	3 x 5=15 High	Packages to be placed on pallets and secured with banding prior to moving. Use of FLT to lift and position pallets in place on vehicle.	2 x 5=5 Medium	FLT LOLER'98 thorough examination. Pre-use checks completed for FLT prior to use(R2C). Drum truck PUWER'98 statutory inspection.	April 23

Task or process description	Identified Associated Hazard/Risk	Person(s) at Risk	Risk Rating L x S =	Existing Control measures	Risk rating following control measures L x S =	Further Control Measure Required	Risk Assessment review Date(s).
				Load secured with ratchet straps by driver (carrier). Traffic route to be managed throughout loading process.		Manual handling training undertaken by Lithium Workshop operatives.	
Handling Lithium Battery Flake	Contact with hazardous chemicals) Lithium Hexafluorophosphate LiPF6, Hydrofluoric Acid, Hydrogen fluoride	Lithium workshop operatives	3 x 5=15 High	Only shred batteries when LEV (filtration system) and Helios fire suppression system fully operational. FFP3 masks to be worn in Shredding Hall during operation or when changing over FIBC bags. Chemical proof Nitrile gloves or gauntlets to be used when handling lithium flake or equipment that is in contact with.	2 x 5=5 Medium	Contaminated PPE to be bagged and placed in clip top drums for hazardous waste disposal. Heath surveillance program in place – lung function, dermatitis, HAV. Face mask fit test undertaken.	April 23

Task or process description	Identified Associated Hazard/Risk	Person(s) at Risk	Risk Rating L x S =	Existing Control measures	Risk rating following control measures L x S =	Further Control Measure Required	Risk Assessment review Date(s).
Cleaning after fire suppression system trigger	Contact with hazardous chemicals Lithium Hexafluorophosphate $LiPF_6$, Hydrofluoric Acid, Hydrogen fluoride	Lithium workshop operatives	3 x 5=15 High	FFP3 masks to be worn. Chemical proof Nitrile gloves or gauntlets to be used when handling lithium flake or equipment that is in contact. Wet vacs to be used to remove contaminated water and emptied into drums/IBCs for Hazardous waste removal.	2 x 5=5 Medium	Litmus tests to periodically test for pH and signs of acidity. Contaminated PPE to be bagged and placed in clip top drums for hazardous waste disposal. Heath surveillance program in place – lung function, dermatitis, HAV. Face mask fit test to be undertaken.	April 23 March 23

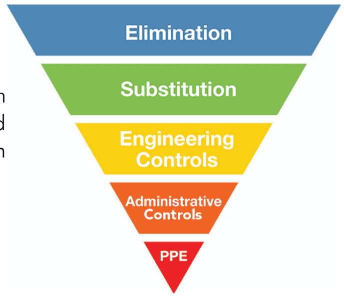
Severity of Harm / Likelihood of Occurrence		Nil/Negligible (scratch, bruise) 1	Minor (First Aid) 2	Moderate (Lost time, medical treatment) 3	Major (Broken bone, Serious injury, disease) 4	Extreme (Fatality, permanent incapacity) 5
Very Unlikely (practically impossible)	1	1	2	3	4	5
Unlikely (rare but could occur)	2	2	4	6	8	10
Possible (occurred before but not common)	3	3	6	9	12	15
Likely (known to occur from time to time)	4	4	8	12	16	20
Very Likely (common, occurs frequently)	5	5	10	15	20	25

A 5x5 risk grid should be used to evaluate the risk.

Risk Rating = Likelihood x Severity

Multiplying relevant likelihood of occurrence by severity of harm gave a risk factor priority risk from identified hazards and activities as low/medium/high rating which was then checked in the table below to decide the level of actions required.

15-25 High / unacceptable - immediate actions required
6-12 Medium – efforts should be made to reduce the risk
1-5 Low / acceptable – no action required – to be monitored



PERSONAL PROTECTIVE EQUIPMENT (PPE) *(tick as appropriate)*

☒ ☒ ☒ ☒ ☐ ☐ ☐ ☒ ☐ ☒

Section 3 | Method Statements – Standard Operating Procedure

1. Only trained, competent and authorised personnel are to undertake the task of battery dismantling.
2. High voltage battery dismantling training undertaken (WAMITAB approved)
3. High risk activities such as dismantling / connecting batteries (>80V) to the discharge unit shall only be undertaken by two members of staff. A single technician may process low voltage batteries (<80V).
4. Only use the tools provided in the work area. Any requirement for additional tools must be approved by the SHEQ Manager.
5. Wear the protective clothing as supplied and use as you have been trained to at all times. Any damage to clothing must be reported at the earliest opportunity. Due to some of the voltages / amperages in complete EV units it is possible for arc-flash over to occur. Arc Flash proof PPE to be utilised when working at voltages above 80V.
6. Observe good manual handling principles.
7. Pack batteries in accordance with ABE export requirements detailed in the manual.
8. In the event of a fire, raise the alarm and ensure the fire brigade are called and if trained and safe to do so, attempt to extinguish the fire. Note: use appropriate fire extinguishers.
9. Always ensure that when the lithium workshop is not occupied, all roller shutter doors and the office door are securely locked.
10. In the event of an electrocution incident, use the bespoke hook to move the person away from the source of energy and call for first aid / the emergency services.

Decommissioning of Battery Packs - Non-Damaged/Non-Burnt Batteries.

1. Open UN approved case used for transportation and check battery for elevated temperature, smoking/vapour release/noises.
2. In the event of signs of potential thermal runaway, a dynamic risk assessment will be conducted to either quarantine or place the affected pack/battery into a quenching tank situated outside the building or covered by a fire blanket and then removed from the building and placed in quarantine area. Emergency Services to be called as required.
3. Check case for any voltage.
4. Move battery onto insulated table which is monitored by a thermal camera
5. Check battery visually and with Temperature camera, voltage check from Orange Main Plug, check case voltage again recording results.
6. Decommission outer shell using insulated tools, air tools and power tools.
7. Once outer casing is removed check temperature and voltage across internal modules to find appropriate halfway voltage point to reduce voltage to safe levels quickly.
8. Remove busbars carefully to separate voltage from modules.
9. Remove Wiring and fixings around Modules.
10. Remove fixings for modules and remove safely.
11. Place Modules destined for reuse into insulated bags and into UN approved packaging awaiting offtake – once packaged these are moved to the temperature-controlled ISO containers equipped with a fire alarm and surrounded by fire retardant concrete blocks. Storage units to be checked twice per day with temperature / thermal camera with the results recorded. If elevated temperatures are recorded, the affected batteries / modules are removed from the ISO containers and placed in the quenching tank or covered by a fire blanket and then placed in the quarantine area. Emergency services to be called as required.
12. Place Modules for End-of-Life Shredding onto insulated trolley to await discharge/shredding procedures

Damaged/ Burnt Batteries.

1. Open case and check battery for elevated temperature, smoking/vapour release/noises.
2. In the event of signs of potential thermal runaway, a dynamic risk assessment will be conducted to either quarantine the affected pack/battery in the designated quarantine area outside the building covered with a fire blanket or placed into the quenching tank situated outside the building. Emergency Services to be called as required.
3. Check case for any voltage.
4. Move battery onto insulated table which is monitored by a thermal camera.
5. Damaged batteries may need additional cutting tools to safely remove outer casing.
6. Check voltage across all busbars visible. Conduct temperature checks.

7. Assess any batteries/components that may be live.
8. Assess and make plans to choose correct tooling and method before decommissioning starts. Consider Air tools, insulated tools, chisel, prybar. If no voltage present and safe to do so a large handling machine and skip can be used to shake battery components/ash away.
9. Burnt components to be placed into bags/drums awaiting shredding.
10. Larger Cases stored and palletised awaiting offtake.

For Unpacked modules/cells.

1. Remove Batteries from packaging and check visually and for temperature.
2. Determine Batteries for 2nd Life or End of Life.
3. Discharge/Shred or repackage where appropriate.

Discharge Operations.

1. Check Voltage on all Modules ready for discharge.
2. Connect/arrange modules with the same voltage, observing correct polarity, for Parallel or Series connections to not overload discharge unit voltage/amperage rating.
3. Make sure Discharge Unit is TURNED OFF.
4. Plug battery array into Discharge unit.
5. Turn on Discharge Unit and programme to discharge to 0.2 volts.
6. Record and refer to max AMP limit list per battery type if history present.
7. Regularly monitor batteries and state of discharged – no discharging is to be undertaken overnight, or when there are no Lithium Workshop operatives in the building.
8. Discharge Unit to only operate under vision of Thermal Camera system.
9. Discharge Unit alerts user after completion of battery discharge, battery to be installed with a short circuit jumper cable immediately, fixed between the positive and negative terminals to stop potential voltage creep (batteries now inert).
10. If battery is left for any sustained period after discharge, battery will need a voltage check first and if voltage present the battery must be discharged back down to 0.2 volts at which point jumper cable is fitted between positive and negative terminals.
11. All fully discharged batteries must be placed in quarantine for a minimum of 1 hour before shredding.

This instruction applies to the operation of the battery discharge and shredding unit.

General Control measures

1. Only trained and authorised personnel to operate the battery shredding system.

2. Always carry out the pre-operational checks as specified by the manufacturer and record these, any defects identified must be rectified by a competent and authorised engineer prior to use.
3. Only fully discharged batteries can be processed by this unit (clearly short circuited with jumper wire).
4. Always operate the equipment in accordance with the manufacturer's guidelines.
5. All repairs to be carried out in accordance with the manufacturer's guidelines by an authorised and competent person – all repairs must be recorded.
6. Feed Conveyor belt to be used to move all fully discharged battery modules to the shredder hopper. Larger batteries bigger than the feed conveyor should be reduced in size first by safe dismantling – feed conveyor is covered by CCTV monitoring input feed.
7. If a blockage occurs, follow the blockage clearance procedure detailed below.
8. In the event of a fire, follow the fire alarm and emergency evacuation procedure.
9. In the event of a liquid spillage (VOC and odour suppression system liquid), use the spill kit.
10. Following shredding, always isolate and lock off the power supply to the unit.
11. Do not store hand tools on top of the FIBC.

Shredding Operations.

1. Conduct operational checks on Shredder Unit to make sure it is operating correctly – shredder may only be used if all sections are fully operational, Shredder, conveyors, LEV, and Helios fire suppression system – if any one part is not working shredding must not take place until an authorised and competent engineer has made repairs.
2. Before Shredding make sure suitable Fire, Extinguishers and Fire blankets are present and checked in date where applicable.
3. Check offtake FIBC bag is in place.
4. Check jumper short circuit wire is in place on batteries whilst on the height adjustable work platform – any batteries without a jumper cable to be returned to discharge.
5. Check battery is at zero volts using a digital multi meter – and batteries that show voltage must have jumper wire removed and taken back to discharge.
6. Check temperature of battery before placing onto feed conveyor – any batteries with elevated temperatures to be removed to quarantine area situated outside the building.
7. Turn on Shredder and allow self-start procedure to finish.
8. Turn on Conveyor.
9. Turn on LEV Extraction system.
10. Check Helios fire suppression system is fully operational.
11. Send Battery for shredding using the feed conveyor.

12. Monitor Process visually using CCTV system fitted in the hopper and with thermal cameras positioned within the shredding room.
13. Monitor offtake bag and stop process when full, as necessary.

In the event of Helios fire system activation.

1. In the event of fire being detected (via either the thermal camera covering the shredding process, or the flame detection sensors fitted to the roof of the hopper and the primary discharge conveyor) the Helios system will self-activate and extinguish the fire, in the event the fire re-starts the Helios system will self-deploy – this process repeats until the fire is extinguished. The Helios system activates within 0.5 seconds from detection with each deployment lasting 2 to 3 seconds – deployment time can be changed by a competent and authorised engineer if required.
2. The Helios system is also fitted with a manual activation button that can be used by the Lithium workshop operatives at any time in the event of failed automatic deployment.
3. The Helios system records all instances of activation, which are fully investigated by the Lithium workshop operatives – CCTV footage is reviewed as part of this process to aid understanding of triggers.

In the event of a fire outside of the Helios fire suppression system coverage.

1. L2 fire extinguishers and fire blankets to be used, if safe to do so the battery can be removed from the building and placed in the quenching tank or in the quarantine area.
2. Emergency services to be called as required.
3. Follow local Emergency Procedures.

Blockage clearance procedure.

1. Only competent and authorised lithium workshop operatives are permitted to deal with blockages.
2. Blockages may only be cleared when two members of staff are present.
3. It is anticipated that a blockage could occur in the feed hopper if the in-feed material is loaded too quickly – to reduce this occurrence, the infeed conveyor is fitted with a variable speed potentiometer.
4. In the event of a blockage in the hopper, stop the shredder and conveyor system leaving the LEV and Helios fire suppression system fully operational. Isolate the appropriate power supply and lock-off using personal padlocks.
5. Each person involved in the clearing the blockage must lock-off the power supply using their personal padlock and if required, a padlock hasp must be used to ensure all locks can be applied.
6. Open the inspection hatch and check the blockage situation.
7. Use a metal insulated pry bar to agitate the material, close the inspection hatch, remove all padlocks from the isolation point and turn the power ON.
8. Run the machine to check that the blockage is cleared.

9. In the event of the blockage not being cleared repeat points 4 to 8 until blockage clears.
10. When blockage cleared, restart the shredding process.

Periodic System Checks

1. Fire Suppression Unit – to be performance tested on a monthly basis for satisfactory water deployment to upper shredder and lower conveyor areas. Manual Trigger buttons to be tested also. It will be noted that during normal operations the system may trigger automatically when dealing with thermal events. These events can replace the need to test separately and recorded.
2. Shredder Unit – to be inspected monthly for general state of health and teeth condition. Shredder teeth to always remain sharp and affective to prevent friction heat build-up.
3. Conveyor System – To be inspected before operation for damage and obstruction. Additionally, during operation periodic thermal camera checks are to be done to check heat build-up on moving parts and flake freshly processed from shredder discharge to FIBC discharge spout.
4. Dust Extraction Unit – Filter replacements to be completed by competent operatives under permit to work. All hot works to be accompanied by a Hot Permit to Work issued by competently trained staff.

Approved by Name: Amanda Clark, Nigel Ingram, Alan Colledge, Joe Chester, Gerry Robinson

Date: April 2023

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WI009-06 Emergency Spillage Cleaning Procedure

1. Emergency Procedure

   Prevention of environmental pollution must be given priority during any emergency event but with full regard to the health and safety of all persons.

2. Immediate actions
   - Raise the alarm where human safety is at risk;
   - If necessary, contact emergency services;
   - Extinguish all naked flames;
   - Obtain help from other members of staff nearby;
   - In all cases wear and use appropriate Personal Protective Equipment;
   - Do not enter tanks or confined spaces unless trained in correct procedures and not before all procedures have been satisfied.

3. Emergency Equipment

   Each site must have sufficient spillage containment and clearage equipment suitable for the quantity of material being stored. This must include at least one oil spillage kit and one chemical spillage kit. There should also be designated brushes and shovels to remove contaminated equipment. If specialised personal protective equipment is identified on the SDS sheet this must also be available.

4. Secondary actions

   Follow appropriate procedures for type of accident as described in the following tables:

Accident Type	Anticipated Consequences	Action to be taken (listed in order of priority)
Overflow or failure of: ▸ Vacuum pump ▸ Tank ▸ Storage tank ▸ Diesel tank Failure of tanker pipe work or controls Chemical spillage Spillages during loading, unloading or transport operations	Potentially polluting liquids flow over ground into; clean drain inlet/ ditch/stream/pond/ surrounding land	▸ If possible quickly stem the source of the spill ▸ Assess route of discharge and identify easiest method and location to prevent further discharge ▸ Identify areas of risk to people and environment ▸ Cordon off area if necessary ▸ If possible block off drains and gullies, using combination of absorbent, sand or earth where practical ▸ Contact Line Manager (this may be whilst any of the above is being carried out) ▸ If the load is hazardous for carriage, consult Emergency Instructions in Writing for further information ▸ If necessary, contact Environment Agency 0800 80 70 60 ▸ If possible, stop further additions to tank ▸ For small spillages absorb product using on board spillage kit ▸ For larger spillages use vacuum tanker to clean up spillage and dispose of safely

Accident Type	Anticipated Consequences	Action to be taken (listed in order of priority)
Failure of pumping system resulting in tank overflow Failure of automatic load control/ball valve Rupture of pipe Contaminated surface water from firefighting or other emergency activity		• Reduce tank contents to a safe level • Make temporary repairs if necessary • Clean up yard/land/ditch/contaminated areas • Dispose of contaminated materials safely • Assess cause and take action to prevent reoccurrence • Record incident, measures taken and to be taken

5. Testing of the emergency spillage clean-up procedure

Periodic testing of this procedure to be undertaken by the SHEQ department in conjunction with the relevant department. Details of the test shall be recorded on F002-02 Accident & Incident Investigation Report and next test due date shall be monitored through REG-005 Thorough Examination Register.

Associated Documents

- COSHH-RA – COSHH Risk Assessment
- PR016 – COSHH Procedure
- REG-028 – COSHH Register
- F002-02 Accident & Incident Investigation Report and
- REG-005 – Thorough Examination Register

DSEAR Assessment for Lithium Battery Shredder

Client	F & R Cawley Ltd. Maidenhall, Bedfordshire.
Contact	Amanda Clark SHEQ Manager
Report issue date	20 March 2023
Report number	R3016012936R1ak




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1. PROJECT DETAILS

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1.1 Revision History

Table 1: Report revision history

Version №	Date	Reason for Revision	Author	Reviewer
R1	20/03/2023	First report with Recommendations	AK	SG

2. EXECUTIVE SUMMARY

DEKRA conducted an explosion safety assessment under the requirements of DSEAR [1] for Cawleys Lithium Battery Shredding Plant located in Maidenhall, Bedfordshire.

The purposes of the study were to conduct an Explosion Risk Assessment and Hazardous Area Classification of the Lithium Battery Shredding Plant, and to assess compliance against the requirements of DSEAR [1].

The main finding of the assessment is that there are gaps in the measures in place for the management of the risks of harm from fires and explosion. These gaps will require additional actions to be taken and these actions have been summarised as recommendations throughout this DSEAR assessment.

The Basis of Safety for the Lithium Battery Shredding Plant is based on:

- The Avoidance of Explosive Dust Atmosphere inside the battery shredder via the application of dust extraction system.
- The Avoidance of Ignition Sources at the dust collection unit through the use of ATEX-certified work equipment.
- The Application of Organisational Measures (battery discharging and testing, compliance with manufacturer's instruction, operator training, etc) for fire prevention inside the shredder.
- The Application of Technical Measures for fire detection and control via fire-resisting materials of construction, spark detection and extinguishment system.

For the Basis of Safety to hold, the recommendations summarised in Section 8 on page 29 should be implemented / actioned so far as is reasonably.

3. ACRONYMS

ATEX: ATmosphères EXplosives

BoS: Basis of Safety

CCTV: Closed Circuit Television

DSEAR: Dangerous Substances and Explosive Atmospheres Regulation

FIBC: Flexible Intermediate Bulk Container

HAC: Hazardous Area Classification

HEDB: High Energy Density Battery

LEV: Local Exhaust Ventilation

MEC: Minimum Explosive Concentration

MIE: Minimum Ignition Energy

NFPA: National Fire Protection Association

PBD: Propagating Brush Discharge

PtW: Permit to Work

SDS: Safety Data Sheet

STEL: Short Term Exposure Limit

WEL: Workplace Exposure Limit

4. DEFINITIONS

ATEX-certified: Equipment certified to the requirements of EU Directive 2014/34/EU and suitable for the hazardous area.

Equipment: machines, apparatus, fixed or mobile devices, control components and instrumentation which are capable of causing an explosion through their own potential sources of ignition.

Explosion: a release of energy that causes a rapid pressure rise.

Flash fire: the term for a slow deflagration of a premixed, truly unconfined, unobstructed fuel-air cloud producing negligible overpressure. Thermal effects are the main hazard.

Fire: a slow combustion where the fuel and air are not premixed. Thermal effects are the main hazard.

Grade of release:

> **Continuous Grade of Release:** release which is continuous or is expected to occur frequently or for long periods.
>
> **Primary Grade of Release:** release which can be expected to occur periodically or occasionally during normal operation.
>
> **Secondary Grade of Release:** release which is not expected to occur in normal operation and, if it does occur, is likely to do so only infrequently and for short periods.

Hot Work: welding, cutting, grinding, brazing, drilling and similar activities which results in sparks, fire, molten slag, or hot surfaces.

Zone 20: an area in which an explosive atmosphere in the form of a cloud of combustible dust in air is present continuously, or for long periods or frequently.

Zone 21: a place in which an explosive atmosphere in the form of a cloud of combustible dust in air is likely to occur in normal operation occasionally.

Zone 22: an area in which an explosive atmosphere in the form of a cloud of combustible dust in air is not likely to occur in normal operation but, if it does occur, will persist for a short period only.

5. INTRODUCTION

F&R Cawley Ltd (Cawleys) have designed and installed a Lithium Battery Shredding Plant at their Recycling Facility in Maidenhall, Bedfordshire. The shredding plant is used for shredding Lithium ion high energy density batteries (HEDB). A significant hazard of the process is dust explosion due to ignition of an explosive dust cloud of the product from the shredding operation.

Cawleys has requested DEKRA Organisational & Process Safety (DEKRA) to conduct an explosion safety assessment as required by the Dangerous Substances and Explosive Atmospheres Regulations (DSEAR) [1].

The project scope is outlined in the DEKRA quotation 3016012936. In summary, the scope of the project is to conduct an Explosion Risk Assessment and Hazardous Area Classification of the Lithium Battery Shredder.

This report does not include assessment of chemical reaction hazards if found on site, although anecdotal comments may be made if appropriate. Also, a fire risk assessment required by the Regulatory Reform (Fire Safety) Order 2005 [9] is outside the scope of this assessment. It is important that such risk assessment is carried out if not done already.

Ade Kalejaiye of DEKRA visited Cawleys Recycling Facility on 16 February 2023 to undertake the assessment. Alan Colledge (Technical Director - Lithium), for Cawleys was present during the assessment and provided valuable information for the exercise.

If a 'Unit Operation' is identified as not being an issue as far as this assessment is concerned, it must be understood that this is only valid as long as the process and circumstance of operation are the same as when the assessment was carried out. If there is any alternation to the Unit Operation in the future e.g., flammable materials are introduced where initially, there were none, then the assessment should be carried out again.

Throughout this report, recommendations are given to either improve safety or fulfil a legal requirement. These recommendations are prioritised using the following principles:

- **Priority H** - High **(H)** recommendations address high-risk issues. This is because the combination of likelihood and severity of the fire/explosion is currently too high. These should be addressed first particularly where the action is easy to implement and / or of low cost.
- **Priority M -** Medium **(M)** recommendations address issues presenting a lower but still moderate risk to personnel. Moreover, recommendation(s) which fulfil a legal duty but are not necessarily addressing a high-risk problem are also marked as M. These items should be addressed in the short term, particularly where the action is easy to implement and / or of low cost.
- **Priority L** - Low **(L)** recommendations address issues presenting low risk issues. Other smaller suggestion to improve safety also fall under this category.

The recommendations given in this report are intended to be a means of ensuring safety for personnel in accordance with the intent of DSEAR. These have all been compiled in Section 8 on page 29. If, however, there is an equally effective way of attaining the same aim, then the two are deemed interchangeable.

It is a legal requirement to review the risk assessment so as to keep it up to date and particularly if significant changes occur in the future. Therefore, the recommendation below is made.

R1. **General -** DSEAR (Regulation 5) requires this assessment to be reviewed at regular intervals. Based on the risks and changes foreseen, it is recommended to review this assessment whenever changes are made but even without changes at no later than 4 years from the date of this report. This should be captured in the site's action tracker or equivalent system. **(M)**

The brief overview of the assessment methodology used in this report is discussed in Appendix B. In summary, it follows the hierarchical 'Three Rules of DSEAR' approach:

1. Do not have a flammable atmosphere, but if you can't and you do…
2. Do not ignite it, but if you can't and you do…
3. Do not hurt anyone.

5.1 Site Overview

Cawleys Recycling Facility in Maidenhall is a multi-purpose waste handling and recycling facility located in a densely populated industrial estate. The Lithium Battery Shredding Plant is located in a warehouse-style building at the southwest corner of the facility (see illustration in Figure 1).

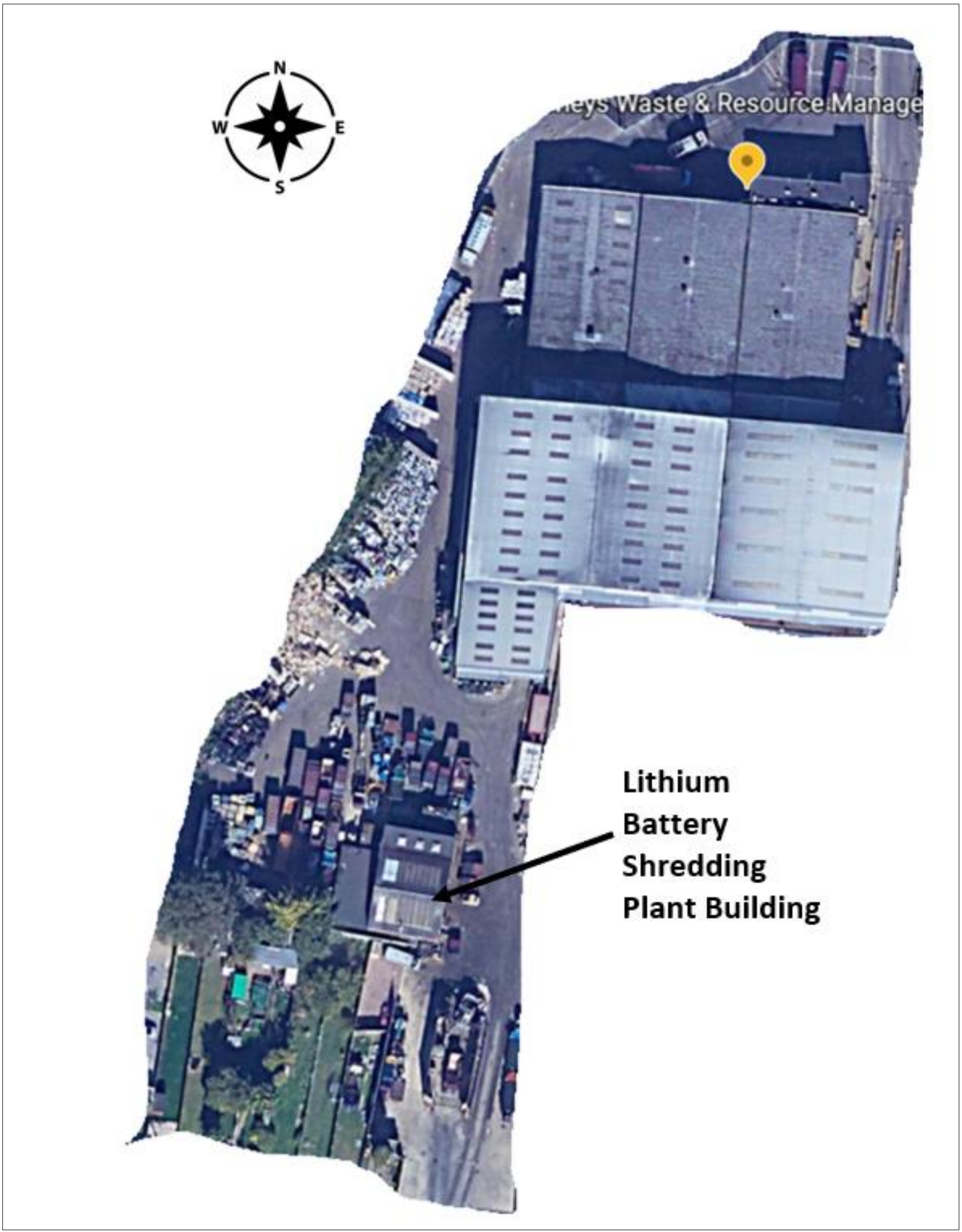

Figure 1: Recycling Facility Layout

6. LITHIUM BATTERY SHREDDING PLANT - HOUSEKEEPING

Good housekeeping is vital in preventing dust explosions in the workplace. Dust layers are extremely dangerous and are known as a major source of secondary dust explosions. Also, layers of dust on items of equipment act as insulators which can cause an item of equipment to overheat which leads to smouldering of the dust layer in contact with the surface of the equipment. Smouldering dust layers are potential ignition sources of explosive dust atmospheres.

At the time of the site visit, there was no discernible dust layers inside the battery shredding plant and it was stated that cleaning of the work area is carried out at the end of the work day. On that basis, it is assumed that dust layers are controlled, and the level of housekeeping was considered to be good.

7. LITHIUM BATTERY SHREDDING PLANT

7.1 Overview of Process

The Lithium Battery Shredding Plant is a warehouse-style building with a roller shutter door located at the east wall of the building and personnel entrance / exit doors located in various areas across the building. Most of the building is open plan but with dividing brick block walls separating offices and the Lithium Battery Shredder from the open plan area.

The primary uses of the open plan area are:

- Storage of batteries waiting to be shredded.
- Storage of 1-ton flexible intermediate bulk containers (FIBC) of battery flakes pending transfer to outdoor storage area.
- Battery discharger and discharging station.
- Battery shredder control panel and video display, and battery loading gravity (roller) conveyor.

The main process steps associated with the battery shredding plant are:

- Battery packs received at the facility are manually dis-assembled into individual batteries.

- The individual batteries are connected to a proprietary battery discharger which ensures that the battery is deep discharged to 0%. The discharger is connected to the power grid and transmits the energy removed from the battery to the grid.

- The discharged battery is kept in a holding area inside the building pending the time they can be loaded into the shredder. A red wire is connected between the positive and the negative terminal of each battery to prevent a build-up of potential difference across the battery terminals.

- The discharged batteries are loaded on to the gravity conveyor, the red wires are removed, and the operator performs a final voltage test to confirm that each battery is fully discharged before starting the battery shredder.

- The battery shredder crushes the batteries to produce flakes of about 10mm particle size which are stored in a 1-ton FIBC. It is understood that the standard practice is to keep the FIBC at less than ¾ of its safe working load so as to limit material losses to the dust extraction unit.

<u>Lithium Battery Shredder</u>

The lithium battery shredder is an assembled equipment comprising of an in-feed belt conveyor, a charging hopper for the shredder element, product (enclosed) belt conveyor [Photograph 1], and a 1-ton FIBC filling station [Photograph 2].

The hopper, product (enclosed) conveyor and FIBC station are fitted with dedicated local extract ventilation (LEV) ducting which is connected to a dust extraction unit that maintains a negative pressure around the shredder unit. It is understood that the battery shredder cannot be started if the dust extraction unit is not working.

There is live closed-circuit television (CCTV) monitoring of the shredder element installed inside the hopper, this allows the operator to have a real time view of the shredding operation inside the hopper.

A spark detection and fire extinguishing (water deluge) system is provided at the inlet side of the shredder element (top of the hopper) and at the outlet side of the shredder element (hopper discharge). It is understood that the drive system for the shredder element has reverse rotation features for managing process upsets.

Whenever a spark or ember is detected inside the hopper, a short (intermittent) burst of water mist is automatically activated to extinguish the fire and an audio alarm is generated at the same time to alert the operator. The spark detection and extinguishing system automatically stops the intermittent burst of water mist when the fire has been extinguished, hence, a manual reset is not required every time the system is activated. This ensures uninterrupted operation of the shredder. It is understood the conveyors are stopped until the fire is extinguished.

The material of construction of the shredder is carbon steel except for the belts on the conveyors. The marking plate on the battery shredder indicated that it was fabricated in August 2020.

<u>Dust Extraction System</u>

Nuisance dust extracted from the battery shredder is passed through a dust collection unit located outside of the building [Photograph 3]. The unit is a two-compartment design that allows automatic cleaning of the filters in one compartment while the filters in the other compartment are in use. The air mover is a centrifugal fan installed at ground level adjacent to the pressurised water reservoir for the spark detection and extinguishing system.

Cleaning of the filters is via a mechanical (pneumatic) shaker. Dust and lithium ion battery flakes collected inside the dust collector hopper are discharged – at timed interval - into an FIBC station at the bottom of the hopper. It is understood that the mechanical shaker is provided to aid the removal of dust and battery flakes from inside the hopper during discharge into the FIBC.

It was stated that the dust collector hopper has an open top for explosion venting. It is unlikely that it will be a permanently open top. There are normally open explosion vents but there is usually a lightweight shield without any fasteners or similar cover arrangements for the vent. Therefore, the following recommendation is made.

R2. **Dust Extraction Unit -** Confirm the details of the explosion vent design with the manufacturer and obtain the technical file for the dust collector. **(M)**

Spark detection and extinguishing system like that installed on the battery shredder is provided at the inlet ducting to the dust extraction unit [Photograph 3].

The dust extraction unit is fabricated from galvanised steel, and it was stated that the unit was installed in 2022.

The ATEX marking plate on the unit provides the certification “Ex II 2D c T80^{o}C”. In the absence of technical documentation for the dust extraction unit, the following recommendation is made.

R3. **Dust Extraction Unit –** Confirm the full details of the ATEX certification from the manufacturer. **(L)**

Photograph 1: Shredder hopper, enclosed product (belt) conveyor and LEV ducting.

Photograph 2: FIBC Filling Station comprising of product conveyor discharge spout, FIBC support frame and FIBC LEV ducting.

Photograph 3: Dust Extraction Unit including spark detection system (red colour, top left) on inlet piping.

7.2 Hazardous Area Classification (HAC)

7.2.1 Flammable Atmospheres

At the time of the visit, there was no information on the explosion characteristics of the flakes produced from the battery shredding process.

Safety Data Sheet (SDS) [2] provided for the battery pack indicates that typical ingredients for the cathode is an oxide of lithium and one or more metals such as Cobalt, Nickel, Manganese, etc. It is understood that the electrolyte is a paste comprising of a Lithium salt and an organic carbonate (e.g., ethylene or propylene carbonate) as the electrolyte solvent.

The anode is stated to be usually carbon powder or graphite which could be up to 20% weight of the battery. Carbon powder is a carbonaceous dust, and it is classed as dust group IIIB (non-conductive dust) according to NFPA 499 [3]. The shredding process is expected to release the carbon powder or pulverise the graphite such that they can pose a dust fire or explosion hazard.

A key step in any dust hazard analysis is a detailed knowledge of explosive characteristics of the powder and/or particulate solid being handled. Such detailed information is often not included in an SDS and would require testing to determine the explosive characteristics. Testing should always be carried out on the finest and driest sample likely to be found in the process. In this case it is likely to be the material entering the FIBC at the base of the dust collector. Testing should also be performed from material collected just prior to the shredder blades being changed as this is usually when the finest particles will be produced. Therefore, the following recommendation is made.

R4. **General –** Conduct explosive characteristics testing of the flakes produced from the battery shredder. The requirements of the test should be discussed with DEKRA. **(H)**

However, for the purposes of this assessment it is assumed that dust produced from the shredding process is capable of dust explosion in the form of a dust cloud and dust fire in the form of a dust layer.

7.2.2 Hazardous Area Classification

The following summarises the sources and grades of release for the purposes of HAC:

Identified Primary Grades of release:

1. Dust collector hopper and dirty side of filter media – this is based on short self-cleaning intervals of the filters which could produce explosive dust cloud periodically during normal operation.

Identified Secondary Grades of Release:

2. Clean-side of the dust filter, inside of fan casing and outlet ducting – due to a filter element failure.
3. Exhaust fan outlet – due to a filter element failure.
4. Hopper discharge spout – due to potential for a short duration dust cloud when the hopper is discharging into the FIBC and when a full FIBC is being replaced.

5. Dust extraction inlet ducting – due to a blunt shredding blade.

Non-Hazardous Area

It is understood that the dust extraction system is designed to control health hazards of dust. Such units will be adequately sized to have sufficient volumetric air throughput to ensure the dust concentration in the workplace is below the workplace exposure limit (WEL) and hence, the dust / air entering the dust collector will be below the minimum explosive concentration (MEC). For example, carbon black has a short term exposure limit (STEL) of 0.007 g/m^3 [4] and its MEC is > 50 g/m^3 [3], the MEC is almost a thousand times the STEL. Based on this design parameter, the following sections of the plant are classed as non-hazardous.

1. Internals of the shredder hopper.
2. The enclosed product conveyor.
3. Internals of the product FIBC.

Filter changing task would generate dust cloud, but a hazardous zone is not required because such a task would be done according to the specialist contractor safe systems of work. However, the following recommendation is made.

R5. **Dust Extraction Unit** - Ensure filter replacement task is completed under a permit to work system which mandates that control of ignition sources. **(L)**

7.2.3 HAC Table

The table below shows the HAC schedule for the Lithium battery shredding plant in accordance with the BS EN IEC 60079-10-2 [5].

Table 2: HAC Schedule for Lithium Battery Shredding Plant

	Source of release			Hazardous Area Classification			Comments
No.	Description	Location	Grade of release (C, P, S)	Zone Type (20/21/22)	Zone extent (m) Horizontal	Zone extent (m) Vertical	
1.	Dust Collector Hopper & dirty side of filter	Dust Extraction System	P	21	Internal volume of the hopper including dirty side of filter.		
2.	Clean side of filter, inside of fan casing and outlet ducting	Dust Extraction System	S	22	Internal volume of clean side of filter including outlet ducting and inside of fan casing.		
3.	Exhaust Fan Outlet	Dust Extraction Unit	S	22	1m radius around fan exhaust outlet.		
4.	Dust Collector Hopper Discharge Spout	Dust Extraction Unit	S	22	1m radius around the hooper spout.		
5.	Dust extraction inlet ducting	Dust Extraction Unit	S	22	Internal volume of inlet ducting		

7.3 Ignition Assessment

The following ignition categories are listed in BS EN 1127-1 [6], but those in bold are the relevant ignition sources applicable to the explosive dust atmospheres identified for the Lithium battery shredder plant.

1. **Hot surfaces.**
2. **Flames and hot gases (including hot particles).**
3. **Mechanically generated sparks.**
4. Unsuitable or malfunctioning electrical equipment.
5. Stray electrical currents, cathodic corrosion protection.
6. **Static electricity.**
7. Lightning.
8. Radio frequency (RF) electromagnetic waves.
9. Visible light electromagnetic waves.
10. Ionising radiation.
11. Ultrasonics.
12. Adiabatic compression and shock waves.
13. Exothermic reactions, including self-ignition of dusts.

The ignition sources assessment is governed by the following two considerations:

1) The probability that the ignition source is present. This depends on the severity of the hazardous area.
    a. For a Zone 22, the only ignition sources considered are those which are present in normal operation.
    b. For Zone 21, ignition sources in normal and expected abnormal situations are considered.
    c. For Zone 20, ignition sources in normal, expected abnormal and rare abnormal situations are considered.
2) The probability that the identified ignition source is effective enough to ignite the explosive dust. The answer to this query depends on two sub-aspects, these are:
    i. The strength of the ignition source can deliver, which is either indicated by the temperature produced or an amount of energy dissipated. This will be judged on a case-by-case basis for each identified ignition source.
    ii. The ignition sensitivity of the explosive dust.

The following sub-sections assesses the relevant ignition sources in this process.

7.3.1 Hot Surfaces

The only location where a hot surface could exist is at the electric motor for the dust extraction fan, but the electric motor is not within an explosive dust atmosphere. Therefore, normal equipment protection is sufficient for the electric motor.

7.3.2 Mechanical Sparks

An obvious source of mechanical sparks will be from dust extraction fan blades if the blades come in contact with the fan casing. This can only occur due to a misalignment of the fan shaft if the casing is not properly supported, or it is installed on shifting ground or it is not installed on level ground. Such issues would have been identified during commissioning and it is not considered further. Regular inspection and maintenance is required to identify issues with the fan if any occur over the life of the unit.

Mechanical sparks may be encountered during maintenance / repair work at or near the dust extraction unit. Examples of sources of mechanical sparks that may be encountered during maintenance / repair work include the use of hand tools such as portable grinder, drills, etc.

Protection against mechanical sparks from such tools will be by control of the use of such tools in areas where explosive dust atmosphere may be present. BS EN 1127-1 [6] allows the use of steel tools (e.g., screwdrivers, spanners, etc.) which can only cause single sparks when they are used in Zones 21 and 22 only.

Tools such as portable grinders, which generate showers of sparks are only permitted if no explosive dust atmosphere is present in the workplace. That is, the use of such tools must be under a permit to work, which ensures that the work area has been adequately made dust-free.

7.3.3 Flames and Hot Gases (including hot particles)

Hot particles could occur due to fires from crushing of a battery that is not fully discharged. The hot particles can be carried to the dust collector. But there are spark detection and extinguishing system provided in the shredder hopper, product conveyor and at the inlet ducting before the dust collector.

Flames or hot particle could occur from hot work associated with repairs / maintenance. Hot work entails welding, cutting, grinding, brazing, drilling and similar activities which results in sparks, fire, molten slag, or hot surfaces. Hot work is automatically assumed to be strong enough to ignite explosive dust atmospheres and initiate smouldering of dust layers.

The principal prevention is to separate out the fuel (flammables / combustibles) and the hot work. Hot work should be managed by a permit to work (PtW) system. The following guidance should be followed as a minimum (not exhaustive):

- Where possible, hot work is not carried out where an explosive dust atmosphere may be present, e.g., it is carried out in workshops under appropriate controls.
- Where hot work has to be carried out inside the dust collector, all combustibles / flammables are removed, and the dust collector is thoroughly de-dusted to ensure there is no potential for explosive dust atmosphere.
- The work is contained, e.g., through the usage of fire blankets and shields.
- A fire watch present during the work independent from the person using the equipment.

- There is provision for an emergency response plan (e.g., fire extinguishers), and this should consider the unique hazards posed by the hot work activity for which existing firefighting provisions may be insufficient.
- There is adequate detection and monitoring prior to and during the hot work.
- A fire watch is present after the work is completed to observe for any developing fires and smoulders and to monitor the temperature of surfaces affected by the work. This is to ensure surface temperatures are sufficiently low before reintroducing a flammable material into the booth.
- Persons issuing hot work permits are competent to do so, familiar with the area in question and suitably trained.

The PtW system was not examined at the time of the site visit. Therefore, the following recommendation is made.

R6. **Dust Extraction Unit –** Ensure there is a permit to work system in place for managing hot work activities. **(L)**

7.3.4 Static Electricity

Static Electricity and use of FIBCs

Static charges can be generated whenever the dust collector is emptied into the FIBC, the charge can accumulate on the deposited material as well as on the fabric from which a FIBC is constructed or any parts of it. An ignition could occur if the accumulated charge is released in the form of an incendiary discharge in the presence of an explosive dust atmosphere. Spark, brush, cone, and propagating brush discharges are all possible when FIBCs are used.

The requirements and specifications which FIBCs should meet depend on the nature and sensitivity of the explosive dust atmosphere present during filling and emptying. The final goal for the construction of FIBC is to exclude incendive discharges from the FIBC fabric during their intended use.

Since discharges of different incendivity (i.e., different types of discharges, such as spark, brush, or propagating brush discharges) may be generated, the necessity of their exclusion and thus the requirements for construction of the FIBC depends on the intended use of the FIBC. For this reason, different types of FIBC have been developed, which are defined as Type A, B, C or D.

- Type A FIBCs are made from fabric or plastic sheet without any measures against the build-up of static electricity.
- Type B FIBCs are made from fabric or plastic sheet designed to prevent the occurrence of propagating brush discharges.
- Type C FIBCs are made from fabric interwoven with connected conductive threads or filaments and designed to prevent the occurrence of incendiary sparks, brush discharges and propagating brush discharges. Type C FIBCs are fitted with dedicated earthing connections and must be connected to earth during filling and emptying operations.
- Type D FIBCs are made from static dissipative fabric with discontinuous conductive threads designed to prevent the occurrence of incendiary sparks, brush discharges

and propagating brush discharges, without the need for a connection from the FIBC to earth.

The four different types of FIBC should be used according to the minimum ignition energy (MIE) of the powder and/or particulate solid as shown in Table 3 below. Other types of FIBC or FIBC of unknown type should only be used in the presence of flammable atmospheres after detailed evaluation by an expert.

Table 3: Use of the different types of FIBC [7]

Material in FIBC	Surroundings	
MIE of material	**Non-flammable atmosphere**	**Dust Zones 21 & 22**
MIE > 1000 mJ	A, B, C, D	B, C, D
3 mJ < MIE ≤ 1000 mJ	B, C, D	B, C, D
MIE ≤ 3 mJ	C, D	C, D

The ability to use an FIBC safely in hazardous explosive dust atmospheres may change if an inner liner is installed in the FIBC. Combinations of FIBC and inner liner that can be used safely in hazardous atmospheres are shown in Table 4.

Table 4: Use of the different types of FIBC [7]

FIBC	Inner Liner		
	Type L1	**Type L2**	**Type L3**
Type B	Not permissible	Permissible	Permissible
Type C	Permissible	Permissible	Not permissible
Type D	Not permissible	Permissible	Not permissible

The three types of inner liners are based on surface resistivity as follows.

- Type L1 inner liners are made from materials with surface resistivity on at least one surface of less than 10 mega-ohms (MΩ) and, where necessary, a breakdown voltage through the material of less than 4 kV.

- Type L2 inner liners are made from materials with surface resistivity on at least one surface of between 1 giga-ohms (GΩ) and 1 tera-ohms (TΩ), and a breakdown voltage through the material of less than 4 kV.

- Type L3 inner liners are made from materials with surface resistivity of greater than 1TΩ and a breakdown voltage through the material of less than 4 kV.

At the time of the site visit, information on an FIBC label indicates that it is 'multi-trip[1]', with a safe working load of 1000 kg and a safety factor of 6. There was no information on the FIBC

[1] FIBCs are classed as either single trip or multi-trip.

type or the inner liner type (if any). This certainly means the FIBCs are not Type C or D as such FIBCs are clearly labelled as such. Therefore, the following recommendation is made.

R7. **General –** Based on the MIE provided by the test in recommendation R4, ensure that the FIBC type and any associated inner liner complies with the requirements presented in Table 3 and Table 4. **(M).**

Spark Discharges

Spark discharges occur from charged isolated conductors i.e., when charge is allowed to accumulate. This can occur for example on unearthed metal and other conductive or static dissipative items of equipment. Spark discharges can ignite explosive dust atmospheres (dependent upon MIE) and should be avoided by effective earthing and bonding of conductors.

A key source of isolated conductors in the explosive dust atmosphere identified in the HAC schedule (Table 2) is damaged earth cable connections in cartridge filters sleeves or clamps, and bag filter supports. During filter cleaning, the self-cleaning (shaker) mechanism may jostle the filter (now an isolated conductor) closer to the grounded dust collector hopper thereby leading to a spark discharge in the presence of an explosive dust atmosphere.

It is nearly impossible to guarantee that all small parts of a dust collector are bonded and earthed by cable connections. Hence, the primary protection measures for such a scenario is by the design and construction of the dust collector unit along with explosion protection. It is understood that explosion venting is provided at the top of the dust collector hopper. ATEX certification indicates that the ignition protection (construction safety) concept for the dust collector unit minimises the likelihood that an ignition source will arise from the unit provided that the equipment is inspected and maintained.

Another source of isolated conductors is charged hand tools that are stored on an FIBC during maintenance work around the dust collector. Whilst not likely to be high energy sparks, if the MIE of the powder is suitably low (not verified as yet), spark discharges even from low capacitance hand tools could be incendive for the dust atmosphere at the discharge of the dust collector hopper or inside the FIBC.

R8. **Dust Extraction Unit -** Until MIE data is available and a better risk judgement can be made, the practice of storing hand tools on top of the FIBC should be prevented as part of the risk assessment process under the permit to work for the maintenance task. **(L)**

Brush Discharges

Brush discharges occur from insulating materials e.g., plastic items or insulating powders. The maximum spark equivalent energy associated with brush discharges is 3 to 4 mJ [**Error! Reference source not found.**7]. Brush discharges can arise from the charging effect that occurs when dust is captured on the surface of a filter medium or from the charge powder itself or from the surface of the FIBC if insulating.

PD CLC/TR 60079-32-1: 2018 [7] states that current knowledge does not provide any indication that brush discharges can cause incendive ignition of combustible dusts independent of their MIE. Therefore, this ignition source can be disregarded.

Propagating Brush Discharges (PBD)

The principal precondition for a PBD is a high electrical charging regime on a thin (less than 10 mm) insulating material. They are more likely to occur if the insulator is in contact with an earthed conductor although this is not a prerequisite for a PBD. They do not occur in all metal plant.

Pneumatic conveying of dusts and particulate solids generates static charges on the materials being conveyed. PBD can occur inside the multi-compartment dust collector if there is a deflection plate used to direct the incoming gas-solid stream to the online filter compartment, and the surface of this deflection plate is coated with an insulating material.

The protection measure for this scenario is avoidance of the use of insulating deflection plates and provision for explosion protection. It is understood that explosion venting is provided at the top of the dust collector hopper. ATEX certification also indicates that the ignition protection (constructional safety) concept for the dust collector unit (based on its Type non-electrical 'c' certification) along with recommended maintenance minimises the likelihood that an ignition source will arise from the unit.

R9. **Dust Extraction Unit** – Verify with the equipment manufacturer if an insulating deflector plate is used inside the dust collector. **(L)**

Cone Discharge

Cone discharges occur from a heap of highly charged non-conductive powder after entering hoppers or silos. These are possible in FIBCs. Whilst unlikely to be incendive to the dust cloud in question, this cannot be completely discounted until MIE data is available.

7.4 Discussion

Discussion at the site visit indicates that there is experience of fires inside the shredder hopper. It was stated that this is due to release of energy from batteries that have not been deep discharged to 0%. The site identified that such an event occurs when batteries received from suppliers are damaged and one or more cells inside a battery are isolated from the charge/discharge circuit. For such batteries, the discharger and test equipment at the site will not identify such faults. The energy released from the charged cell(s) is incendive to combustible particles from the shredding process. Hence, the site installed the spark detection and extinguishing system at the hopper inlet and outlet, and at the inlet to the dust collection unit. It is understood that there is a maintenance service plan for the spark detection and extinguishing system. However, the following recommendation is made.

R10. **General –** Ensure that the tasks associated with the maintenance service plan for the spark detection and extinguishing system includes a performance test of the system. **(L)**

BS EN IEC 62485-6:2021 [8] indicates that lithium-ion batteries do not contain lithium metal. Therefore, the use of water as a fire extinguishing agent does not pose reactive and hydrogen generation hazards associated with the interaction between water and lithium metal.

Concerns were raised about the potential for smouldering fires under a pile of battery flakes inside the product FIBC because it was thought that the battery flakes may still be hot from the frictional heating by the shredder element. However, thermal imaging conducted during the site visit at the discharge of the hopper, along the product conveyor and across the content inside the FIBC indicated no hot spots and showed that the flakes are at ambient temperature. This indicated that the shredder mechanism uses very low force of attrition and would not lead to frictional heating. However, the following recommendation is made.

R11. **Battery Shredder –** Ensure there is a system in place for regular inspection and replacement of the shredder blades if this has not been specified by the shredder manufacturer. **(L)**

R12. **Battery Shredder -** Consider carrying out periodic thermal imaging of the shredded product from the shredder discharge through to the FIBC discharge spout. **(L)**

Dust explosion inside the dust collector is a known hazard to the site. Hence, the site has made provision for explosion protection and installed the dust collector outdoors. It is apparent that there are gaps in the explosion protection design basis and sufficient information of the dust extraction unit. These gaps have been captured by relevant recommendations.

7.5 Basis of Safety

The Basis of Safety for the Lithium battery shredding plant is based on:

- The Avoidance of Explosive Dust Atmosphere inside the battery shredder, enclosed conveyor and product FIBC via the application of dust containment and extraction system.

- The Avoidance of Ignition Sources at the dust collection unit through the use of ATEX-certified work equipment, spark detection and appropriate maintenance of the equipment and earthing and bonding. Explosion venting and isolation is present as a secondary basis of safety.

- The Avoidance of Ignition Sources during FIBC filling by ensuring correct choice of FIBC and liner, and appropriate measures to ensure the FIBC is used correctly.

- The Application of Organisational Measures (battery discharging and testing, compliance with manufacturer's instruction, operator training, etc.) for fire prevention inside the shredder.

- The Application of Technical Measures for fire detection and control via fire-resisting materials of construction, spark detection and extinguishment system.

For the Basis of Safety to hold, the recommendations summarised below should be implemented / actioned as far as is reasonably practicable.

7.6 Recommendations

R2. **Dust Extraction Unit -** Confirm the details of the explosion vent design with the manufacturer and obtain the technical file for the dust collector. **(M)**

R3. **Dust Extraction Unit –** Confirm the full details of the ATEX certification from the manufacturer. **(L)**

R4. **General –** Conduct explosive characteristics testing of the flakes produced from the battery shredder. The requirements of the test should be discussed with DEKRA. **(H)**

R5. **Dust Extraction Unit** - Ensure filter replacement task is completed under a permit to work system which mandates that control of ignition sources. **(L)**

R6. **Dust Extraction Unit –** Ensure there is a permit to work system in place for managing hot work activities. **(L)**

R7. **General –** Based on the MIE provided by the test in recommendation R4, ensure that the FIBC type and any associated inner liner complies with the requirements presented in Table 3 and Table 4. **(M).**

R8. **Dust Extraction Unit -** Until MIE data is available and a better risk judgement can be made, the practice of storing hand tools on top of the FIBC should be prevented as part of the risk assessment process under the permit to work for the maintenance task. **(L)**

R9. **Dust Extraction Unit –** Verify with the equipment manufacturer if an insulating deflector plate is used inside the dust collector. **(L)**

R10. **General –** Ensure that the tasks associated with the maintenance service plan for the spark detection and extinguishing system includes a performance test of the system. **(L)**

R11. **Battery Shredder –** Ensure there is a system in place for regular inspection and replacement of the shredder blades if this has not been specified by the shredder manufacturer. **(L)**

R12. **Battery Shredder -** Consider carrying out periodic thermal imaging of the shredded product from the shredder discharge through to the FIBC discharge spout. **(L)**

8. CONCLUSION AND RECOMMENDATION SUMMARY

A DSEAR assessment has been undertaken for F&R Cawley Ltd for the activities undertaken at the Lithium Battery Shredding Plant in Maidenhall, Bedfordshire.

The main finding of the assessment is that there are gaps in the measures in place for the management of the risks of harm from fires and explosion. These gaps will require additional actions to be taken and these actions have been summarised as recommendations throughout this DSEAR assessment.

The Basis of Safety for the Lithium Battery Shredding Plant is based on:

- The Avoidance of Explosive Dust Atmosphere inside the battery shredder via the application of dust extraction system.
- The Avoidance of Ignition Sources at the dust collection unit through the use of ATEX-certified work equipment.
- The Application of Organisational Measures (battery discharging and testing, compliance with manufacturer's instruction, operator training, etc) for fire prevention inside the shredder.
- The Application of Technical Measures for fire detection and control via fire-resisting materials of construction, spark detection and extinguishment system.

For the Basis of Safety to hold, the recommendations summarised below should be implemented / actioned so far as is reasonably practicable.

<u>Recommendation</u>	<u>Page No.</u>
R1. **General -** DSEAR (Regulation 5) requires this assessment to be reviewed at regular intervals. Based on the risks and changes foreseen, it is recommended to review this assessment whenever changes are made but even without changes at no later than 4 years from the date of this report. This should be captured in the site's action tracker or equivalent system. **(M)**	9
R2. **Dust Extraction Unit -** Confirm the details of the explosion vent design with the manufacturer and obtain the technical file for the dust collector. **(M)**	13
R3. **Dust Extraction Unit –** Confirm the full details of the ATEX certification from the manufacturer. **(L)**	13
R4. **General –** Conduct explosive characteristics testing of the flakes produced from the battery shredder. The requirements of the test should be discussed with DEKRA. **(H)**	17
R5. **Dust Extraction Unit** - Ensure filter replacement task is completed under a permit to work system which mandates that control of ignition sources. **(L)**	18
R6. **Dust Extraction Unit –** Ensure there is a permit to work system in place for managing hot work activities. **(L)**	22
R7. **General –** Based on the MIE provided by the test in recommendation R3, ensure that the FIBC type and any associated inner liner complies with the requirements presented in Table 3 and Table 4. **(M).**	24

9. FLAMMABILITY DATA

The following table gives the flammability data for typical ingredients in the HEDBs handled on site. The information was sourced from NFPA 499 [3].

Table 5: Flammability data for powders

Classification of Data	Ignition Sensitivity			Explosion Severity		Electrostatic Properties		Thermal Decomposition	Burning Behaviour	Limits	
Test Parameter	Layer Ignition Temp. (LIT)	Cloud Ignition Temp. (CIT)	Minimum Ignition Energy (MIE)	20 litre Sphere		Resistivity (Low RH)	Charge Relaxation Time (Low RH)	Onset Temp.	BZ Number	Minimum Explosible Conc. (MEC)	Limiting Oxygen Conc. (LOC)
Units	°C	°C	mJ	P_{max} barg	K_{st} bar m/s	Ohm m	hours	°C	-	g/m^3	% $^{v}/_{v}$
Carbon Powder										> 50	

Key:

- Blank fields mean no data are available from the information sources used.

10. REFERENCES

1. "*Dangerous Substances and Explosive Atmospheres Regulations 2002*", S.I.2002 No.2776 (DSEAR 2002).
2. *"High Energy Density Battery – Safety Data Sheet*", Assembly 0754A12-002, Rev. A1, Issue Date: 01/04/2018, UEC Electronics.
3. NFPA 499:2021, "*Recommended Practice for the Classification of Combustible Dusts and of Hazardous (Classified) Locations for Electrical Installations in Chemical Process Areas"*, NFPA.
4. *"EH40/2005 Workplace Exposure Limits"*, 4th Edition, HSE.
5. BS EN IEC 60079-10-2:2015, "*Explosive atmospheres. Classification of areas. Explosive dust atmospheres*", BSI
6. BS EN 1127-1:2019, "*Explosive atmospheres. Explosion prevention and protection. Basic concepts and methodology*", BSI.
7. *PD* CLC/TR 60079-32-1:2018, "*Explosive atmospheres. Electrostatic hazards, guidance. British Standards Institution*", BSI.
8. BS EN IEC 62485-6:2021, *"Safety requirements for secondary batteries and battery installations. Safe operation of lithium-ion batteries in traction applications"*, BSI.
9. "*Regulatory Reform (Fire Safety) Order 2005*", S.I. 2005 No. 1541

APPENDIX A DSEAR 2002

The following is a summary of the regulations of DSEAR:

- **Regulations 1 to 4** deal with preliminary issues, i.e., the date of entry into force of the Regulations, scope and definitions.
- **Regulation 5** requires employers and the self-employed to assess risks to employees and others whose safety may be affected by the use or presence of dangerous substances at work.
- **Regulation 6** sets out how the risk to safety from dangerous substances should be eliminated or reduced.
- **Regulation 7** contains specific requirements to be applied where an explosive atmosphere may be present (in addition to the requirements in regulation 6).
- **Regulation 8** requires the provision of arrangements to deal with accidents, incidents and emergencies.
- **Regulation 9** requires the provision of information, training and instruction on dangerous substances.
- **Regulation 10** requires the identification of pipes and containers where these contain dangerous substances.
- **Regulation 11** addresses the need to coordinate explosion protection measures where employers share the same workplace.

A.1 When does DSEAR Apply?

DSEAR applies whenever:

- There is work being carried out by an employer (or self-employed person), and
- A *dangerous substance* is present (or is liable to be present) at the workplace, and
- The dangerous substance could be a risk to the safety of people as a result of fires, explosions or similar energetic events or through corrosion to metal.

Fires and explosions create harmful physical effects such as thermal radiation, overpressure effects and oxygen depletion. These effects can also be caused by other energetic events such as runaway exothermic reactions involving chemicals or decomposition of unstable substances such as peroxides. These events are also covered by DSEAR.

Gases under pressure can also cause explosions creating harmful effects. Substances that are corrosive to metal may cause damage to metal/metal containing structures which could result in reduced structural integrity.

A.2 Definition of Dangerous Substances?

Dangerous substances include:

- A substance or mixture which meets the criteria for classification as hazardous within any physical hazard class laid down in the CLP Regulation whether or not the substance is classified under that regulation.
- Any kind of dust that when spread in air to form a cloud (ie form an explosive atmosphere), can explode.

- Any other substances, or mixtures of substances, which because of their physical properties and the way in which they are present in the workplace create a risk to safety from fires and explosions, but which may not be covered by CLP Regulation. For example high flashpoint liquids present in the workplace at elevated temperatures.

A.3 Main Requirements of DSEAR

In summary, DSEAR places duties on employers (and the self-employed, who are considered employers for the purposes of the Regulations) to assess and eliminate or reduce risks from dangerous substances. Specific requirements are discussed below.

A.3.1 Assessing Risks

Before work is carried out, employers must assess the risks that may be caused by dangerous substances. The purpose is to help employers to decide what they need to do to eliminate or reduce the risks from dangerous substances. If there is no risk to safety, or the risk is trivial, no further action is needed. If there are risks then employers must consider what else needs to be done to comply fully with the requirements of DSEAR.

As part of the risk assessment, employers must classify areas where hazardous explosive atmospheres may occur into zones. The classification given to a particular zone, and its size and location, depends on the likelihood of an explosive atmosphere occurring and its persistence if it does.

DSEAR defines a place where an explosive atmosphere may occur in quantities that require special precautions to protect the health and safety of workers as **hazardous**. A place where an explosive atmosphere is not expected to occur in quantities that require such special precautions is deemed to be **non-hazardous**. For these purposes "**special precautions**" means precautions to control potential ignition sources within a hazardous area, particularly in relation to the construction, installation and use of equipment.

Identifying hazardous or non-hazardous areas should be carried out in a systematic way. Risk assessment should be used to determine if hazardous areas exist and to then assign zones to those areas. The assessment should consider such matters as:

a) The hazardous properties of the dangerous substances involved;

b) The amount of dangerous substances involved;

c) The work processes, and their interactions, including any cleaning, repair or maintenance activities that will be carried out;

d) The temperatures and pressures at which the dangerous substances will be handled;

e) The containment system and controls provided to prevent liquids, gases, vapours or dusts escaping into the general atmosphere of the workplace;

f) Any explosive atmosphere formed within an enclosed plant or storage vessel; and,

g) Any measures provided to ensure that any explosive atmosphere does not persist for an extended time, e.g. ventilation.

Before a workplace containing zoned areas comes into operation for the first time, the employer must ensure that the overall explosion safety measures are confirmed (verified) as being safe. This must be done by a person or organisation competent to consider the particular risks in the workplace, and the adequacy of the explosion control and other measures put in place.

If an employer has five or more employees, the employer must record the significant findings of the risk assessment.

A.3.2 Preventing or Controlling Risks

Employers must put control measures in place to eliminate risks from dangerous substances, or reduce them as far as is reasonably practicable. Where it is not possible to eliminate the risk completely employers must take measures to control risks and reduce the severity (mitigate) the effects of any harmful event.

The best solution is to eliminate the risk completely by replacing the dangerous substance with another substance, or using a different work process. This is called substitution in the Regulations.

In practice this may be difficult to achieve, but it may be possible to reduce the risk by using a less dangerous substance. For example, replacing a low flashpoint liquid with a high flashpoint one. In other situations it may not be possible to replace the dangerous substance at all. For example, it would not be practical to replace petrol with another substance at a filling station.

A.3.3 Control Measures

Where the risk cannot be eliminated, DSEAR requires control measures to be applied in the following priority order:

- Reduce the quantity of dangerous substances to a minimum.
- Avoid or minimise releases of dangerous substances.
- Control releases of dangerous substances at source.
- Prevent the formation of a dangerous atmosphere.
- Collect, contain and remove any releases to a safe place (for example, through ventilation).
- Avoid ignition sources. Areas classified into zones must be protected from sources of ignition. Equipment and protective systems intended to be used in zoned areas should be selected to meet the requirements of the *Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 1996*. Equipment already in use before July 2003 can continue to be used indefinitely provided a risk assessment shows it is safe to do so.
- Avoid adverse processing conditions (for example, exceeding the limits of temperature or control settings) that could lead to danger.
- Keep incompatible substances apart.

These control measures should be consistent with the risk assessment and appropriate to the nature of the activity or operation.

A.3.4 Mitigation

In addition to control measures DSEAR requires employers to put mitigation measures in place. These measures should be consistent with the risk assessment and appropriate to the nature of the activity or operation and include:

- Reducing the number of employees exposed to the risk.

- Providing plant that is explosion resistant.
- Providing plant that is corrosion resistant.
- Providing explosion suppression or explosion relief equipment.
- Taking measures to control or minimise the spread of fires or explosions.
- Providing suitable personal protective equipment.

A.3.5 Preparing Emergency Plans and Procedures

Arrangements must be made to deal with emergencies. These plans and procedures should cover safety drills and suitable communication and warning systems and should be in proportion to the risks. If an emergency occurs, workers tasked with carrying out repairs or other necessary work must be provided with the appropriate equipment to allow them to carry out this work safely.

The information in the emergency plans and procedures must be made available to the emergency services to allow them to develop their own plans if necessary.

A.3.6 Providing Information, Instruction and Training for Employees

Employees must be provided with relevant information, instructions and training. This includes:

- The dangerous substances present in the workplace and the risks they present including access to any relevant safety data sheets and information on any other legislation that applies to the dangerous substance.
- The findings of the risk assessment and the control measures put in place as a result (including their purpose and how to follow and use them).
- Emergency procedures.

Information, instruction and training need only be provided to other people (non-employees) where it is required to ensure their safety. It should be in proportion to the level and type of risk.

The contents of pipes, containers, etc must be identifiable to alert employees and others to the presence of dangerous substances. If the contents have already been identified in order to meet the requirements of other law, this does not need to be done again under DSEAR.

APPENDIX B HAZARD AND RISK ASSESSMENT METHODOLOGY

This section gives a brief overview of the methodology used to assess the fire and explosion hazards and risks (where possible).

1. Firstly, the flammability properties, quantities involved, circumstances or work and the process is assessed to determine whether a flammable atmosphere is or could be present under credible abnormal situations. If not, the unit operation can be concluded to being non-hazardous and the assessment can be regarded as being completed. The supporting justification is documented so there is a record that it has been formally assessed.
2. If there is a potential flammable atmosphere present, then the next sub-section discusses how it can be prevented from forming, or how it can be reduced in size or duration – this is the Hazardous Area Classification (HAC) part of the assessment.
3. Once hazardous areas have been identified, the ignition sources present and capable of igniting the hazardous areas are assessed. The objective here is to identify the relevant ignition sources and assess whether they are adequately controlled when examined a built facility. Where appropriate, guidance would be given on how ignition sources can be adequately controlled.
4. Once the ignition sources have been assessed, the fire and explosion hazard scenarios are identified. Where possible and required, the hazard likelihood and consequence(s) are assessed, and this allows a view to be formed about the risk of the process unit. By this stage, a Basis of Safety (strategy for keeping personnel safe from the hazards of fires and explosions) can be identified or proposed.
5. Following all of this, or throughout the above steps: recommendations are made. The recommendations are then accumulated in Section 8, page 29, as a 'check off' list

The following subsections give a more detail about the methodology employed to assess the fire and explosion hazards.

B.1 Plant Overview and Process Description

This section provides an overview of the relevant information about the process and plant to enable the assessment to be carried out. The process description should give consideration:

- Material(s), quantities or flow rates involved.
- Relevant process conditions e.g., temperature, pressure, or any parameter that can affect the explosion hazards and risks.
- Major plant items and statement or indication on sizes and materials of construction.
- Any procedural aspects of the process which have ramifications on the fire/explosion hazard e.g. sampling, or line breaking etc.
- Facility siting.
- Risk control systems such as safeguards, citation to existing protection against any aspect of explosion safety may be given.

B.2 Hazardous Area Classification (HAC)

A relevant standard e.g., BS EN IEC 60079-10-2 [5] for dusts is first identified and then used as the method to identify the sources and grades of release and assign the hazardous area(s) taking into account the various factors which influence the overall zones.

In order to determine whether a *hazardous* flammable atmosphere (*hazardous area* for short) is present, the properties of the material(s), quantities involved, circumstances or work and the process is assessed to check whether ignition of the flammable atmosphere could cause harm to personnel.

If ignition of the flammable atmosphere could harm personnel, then a formal hazardous area may need to be assigned and ignition sources rigorously controlled. If not, then assigning a formal hazardous area is unnecessary e.g., spray cleaning using a low flash point, high boiling point liquid from a small (less than 1 litres) bottle would release very little flammable vapours that even if ignition occurred, serious harm to personnel would not occur. As such special precautions such a ATEX certified equipment is not required.

The conclusions of the HAC are typically given in a tabulated form, from which plan and elevated drawings can be derived. NB: HAC plan and elevation drawings are not part of the standard delivery of an explosion safety assessment.

B.3 Ignition Sources

Next, ignition source(s) present in the identified hazardous areas that is/are capable of igniting the flammable atmosphere are assessed. If none are present, or they can be adequately controlled, then safety can be based on *Avoidance of Ignition Sources*. Possible sources of ignition that should be considered for a process are listed in full in BS EN 1127 [6]:

1. Hot surfaces
2. Flames and hot gases (including hot particles)
3. Mechanically generated sparks
4. Unsuitable or malfunctioning electrical apparatus
5. Stray electrical currents, cathodic corrosion protection
6. Static electricity
7. Lightning
8. Radio Frequency (RF) electromagnetic waves
9. Visible light electromagnetic waves
10. Ionising radiation
11. Ultrasonics
12. Adiabatic compression and shock waves
13. Exothermic reactions, including self-ignition of dusts

The ignition sources assessment is directed by the following two considerations:

1. The likelihood of the ignition source being present. This is guided by the following principles (as detailed in BS EN 1127 [6]):
   i. For Zone 22 areas, ignition sources during normal operation shall be considered.
   ii. For Zone 21 areas, ignition sources during normal operation and expected malfunctions shall be considered.
   iii. For Zone 20 areas, ignition sources during normal operation, expected malfunctions and rare malfunctions shall be considered.

2. The likelihood of the identified ignition source being effective enough to ignite the material(s) of concern. The answer to this query depends on two sub-aspects:
   i. The strength that the ignition source can deliver, which is typically either indicated by a temperature or an energy dissipated. This will be judged on a case-by-case basis for each identified ignition source.
   ii. The ignition sensitivity of the flammable material(s).

If an effective ignition source has been identified, control measures to either being stop its occurrence or neutralise its effectiveness is explored.

B.4 Discussion on Hazards and Risks

This section identifies the fire and explosion hazards of the process. If possible, a view about the associated risks is also given. Once the hazard scenarios have been identified, their likelihood is assessed by taking into consideration the conclusions from the HAC i.e., likelihood of flammable atmosphere, and the ignition assessment.

The scale of the anticipated effects and extent of harm (i.e., consequences of the event), and occupancy patterns of personnel in the affected area are also considered when appropriate. The above factors are combined with any other relevant conditional modifiers and safeguards to give a view about the risk.

Where a view has been expressed about the acceptability of a risk, this is normally a qualitative judgement based on what would typically be expected by industry norms for that process or operation. It is assumed this would correspond to a tolerability criterion acceptable under the law.

- Where a risk has been deemed to be acceptable, it means it exceeds or is at least aligned with good engineering practice, industry norms or demonstrably of no significant concern. As such, the process can run although minor improvement may still be recommended.
- Where a risk has been deemed to be ALARP (as low as reasonably practicable), this will invariably entail a cost-benefit analysis showing the cost to achieve further risk reduction to bring the risk into the tolerable region is grossly disproportionate to the benefit achieved.
- Where a risk has been deemed to be unacceptable or intolerable, this process would ideally cease from operation until the major improvement have been made.

B.5 Basis of Safety

A summary of the Basis (or Bases) of Safety is given in this section taking into consideration the hierarchy of risk management under the law.

B.6 Recommendations

This section lists the recommendations for the process being assessed. The objective is to identify all necessary recommendations to make the risk(s) acceptable or ALARP. At time, there could be in an information gap that needs to be addressed first, and that too is often captured in the recommendations list.

No.	Recommendations	Priority
1	DSEAR (Regulation 5) requires the DSEAR assessment to be reviewed at regular intervals. Based on the risks and changes foreseen, it is recommended to review this assessment whenever changes are made but even without changes at no later than 4 years from the date of this report. This should be captured in the site's action tracker or equivalent system.	Medium
2	Dust Extraction Unit - Confirm the details of the explosion vent design with the manufacturer and obtain the technical file for the dust collector.	Medium
3	Dust Extraction Unit – Confirm the full details of the ATEX certification from the manufacturer.	Low
4	General – Conduct explosive characteristics testing of the flakes produced from the battery shredder. The requirements of the test should be discussed with DEKRA.	High
5	Dust Extraction Unit - Ensure filter replacement task is completed under a permit to work system which mandates that control of ignition sources.	Low
6	Dust Extraction Unit – Ensure there is a permit to work system in place for managing hot work activities.	Low
7	Based on the MIE provided by the test in recommendation R4, ensure that the FIBC type and any associated inner liner complies with the requirements presented in Table 3 and Table 4.	Medium
8	Dust Extraction Unit - Until MIE data is available and a better risk judgement can be made, the practice of storing hand tools on top of the FIBC should be prevented as part of the risk assessment process.	Low
9	Dust Extraction Unit – Verify with the equipment manufacturer if an insulating deflector plate is used inside the dust collector.	Low
10	General – Ensure that the tasks associated with the maintenance service plan for the spark detection and extinguishing system includes a performance test of the system.	Low
11	Battery Shredder – Ensure there is a system in place for regular inspection and replacement of the shredder blades if this has not been specified by the shredder manufacturer.	Low

12	Battery Shredder - Consider carrying out periodic thermal imaging of the shredded product from the shredder discharge through to the FIBC discharge spout.	Low

Responsible Person(s)	Actions Taken	Target Date	Date Closed
Amanda Clark	To include the DSEAR assessment survey on the Reg - 005 Thorough Examination register.	01-Apr-23	01/04/2023
Nigel Ingram	NI - To contact portable conveyors to obtain the technical file for the dust collector. To chase again 09.05.23 update 23.05.23 - technical file received and	30-May-23	23/05/2023
Nigel Ingram	NI - To contact portable conveyors and obtain the ATEX certification from the manufacturer. To chase again 09.05.23 update 23.05.23 - documents received.	30-May-23	23/05/2023
Alan Colledge / DEKRA	Sample sent 26th April 2023 - results due back week commencing 5th July 2023.	30-May-23	
SHEQ	PTW is established and would be implemented for this task.	01-Apr-23	01/04/2023
SHEQ	PTW is established and would be implemented for this task.	01-Apr-23	01/04/2023
Alan Colledge / DEKRA	Sample sent 26th April 2023 - results due back week commencing 5th July 2023.	30-May-23	
SHEQ	RAMS 09-24 has been reviewed to stipulate that hand tools are not to be stored on top of the FIBC.	01-Apr-23	01/04/2023
Nigel Ingram	NI - to contact portable conveyors to verify if the insulating detector palte is used inside the dust collector.To chase again 09.05.23 update from manufacturer 23.05.23 - 'We do not use an insulating deflector plate as we have inlet sections to	30-May-23	23/05/2023
Alan Colledge	Alan Colledge - To review SOP/RAM and to test and record system on a monthly basis to commence May 23.	30-Apr-23	01-May-23
Nigel Ingram/Alan Colledge	RAMS 09-24 have been reviewed to include inspections of the shredder blades.	30-Apr-23	9th May 2023

Alan Colledge	Alan Colledge - To review SOP/RAM and to test and record system on a monthly basis to commence May 23.	30-Apr-23	01-May-23

Status
Closed
Closed
Closed
In progress
Closed
Closed
In progress
Closed
Closed
Closed
Closed

Closed

EC DECLARATION OF INCORPORATION OF COMPLETED MACHINERY

We: Air Plants Dust Extraction Ltd:

Declare that the completed machinery described by and limited to the APDEL contract number (listed below) has been manufactured in conformity with the Supply of Machinery (safety) Regulations 2008, in so far that the equipment supplied is intended to form a completed system. The system is itself is declared as fully compliant with the provisions of the said regulations and therefore compliant with Directive 2006/42/EC.

Technical documentation has been complied in accordance with annex VII (Part 7) and will be made available to national authorities in response to a reasoned request either as a hard copy or in electronic format.

We further declare that when incorporated into the complete system the equipment supplied conforms with the following directives:

Low Voltage Directive 2014/35/EU

Pressure Equipment Directive 2014/68/EU

EMC Directive 2014/30/EU

ATEX Directive 2014/34/EU

APDEL Contract No.:	11190
Functional Description:	Dust Extraction System
Authorised Representative:	Mick Johnson
Signature of Authorised Representative:	M Johnson

EU Certificate of conformity
Explosion isolation flap valves VIGILEX

CUSTOMER

Customer :	MACCLANCY AND SONS LTD
Purchase order number :	059330-140 Qty : 1/3
Customer reference S/N:	CS2020102301
Item code STIF P/N:	57VPA0401B51TB00_3020

PRODUCT SPECIFICATIONS

Marking ATEX :	Ex II D		
Type DN:	VIGIFLAP Ø 400 STD	Date of manufacturing :	50/2020
Body material :	MILD_STEEL_RAL3020	Serial number :	059330-140-1
Assembly :	Checking lock mechanism	Customer S/N :	
Flap gasket :	EPDM		
Lock flap sensor :	YES		
Capacitive sensor (option) :	NO		

DUST PARAMETERS

All dust kind :	Kst max :	≤ 250 bar.m/s
	Vessel, Pred max :	≤ 0.5 bar
	Body pressure resistance :	≤ 2.0 bar
	Pmax :	≤ 10 bar
	TMI (MIT) :	≥ 400° C / 752° F
	EMI (MIE) :	≥ 10 mJ
	IEMS (MESG) :	≥ 1.7mm

PRODUCTION QUALITY INSURANCEON

Notified body:	INERIS
Address:	Parc Technologique Alata BP 2 F-60550 Verneuil-en-Halatte
N° of notified body:	0080
N° of quality certificate:	INERIS 08ATEXQ406

production quality Insurance certificate according to instruction of appendix IV and VII of the ATEX directive

ATEX CERTIFICATION

Notified body:	INERIS
Address:	Parc Technologique Alata BP 2 F-60550 Verneuil-en-Halatte
N° of notified body:	0080
N° of quality EC certificate:	INERIS 19ATEX0016X_00
Technical file:	BE1257003 - 01/20
Harmonized norm:	EN16447 : 2014
European ATEX directive:	94/9/EC (up to 19 April 2016) - 2014/34/EU (from 20 April 2016)

We certify that safety device covered by this data has been manufactured, inspected, tested and packaged in accordance with the purchase order requirements.
All guaranty documents of this conformity certificate are on file available for examination.

Raphaël CERIZIER 08/12/2020
ATEX manager

STIF
SOCIÉTÉ DE TOLERIE INDUSTRIELLE FRANÇAISE
S.A.S. au Capital de 800 000 €
Z.A. de la Lande - 49170 ST GEORGES SUR LOIRE
Tél. : 33 (0)2.41.72.16.80
SIRET 328 876 503 00025 RC Angers 84 B 12

Z.A. de la lande - 49170 Saint-Georges-sur-Loire - France
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Email : sales@stifnet.com - Site internet : www.stifnet.com
SAS au capital de 800 000 € - R.C.S. Angers B 328 876 503 - 84B12 APE 2511Z - N° TVA FR 35 328 876 503

EU Certificate of conformity
Explosion isolation flap valves VIGILEX

CUSTOMER

Customer :	MACCLANCY AND SONS LTD
Purchase order number :	059330-140 Qty : 1/3
Customer reference S/N:	CS2020102301
Item code STIF P/N:	57VPA0401B51TB00_3020

PRODUCT SPECIFICATIONS

Marking ATEX :	Ex II D		
Type DN:	VIGIFLAP Ø 400 STD	Date of manufacturing :	50/2020
Body material :	MILD_STEEL_RAL3020	Serial number :	059330-140-2
Assembly :	Checking lock mechanism	Customer S/N :	
Flap gasket :	EPDM		
Lock flap sensor :	YES		
Capacitive sensor (option) :	NO		

DUST PARAMETERS

All dust kind :	Kst max :	≤ 250 bar.m/s
	Vessel, Pred max :	≤ 0.5 bar
	Body pressure resistance :	≤ 2.0 bar
	Pmax :	≤ 10 bar
	TMI (MIT) :	≥ 400° C / 752° F
	EMI (MIE) :	≥ 10 mJ
	IEMS (MESG) :	≥ 1.7mm

PRODUCTION QUALITY INSURANCEON

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afaq ISO 9001 Qualité AFNOR CERTIFICATION

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EU Certificate of conformity
Explosion isolation flap valves VIGILEX

CUSTOMER

Customer :	MACCLANCY AND SONS LTD
Purchase order number :	059330-140 Qty : 1/3
Customer reference S/N:	CS2020102301
Item code STIF P/N:	57VPA0401B51TB00_3020

PRODUCT SPECIFICATIONS

Marking ATEX :	Ex II D		
Type DN:	VIGIFLAP Ø 400 STD	Date of manufacturing :	50/2020
Body material :	MILD_STEEL_RAL3020	Serial number :	059330-140-3
Assembly :	Checking lock mechanism	Customer S/N :	
Flap gasket :	EPDM		
Lock flap sensor :	YES		
Capacitive sensor (option) :	NO		

DUST PARAMETERS

All dust kind :	Kst max :	≤ 250 bar.m/s
	Vessel, Pred max :	≤ 0.5 bar
	Body pressure resistance :	≤ 2.0 bar
	Pmax :	≤ 10 bar
	TMI (MIT) :	≥ 400° C / 752° F
	EMI (MIE) :	≥ 10 mJ
	IEMS (MESG) :	≥ 1.7mm

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Raphaël CERIZIER 08/12/2020
ATEX manager

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SAS au capital de 800 000 € - R.C.S. Angers B 328 876 503 - 84B12 APE 2511Z - N° TVA FR 35 328 876 503

EU Certificate of Conformity
VIGILEX Vent Panel

CUSTOMER

Customer : MACCLANCY AND SONS LTD
Purchase order number : 083212-010 Qty : 100
Customer reference S/N : 2022080302/A
Item code STIF P/N: 57VLBE30052092

PRODUCT SPECIFICATIONS

Product type : VIGILEX VL
Nominal size : 524x924
Material : 1.4307 / EPDM
ATEX marking : Ex II GD

Serial number : 083212-010-1 / 395668
Date of manufacturing : 45/2022
Manufactured quantity : 108
Serial customer S/N :

BURST TEST RESULTS

Test made according EN 14797:2006

Pstat : 100mbar ±15% @22° C / Min : 85mbar - Max : 115mbar
Vacuum : 50mbar
Quantity tested : 8

Test résult :

(1) 105mbar	(5) 112mbar	(9) mbar	(13) mbar	(17) mbar
(2) 109mbar	(6) 104mbar	(10) mbar	(14) mbar	(18) mbar
(3) 113mbar	(7) 113mbar	(11) mbar	(15) mbar	(19) mbar
(4) 110mbar	(8) 105mbar	(12) mbar	(16) mbar	(20) mbar

Tests realized in an ambient temperature included between 15° C and 25° C.

BUILDING MATERIALS

Component	Material	Material's certificate
- Vent panel :	1.4307 (304L)	Material batch : 220702
- Gasket :	EPDM (black)	

PRODUCTION QUALITY INSURANCE INFORMATION

Notified body : INERIS
Address : Parc Technologique Alata BP 2 F-60550 Verneuil-en-Halatte
N° of notified body : 0080
N° of quality certificate : INERIS 08ATEXQ406
Production quality Insurance certificate according to instruction of appendix IV and VII of the ATEX directive

ATEX CERTIFICATION INFORMATION

Notified body : INERIS
Address : Parc Technologique Alata BP 2 F-60550 Verneuil-en-Halatte
N° of notified body : 0080
N° of quality EU certificate : INERIS 15ATEX0001X - 02
Technical file : BE1257001- B
Harmonized norm : EN14491 : 2012 / EN14994 :2007 / EN14797 : 2006
European ATEX directive: 2014/34/UE

We certify that safety device covered by this data has been manufactured, inspected, tested and packaged in accordance with the purchase order requirements.
All guaranty documents of this conformity certificate are on file available for examination.

Jean-Marc FAURIE Date :07/11/2022
Products engineer

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EMERGENCY RESPONSE INFORMATION

Lithium Workshop

Cawleys
local recycling global responsibility

FIRE SERVICES	HOSPITAL - A&E	POLICE STATION	ENVIRONMENT AGENCY	FIRE ASSEMBLY POINT	LOCATION OF COMBUSTIBLES	LOCATION OF FIRE EXTINGUISHERS	FIRST AID KIT & ACCIDENT BOOK	WATER	ELECTRICITY	GAS	FUEL / DIESEL
Luton Fire Brigade, Studley Rd, Luton LU3 1BB	The L&D Hospital, Lewsey Rd, Luton LU4 0DZ	Luton Police Station, Buxton Rd, Luton, LU1 1SD	Incident hotline/ Report an incident (Freephone, 24-hour service)	By the site's perimeter fence (rear gate)		Various locations as marked on the plans below	As marked on the plan below (accident book in Lithium Workshop Office)	Bin Shed / Canteen (LHS Gents Toilet) Affinity Water	As marked on the plan below. UK Power Networks	N/A	Dieses in double bunded tank adjacent to the Lithium Workshop
T: 01234 845 000	T: 01582 491 166	T: 01582 401 212	T: 0800 80 70 60					T: 0345 357 2407	T: 0800 31 63 105		

EMERGENCY SITE CONTACTS

Alan Colledge:	07970 213692
Nigel Ingram:	07392 870 906
Amanda Clark:	07827 772 557

LEGEND

- Diesel Tank
- Battery Discharge Unit
- Suppression Syst. Tank
- LEV Extraction Unit
- AdBlue Pump
- Air compressor
- Pedestrian walkway
- Emergency spill kit
- First aid kit
- Electric board
- Electric Car Charging Point
- Conveyor Belt Controls & Emergency Stop
- Fire exit route
- Fire Alarm Bell
- Fire call point
- Fire extinguisher
- Emergency Light
- Fire Blanket
- Fire Action Control Panel
- Fire assembly point
- Barrier

IN CASE OF AN EMERGENCY CALL 999

Specific Unlikely Scenarios across touchpoints

All eventualities of the Lithium Recycling process have been documented through our Risk Assessment and Method statements. In order to enhance these the following narrative describes the likely procedures should a fire or thermal runaway develop at the various stages where the live batteries are handled and processed at the following touch points.

Off Loading/loading and general moving of Lithium Batteries

- *Risk Scenario*

In the unlikely event that a battery is abused either through dropping, forklift piercing and then develops into thermal runaway leading to a fire.

- *Immediate Action*

Raise the alarm, call emergency services where appropriate.
Should the battery cell/module/pack show signs of thermal runaway (elevated temperature, vapour release, unusual noises, cell expansion) then the battery cell/module/pack is to be moved by forklift and placed into the onsite quenching tank where safe to do so.
If the battery is on fire with naked flame then this is to be attended by using Lith-EX fire extinguishers and/or Bridgehill fire blanket to contain flames and heat transfer. Where safe to do so the battery can then be moved away from the workshop into the Sterile zone at the front of the building using a forklift truck and into the onsite quenching tank where safe to do so.

Decommissioning and dismantling of Lithium Batteries

- *Risk Scenario*

In the unlikely event that a live battery is abused through the action of dismantling such as short circuit across battery terminals, dropping a module half out of the pack casing and then develops into thermal runaway leading to a fire.

- *Immediate Action*

Raise the alarm, call emergency services where appropriate.
Should the battery cell/module/pack show signs of thermal runaway (elevated temperature, vapour release, unusual noises, cell expansion) then the battery cell/module/pack is to be moved by forklift (or by hand in the case of cells and modules supported by dynamic risk assessment) and placed into the onsite quenching tank where safe to do so.
If the battery is on fire with naked flame then this is to be attended by using Lith-EX fire extinguishers and/or Bridgehill fire blanket to contain flames and heat transfer. The dismantling table can also be removed from the workshop area using a forklift truck as an option and left in the Sterile zone at the front of the building. Once flames are extinguished the battery cell/module/pack can be moved by forklift from the workshop/sterile zone and placed into the onsite quenching tank where safe to do so.

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Discharging of Lithium Batteries

- *Risk Scenario*

In the unlikely event that a live battery is abused through the action of discharging such as short circuit across battery terminals, dropping a module while manually moving it and reverse polarity error on connection which then develops into thermal runaway leading to a fire.

- *Immediate Action*

The emergency electrical stop button is to be pressed to isolate the electrical supply from the batteries.
Raise the alarm, call emergency services where appropriate.
Should the battery cell/module/pack show signs of thermal runaway (elevated temperature, vapour release, unusual noises, cell expansion) then the battery cell/module/pack is to be cut from any wiring and moved by forklift (or by hand in the case of cells and modules supported by dynamic risk assessment) and placed into the on site quenching tank where safe to do so. The discharge trolley is mobile on wheels and if the option is safe, can be pushed through the adjacent roller shutter door and left in the Sterile zone at the front of the building or directly to the quenching tank.
If the battery is on fire with naked flame then this is to be attended by using Lith-EX fire extinguishers and/or Bridgehill fire blanket to contain flames and heat transfer. The discharging trolley can be removed from the workshop area manually using a forklift truck as an option and left in the Sterile zone at the front of the building. Once flames are extinguished the battery cell/module/pack can be moved by forklift from the workshop/sterile zone and placed into the on site quenching tank where safe to do so.

Loading of Lithium batteries onto shredder conveyor

- *Risk Scenario*

In the unlikely event that a fully discharged and short circuited battery cell or module is abused through the manual movement onto the gravity table and conveyor belt of the shredder such as dropping a module while manually moving it which then develops into thermal runaway leading to a fire.

- *Immediate Action*

Raise the alarm, call emergency services where appropriate.

Should the battery cell/module show signs of thermal runaway (elevated temperature, vapour release, unusual noises, cell expansion) then the battery cell/module is to be moved by forklift (or by hand in the case of cells and modules supported by dynamic risk assessment) and placed into the on site quenching tank where safe to do so.
If the battery is on fire with naked flame then this is to be attended by using Lith-EX fire extinguishers and/or Bridgehill fire blanket to contain flames and heat transfer. At this position (on or near the feed conveyor) several options are available.

Battery on Conveyor - If the battery cell/module is on the conveyor already then this can continue to be loaded into the shredder hopper and utilise the fire suppression system built in as it may be difficult to handle a partially flame damaged battery module whilst elevated.
Battery on Gravity table - The whole gravity table which is on wheels can be removed using a fork lift truck and left in the Sterile zone at the front of the building.
In either cases once flames are extinguished the battery cell/module/pack can be moved by forklift from the workshop/sterile zone and placed into the on site quenching tank where safe to do so.

Storage of Lithium Batteries (doors open)

- *Risk Scenario*

In the unlikely event that a battery is abused during storage in the designated ISO containers either through dropping, forklift piercing and then develops into thermal runaway leading to a fire. Assumes personnel operating in the area with the container doors open.

- *Immediate Action*

Raise the alarm, call emergency services where appropriate.
Should the battery cell/module/pack show signs of thermal runaway (elevated temperature, vapour release, unusual noises, cell expansion) and is accessible then the battery cell/module/pack is to be moved out of the container by forklift and placed into the on site quenching tank where safe to do so. Other batteries stored on the same pallet need not be separated at this point and all can go in the quench tank.
If the battery is on fire with naked flame then this is to be attended by using the containers built in sprinkler system, monitor lance linked to the front hydrant or by Lith-EX fire extinguishers and/or Bridgehill fire blanket to contain flames and heat transfer where safe to do so. Only once all flames are extinguished the battery can be moved away from the storage containers into the Sterile zone at the front of the building using a forklift truck and placed into the on site quenching tank where safe to do so.
In the event of a large scale fire, evacuation procedures should be followed awaiting the emergency services and letting the inbuilt sprinkler system .

Storage of Lithium Batteries (doors closed)

- *Risk Scenario*

In the unlikely event that a battery fire is discovered in the designated ISO containers when the doors are shut.

- *Immediate Action*

Raise the alarm, call emergency services where appropriate.
Do not open the container doors. Evacuation procedures should be followed awaiting the emergency services and letting the inbuilt sprinkler system to flood the container with water. If safe to do so a monitor lance can be connected to the hydrant at the front entrance and be pointed at the container to aid in preventing the thermal transfer of heat.