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Applicant details	Sharpsmart Limited 9 Longport Enterprise Centre Scott Lidgett Road Stoke on Trent ST6 4NQ
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Author	Rebecca Hodkinson EHS Consultant
Signature	

NOTE: This document is marked as 'confidential' and its exclusion from the public register is requested.

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1 Introduction

1.1 General

Sharpsmart Ltd (the 'applicant') has requested that Reva Environmental Ltd (the 'agent') prepares an Environmental Permit (EP) variation application, for its clinical waste facility at 9 Longport Enterprise Centre, Scott Lidgett Road, Stoke on Trent, ST6 4NQ.

The applicant current supplies re-usable sharps containers to the healthcare sector and provides a collection service to its customers whereby the used containers are taken to one of the applicant transfer facilities, emptied and cleaned and sent back to the customer. The contents are transferred to an appropriately permitted facility for recovery or disposal.

The objective of this application is to obtain a varied EP which enables the applicant to carry out a waste treatment activity at the Stoke facility, as a supporting activity to the existing transfer operations.

The proposed treatment plant is an autoclave which will have the capacity to process more than 10 tonnes per day; it is therefore a 'listed activity' and the EP will be an Installation EP as a result of its inclusion. The plant also includes a standalone shredder unit pre-treatment, and a standalone compaction unit post-treatment. The listed activity that covers all 3 parts of the treatment plant is as follows:

- Section 5.3 Part A(1)(a)(ii) – Disposal or recovery of hazardous waste with a capacity exceeding 10 tonnes per day, by physico-chemical treatment.

There is no intention to change the type of waste being received at the facility; the permitted waste list in the current EP (V005) is not required to be amended.

The quantity of hazardous waste that will be stored at the facility, pending treatment, is constrained by the floor space in the existing building. It is limited to <50 tonnes and is therefore below the threshold for a listed activity under Section 5.6 of the EP Regulations; instead the temporary storage of hazardous waste is a directly associated activity (DAA) to the treatment activity. The maximum storage period for any load of waste is 2 weeks; this provides allowance for the operational contingency plan to be implemented.

The steam required for the autoclave process will be delivered by a new gas-fired steam-raising boiler. The input capacity of the boiler is below the threshold for a listed activity under Section 1.1 of the EP Regulations and will therefore be a second DAA to the treatment activity. The applicant does recognise that as the input capacity exceeds 1 MWth the Medium Combustion Plant Directive (MCPD) is applicable and that emission limits will be imposed on this exhaust via permit conditions.

The facility will provide the ability to treat metal instruments and laboratory wastes that are classified under the EWC codes above. Neither of these will require (or suit) pre-shredding so would be loaded directly into the autoclave unit. This will allow the direct recovery of these wastes that would otherwise not be recovered.

The presence of the standalone shredding unit will also provide the ability to shred offensive (non-hazardous) waste in isolation. The shredded offensive waste can be compacted with the autoclaved waste (non-hazardous) so it can be transferred off site as RDF. The offensive waste would only be subjected to shredding; it would not be treated in the autoclave. Prior to the shredding of any non-hazardous waste, the shredder would be thoroughly cleaned in order to prevent any cross contamination of this waste from preceding hazardous waste loads.

1.2 Assessment of BAT

As required by Question 6 in Appendix 1 of EA Application Form Part C4, a best available techniques (BAT) assessment is required to support the choice of treatment technology proposed in this variation application.

The autoclave treatment plant has been assessed against indicative best available techniques (BAT), in accordance with the following EA guidance:

- Sector Guidance Note EPR S5.06 "Recovery and disposal of hazardous and non-hazardous waste", version 5 dated May 2013.
- Sector Guidance Note EPR S5.07 "How to comply with your environmental permit, additional guidance for clinical waste", version 1.1 dated January 2011.
- EC guidance "Best Available Techniques (BAT) Reference Document for Waste Treatment", dated 2018.

The BAT assessment has been written on the basis of information provided to the agent by the applicant in relation to the operation of the autoclave plant.

Sections 2 to 4 set out how the autoclave plant meets BAT. Section 5 has been added to this assessment to document the applicant's decision making process in choosing the autoclave plant over the other treatment options available. This is a qualitative approach as a quantitative options appraisal (for example using the EA's H1 tool) is not possible due to the lack of available data.

2 Managing the Activities

2.1 General Management

The applicant recognises that an effective management system is a key technique for ensuring that pollution prevention and control techniques are implemented and support compliance with BAT. Sector guidance EPR S5.06 recommends certification to a recognised standard such as ISO 14001 or EMAS.

Section 1 of EPR S5.07 requires appropriate measures to be in place and implemented, in relation to management of shutdown as a result of maintenance, incidents and non-conformances. A malfunction or shutdown can lead to permit conditions being breached.

2.1.1 Procedures

The applicant operates the current facility in accordance with a certified environmental management system (EMS). The EMS is certified by The British Assessment Bureau and was last audited in 2017 against the requirements of ISO 14001: 2015. The applicant will integrate the operation of the treatment plant into its existing management system for the facility. The applicant has already carried out an initial gap analysis and identified the need for the following new or updated procedures:

- Waste pre-acceptance procedure – applicable for waste subject to treatment in the autoclave. This is further discussed in Section 3.2 below;
- Disinfection procedure – for the maintenance of the shredder as it is contaminated with untreated clinical waste; and
- Treatment Facility Operational procedure – applicable to the operation of the thermal treatment facility in its entirety.

Prior to operation, either existing procedures will be updated or new procedures will be developed to put in place appropriate control and mitigation measures to prevent malfunctions or accidents occurring.

The EMS includes a process of internal auditing, raising of non-conformances, reporting and investigation of incidents, maintenance and routine servicing. It also includes an Accident Management Plan which covers existing waste transfer operations at the site. This has been updated to reflect additional measures or considerations that are pertinent to the proposed treatment activity. A copy of the Accident Management Plan is provided in **Appendix J**.

2.1.2 Plant Design

The design of the treatment plant is such that the three parts (shredding, autoclaving, and compaction) can each operate in isolation. This enables the operator to carry out maintenance or repair works on any one part of the plant whilst the other parts can continue to operate. For example, if there is a breakdown of the shredder this can be repaired whilst a treatment cycle is underway. This system reduces the impact of failure or shutdown on the overall plant operation.

The proposed treatment plant and ancillary equipment is in wide use within the UK. As a result the availability of spare parts is good. The operator has received technical advice from the plant manufacturer regarding the ongoing maintenance and repair of the equipment and, on this basis, will retain a stock of key spare parts at the facility. An inventory of these spare parts will be maintained, and stock replaced upon use to ensure that a sufficient level of parts is always available at the facility. Scheduled maintenance and service will be carried out by the manufacturer (or manufacturer's contracted provider); the tools and expertise required for this is therefore assured.

At the time of this variation application, the applicant is in the process of finalising the technology design. As such no HAZOP or risk assessments have yet been completed for the operation of the plant. Once finalised, a HAZOP will be carried out and will seek to identify any known or predictable malfunctions in order to risk assess these and put in place appropriate measures to react to them. At that point, the applicant will also generate a procedure that will sit within the existing certified EMS and will assist the identification of items of plant that should be prioritised for planned preventative maintenance (PPM).

Part of the procedure will include the production of an inventory of equipment whose failure could directly or indirectly lead to an impact on the environment. It is expected that this will include (but not be limited to) the IBCs (effluent storage), pipework (effluent to sewer), waste containers, the shredder, and the LEV system.

2.1.3 Contingency

When the treatment plant is not available, as a result of planned shutdown or unplanned failure, the contingency plan will be activated. The contingency plan also addresses the need to manage materials if the third party recovery facilities are unavailable due to their own planned shutdown or unplanned failure. The contingency plan addresses the need to manage the following streams:

- Incoming waste;
- Floc; and
- Liquid effluent.

In the event of unavailability of the autoclave treatment plant, the incoming waste will continue to be accepted via the permitted transfer activity at the facility as is currently the case. Processed waste is transferred off-site for treatment at a third party permitted plant with which the applicant has a contractual relationship. This will ensure that waste storage and throughput limits set by the EP will

not be exceeded. If required, the operator would cease accepting orange bagged waste into the facility and transport this directly to alternative treatment from its customer sites. There are 15 alternative treatment facilities that are able to accept this waste in the UK. The acceptance of sharps would continue through the transfer facility, but the capacity would be optimised in this approach.

The floc will be classified as 19 02 10 (non-hazardous) and will be transferred to a waste to energy plant with R1 status. Should the primary contracted recovery facility for the floc be unavailable, there are three other R1 rated energy from waste plants in the UK that are able to take the waste as well as a number of R1 status energy from waste plants in Europe.

The liquid effluent will be classified under 16 10 02 (non-hazardous) and will be transferred to a waste to energy plant that is permitted to take this waste. Should the primary contracted facility for the effluent be unavailable, there are two other incinerators in the UK that are permitted to take this waste, and additional plants across Europe including one in Holland that is a recovery operation as steam is used for district heating. The use of facilities outside of the UK would be dependent on successful grant of transfrontier shipment approval.

The contracted, and contingency, plants themselves carry out planned shutdowns; details of these are provided to the applicant so that the contingency plan reflects actual availability. Waste producers/customers are also provided with information regarding the applicant's contingency plan.

The applicant will seek to honour its waste collection contracts and will not cease accepting waste from its customers if there is a viable outlet for treatment that would enable continued operation of the facility within the EP storage limits. This is irrespective of the location of the contingency facility and cost of recovery/disposal.

2.2 Energy Efficiency

The addition of the autoclave plant will have an impact on the overall energy use at the facility. The energy use will comprise:

- Mains supplied electricity - for the bin tipper, shredder, conveying of the autoclave bin, the compactor, and building infrastructure (lighting, fire detection, CCTV etc.)
- Natural gas – for the new steam raising boiler that will be installed in the treatment facility portion of the building.

Energy is monitored at the facility at a number of sub-meters (there is a meter at each supply location, into each of the separate building units). Data provided by the applicant indicates that usage is on average 675 kWh per day. Energy use to date has been limited to mains supplied electricity as there is currently no natural gas supply to the facility. Energy use relates to the operation of the repackaging plant, the washing/drying plant, facility lighting and heating, office equipment, CCTV and fire systems.

No energy consumption data has been provided by the manufacturer for the proposed treatment plant as the exact design has not yet been finalised. The overall consumption will comprise of both electricity and natural gas use. The quantity of natural gas will depend on the boiler that is chosen to be installed. As part of the EMS, efficiency measures are reviewed and implemented as appropriate. When purchasing new equipment, its energy needs are assessed as part of the technology selection process. The gas supply will be limited to the operation of the boiler so the energy consumption of this combustion activity can be identified. The additional equipment will operate in separate units which will run off separate mains electricity supplies so energy consumption can be identified for each key process.

The proportion of waste that will be diverted to the treatment plant is currently transferred off site for incineration (with no energy recovery). Upon commencement of operation of the treatment plant

on site, the floc and effluent generated from this waste stream will be going to an R1 rated energy from waste facility. The generation of energy from that plant therefore serves to offset some of the energy used by the treatment plant.

2.3 Efficient Use of Raw Materials and Water

Following variation, a new style EP will be in place and, in accordance with the standard requirements in that EP, a review of raw material use will be carried out at least every four years. This will seek to identify if there are suitable alternative materials that could reduce the environmental impact, or identify opportunities to improve the efficiency of the raw material and water use.

The condenser on the autoclave unit will be an air to air type which will minimise water use for the new activity.

2.3.1 Chemicals & Reagents

The current operations at the facility use a disinfecting chemical ('Solid Hero') to clean the incoming waste containers in the wash plant. This is a detergent that contains 35 to <50% sodium hydroxide. Following the variation application and the installation of the treatment plant, an additional disinfecting chemical will be required (sodium hypochlorite) for the cleaning of the shredder prior to maintenance or service (or prior to shredding of offensive waste as a standalone activity). It is anticipated that the quantities required to clean the shredder will be small (it will be sprayed in), however the usage cannot be quantified until the throughput increases once the EP is varied.

There will be extraction of air from around the shredder unit. This will be passed via a HEPA filter and carbon filter system. The differential pressure reading over the filter will determine when it is no longer providing appropriate levels of filtration and needs replacing (HEPA) or replenishing (carbon). The quantity of filter material required over an operating year is unlikely to be large however the usage cannot be quantified until the EP is varied and the plant is operational.

The quantity of chemicals, filters and reagents used at the facility will be recorded and tracked during the lifetime of the EP and assessed at regular intervals.

2.3.2 Water

Water is currently used at the facility for the purposes of cleaning the incoming waste containers, for general cleaning of the building area, and for welfare facilities (kitchen, toilets, sinks etc.). The wash plant is the primary user and records show that this uses, on average, 4 m^3 per day. Additional water will be required to supply the new boiler to generate the steam required for the autoclave plant. Estimated water usage data has been provided by the manufacturer for the proposed treatment plant and states that each cycle will require 115 litres. It is anticipated that the plant will initially operate up to 16 cycles per week.

Whilst the current intention is to process only in-house waste, from contracted customers, the capacity of the treatment plant will allow the acceptance of third party waste too if appropriate. In the event that this is the case, there will be a need for the installation of a bin washer unit to enable third party waste exchange. This will use water however for this plant, the operator would seek to reuse the waste several times before discharging to sewer instead of using mains water for each cycle.

Consideration has been taken of the potential to re-use condensate from the autoclave process however this has been determined to be inappropriate due to the likely composition of the condensate. The boiler will be sensitive to the quality of the feed water and the use of condensate rather than mains water would lead to scale and sedimentation, and potentially corrosion, of the unit. The reuse of the condensate would therefore not represent BAT.

The quantifiable water use (the autoclave cycle) will be approximately 0.26 m3 per day, this is an estimated 6.5% increase in the overall consumption of water for the facility.

2.3.3 Plastic

The current repackaging process involves the emptying of sharps containers into lined 770 skip bins. The bins are lined with heavy duty (80 micron) bags as the waste is then being transferred off site for incineration. When the treatment plant is installed, a proportion of the current repackaged waste stream will go to the treatment plant and be tipped into the shredder i.e. it will not leave the facility or require further handling. For that waste the bag does not therefore need to be heavy duty and will either be eliminated entirely or a 40 micron bag used. This will reduce the overall use of plastic at the facility.

2.4 Avoidance, Recovery and Disposal of Wastes

The inherent purpose of the proposed autoclave plant is to render the incoming hazardous waste (hazardous by virtue of its infectious nature) non-hazardous, and to treat it to produce residues from which energy can be recovered. There are a number of reasons that highlight the benefit of autoclaving the proposed waste stream, including the following:

- The installation of the plant supports the current market for reusable sharps containers (which can be used up to 500 times) and also promotes the market for them. This is a more sustainable option and in turn removes a large quantity of plastic (burn bins) from autoclaving and incineration plants, a waste that can cause difficulties for such plants in relation to damage/maintenance and emissions;
- The plant will reduce the burden on an ageing infrastructure across the UK for clinical waste incineration (there are 20 plants of which only 5 can accept bulk sharps waste). The operation of the plant provides a level of futureproofing given that some of the existing infrastructure is nearing the end of its operational life;
- Operating the plant to treat the current waste throughput will release approximately 2000 tonnes of capacity in existing incinerators across the UK, enabling them to accept more yellow bag/bin clinical waste. The plant will actually have the potential to release up to 8000 tonnes from the incineration route;
- The use of the shredder to process offensive waste will facilitate the production of RDF which can then be processed at an R1 status energy from waste plant, providing renewable heat and/or power;
- The use of the autoclave to sterilise single use metal instruments (which have been segregated at source into reusable containers) will enable the recovery of metals that would otherwise be disposed of. This accords with ISO 23907 which currently only relates to single use instruments but will be augmented to cover reusable sharps by February 2019;
- The use of the autoclave to sterilise electrical medical instruments which can then be recycled via an appropriate WEEE route rather than being incinerated.

With respect to waste generation, the autoclave plant will result in just two primary residues:

- Floc – the shredded and treated clinical waste which will be compacted (post autoclave) and placed into 770 litre bins (200 kg per bin); and
- Liquid effluent – the condensed steam from the autoclave plant and the wash water from cleaning the shredder plant. This will be collected in a sump located under the autoclave.

The floc will be classified as 19 02 10 and will be transferred to a waste to energy plant with R1 status, for recovery. There are four plants in the UK that are permitted for this waste. The shredding of the waste prior to autoclaving enables the recovery of the floc as it meets the requirement of the R1 status for RDF which is that the waste cannot be recognisable as healthcare waste.

The liquid effluent will be classified under 19 13 08 or 16 10 02 and will be stored in IBCs before being transferred by lorry to a plant that is permitted to take this waste. There are three incinerators in the UK that are permitted to take this waste, and additional plants across Europe. The applicant has obtained an effluent sample from an autoclave plant in the USA that is deemed to closely represent the likely composition of the effluent from the proposed plant at the Stoke facility. This has been analysed by the operator of the proposed UK outlet and the applicant has received confirmation that it is suitable for acceptance.

As detailed in 3.1 below, the liquid effluent stream is managed in one of two ways, depending on the composition of it. This will enable the discharge of the effluent to sewer under the existing discharge consent, in certain scenarios.

The treatment activity will also generate the following, ancillary residues/wastes:

- Spent HEPA filters; and
- Spent carbon from the carbon filter.

The HEPA filters can become blinded with particulate over time, increasing the resistance to air flow through them, reducing the flow and potentially resulting in a reduction in air quality. Filters usually last anything from 1 – 5 years depending on the loading. When they require replacement, the spent filters are disposed of at an appropriate facility, suitable for the waste type.

The carbon filters can become saturated and their absorptive capacity reduces over time. When they require replacement, the spent filters are disposed of at an appropriate facility, suitable for the waste type.

3 Operations

3.1 Permitted Wastes

The variation application does not seek to add any new wastes to that already included in the existing EP for the facility. It is recognised that the guidance sets out the wastes that are considered suitable for alternative treatment and that it limits this to infectious waste, suggesting that wastes that contain other chemical, pharmaceutical or anatomical characteristics may not be suitable for alternative treatment so the reasons for treating such waste need to be fully justified.

The current EP waste list includes non-infectious waste but it is not proposed that all currently permitted waste types will be treated in the autoclave as the treatment plant will operate alongside the existing transfer activity. The proposed treatment plant will primarily process the following existing waste streams:

- 18 01 03* – wastes whose collection and disposal is subject to special requirements in order to prevent infection (from human source);
- 18 01 03*/09 – dual coded medicinally contaminated sharps; and
- 18 02 02* – wastes whose collection and disposal is subject to special requirements in order to prevent infection (from animal source).

As described in Section 1.1 of this BAT Assessment, the presence of the standalone shredding unit will also provide the ability to shred offensive (non-hazardous) waste (18 01 04) in isolation. The shredded offensive waste can be compacted with the autoclaved waste (non-hazardous) so it can be transferred off site as RDF. The offensive waste would only be subjected to shredding; it would not be treated in the autoclave. Prior to the shredding of any non-hazardous waste, the shredder would be thoroughly cleaned in order to prevent any cross contamination of this waste from preceding hazardous waste loads.

The applicant has had extensive pre-application discussions with the EA and it is acknowledged that a concern of the regulator is the potential for sharps to have a level of pharmaceutical contamination which could lead to undesirable emissions to air and/or water. It is confirmed that pure pharmaceuticals will not be processed through the treatment plant; these will continue to be transferred off site via the current transfer activity. Whilst there is the potential for pharmaceutical contamination in the infectious waste types proposed, this is likely to be <5%. The resultant non-hazardous floc generated by the treatment process will be transferred to an R1 recovery status waste to energy facility which will address the potential contamination as it will be subject to sufficient incineration temperatures for the destruction of pharmaceutical content.

The proposed treatment plant is described in the Supporting Statement provided with this variation application; it is also depicted in the process flow diagram provided in **Appendix B**.

With respect to air emissions, there is an emergency vent from the autoclave but that will only release to atmosphere under abnormal operating conditions so is not an active release to air. Instead, during normal operations, venting is performed through a condenser unit to produce a small volume of liquid effluent, approximately 200 litres per cycle. The post-vacuum cycle removes residual steam from the autoclave and flashes residual liquids, drying the waste. This also controls odour.

The condenser uses atmospheric air as the cooling energy so does not require any cooling water to be used. In essence it is a heat exchanger through which the autoclave process steam will travel, whilst a set of fans force atmospheric air across it. The condensate is collected in a sump under the autoclave.

In addition to the condensate there is a potentially contaminated effluent generated when the shredder is cleaned and disinfected. The combined liquid effluent stream is managed in one of two ways, depending on the composition, as follows:

- If the effluent generated is from the autoclaving of yellow bagged or any sharps bin waste, then it is considered potentially pharmaceutically contaminated and is not discharged to sewer. Instead it is collected in an engineered sump and pumped into intermediate bulk containers (IBCs) for transfer to a permitted energy from waste facility for recovery. The same applies if the effluent contains wash water from cleaning the shredder.
- If the effluent generated is from the autoclaving of a batch of solely orange bagged waste, then it is considered that there is no pharmaceutical contamination and the effluent is no different to that produced by the transfer facility and can be discharged to sewer under the existing consent. The same applies if the effluent contains wash water from cleaning the shredder when it has only been used for offensive waste.

The anticipated design of the drainage system from the treatment plant portion of the building will include a valve that will allow the operator to define the route, depending on the source of the effluent above.

To summarise, whilst there is the potential for pharmaceutical content to be carried over in the floc and the effluent, this is acceptable for disposal at the designated R1 energy from waste facilities as it

will be subject to sufficient incineration temperatures for the destruction of pharmaceutical content. The use of alternative treatment for this waste stream is therefore considered to be appropriate.

3.2 Waste Acceptance

Waste acceptance is split into two stages, pre-acceptance and acceptance.

The existing certified EMS includes a waste acceptance procedure and this remains unchanged and unaffected as a result of the installation of the treatment plant because the incoming waste will still be arriving at the facility in the same way. The bulked waste (bagged and in 770 litre skip bins) will be accepted into the transfer facility and subject to the existing weighing and labelling system before being moved to the storage area for waste pending treatment, and the sharps containers will still be repackaged in the existing permitted transfer facility before being moved to the storage area for waste pending treatment. There will be an opportunity to carry out a visual inspection of the waste when it is tipped into the shredder as there is a camera providing a live feed from within the unit.

The existing rejection procedure also remains applicable.

The existing EMS does not include a pre-acceptance procedure; this is because this is not a requirement for a facility only carrying out a transfer activity. As specified in 2.1.1. above, the applicant has already carried out an initial gap analysis and identified the need for a waste pre-acceptance procedure for the treatment activity and this will be in place prior to the operation of the treatment plant. The applicant has already started the process of requesting pre-acceptance audits from the waste producers. BAT requirements, as set out in Section 2.1.1 of EPR 5.06 will be fully implemented via this procedure.

3.3 Validation of Treatment

Section 2.3 of EPR S5.07 sets out the mandatory standards and measures for clinical waste treatment activities. It confirms that the applicant must demonstrate that the treatment process is able to render the waste safe, by way of efficacy testing. It is understood that the varied EP will include a pre-operational condition requiring the applicant to submit a written site commissioning validation report to the EA for approval.

Autoclaving is a proven technology in the UK with a number of facilities operating successfully in relation to the treatment of healthcare waste. Whilst the UK facilities do not currently treat sharps waste, there are facilities in the USA and Europe that do so, and continue to meet the standards required to render the waste safe.

As referred to in 2.4 above, the applicant has obtained an effluent sample from an autoclave plant in the USA that is deemed to closely represent the likely composition of the effluent from the proposed plant at the Stoke facility.

Tests have been carried out on similar flocs from a couple of alternative treatment technologies to confirm its suitability for transfer as RDF (comprising orange bag floc and offensive waste floc). Whilst it has not been possible to test waste sharps floc as there is no existing source of this, the applicant has carried out a mock test using product/unused sharps. The proposed treatment plant floc is expected to be a mix of all three.

The floc from the treatment will be sent as RDF as the applicant has an agreement in place with a UK waste disposal company to send this to its energy from waste plants; the applicant is also putting in place contingencies to send the RDF to an exporter with contracts in Europe. The data from the testing has been provided to the proposed waste disposal contractor who has confirmed that it meets the specification for receipt as RDF.

4 Emissions and Monitoring

4.1 Waste storage, handling and dispatch

In relation to waste handling, this is carried out in accordance with the facility waste acceptance procedure and remains relevant and applicable to the facility with the inclusion of the treatment plant. The waste will continue to arrive at the facility in its current form, in proprietary and appropriate containment. Details regarding the tracking processes for the incoming waste and the reusable containers are provided in the Supporting Statement.

Manual handling is minimised at the treatment plant by way of the use of an automated bin tipper to raise up and empty the contents of a bin into the shredder unit. Shredded waste is automatically fed into the autoclave cart which is moved into the autoclave by forklift truck. The feeding of the treated waste from the autoclave cart into the compactor is also by means of forklift which will move the cart to the bint tipper on the compactor. The area of the building in which the treatment plant, and associated storage activities, benefits from an impermeable flooring with a sealed drainage system. This is commensurate with the existing transfer activity.

Waste pending treatment will be stored in a dedicated area and segregated from other types of waste. There is a solid wall dividing the part of the building that will house the treatment activity from the part of the building in which the transfer activity takes place. There is just one route through from one to the other for the movement of waste into the treatment area. This aids the implementation of good waste segregation. As for the existing transfer facility, areas will be marked up on the floor to identify their use (red is for waste pending treatment, grey is for treated waste pending transfer off site for recovery, green is for clean empty containers). All waste storage is within the confines of the building; no waste is stored outside.

Existing measures in place to ensure that containers are cleaned, inspected and repaired or replaced will be applied to the treatment activity. The existing procedures also ensure that waste is processed quickly such that no problems with odour, litter, vermin or pests occur. The contingency plan has been implemented to ensure that storage of waste pending transfer or treatment does not exceed 2 weeks. After 2 weeks, the waste will be transferred off site for incineration or alternative treatment elsewhere.

Dispatch of waste from the facility is covered by existing procedures, in relation to the bulk and repackaged waste currently managed with the transfer activity. Whilst the installation of the treatment plant will introduce new types of waste (the floc and the effluent), the procedures relating to their packaging, loading onto vehicles, tracking and documentation remain the same and will be applied immediately.

There is no designated quarantine area at the site currently. There cannot be an external area, as the land outside the building is public and not under ownership or control of the applicant. It is used on an ongoing basis by other parties present at the industrial estate. Under normal operations, receipt of non-conforming waste or that which would require quarantining is rare as waste is collected from serviced customers, in the applicants own (sealed) containers. As the site operates as a waste transfer facility, should waste arrive that can't be processed, this would be transferred on immediately to a treatment facility.

All waste storage infrastructure is subject to regular inspection and any issues recorded and actioned. If damage, deterioration or leakage is found then waste will be removed from the area until repairs are completed.

4.2 Emissions Monitoring

EPR S5.06 recognises that the level of detail relating to fugitive emissions e.g. odour and noise should be in keeping with the risk of causing annoyance at sensitive receptors.

With regards to odour, it is noted that the proposed variation does not alter the types of waste that will be accepted at the site from those which already are and have been under the existing EP. Of the three stages of the proposed treatment activity, the latter two are fully enclosed when in operation (the autoclave and the compactor). There is therefore very low potential for the release of odours. The first stage, the shredder, is fully enclosed and the air extracted from it and filtered via HEPA and carbon filters. There is also air extraction around the autoclave unit and this is filtered in the same way. The pathway to receptors is through building openings only as no waste is stored or treated outside it, and all doors are kept closed when there is no delivery or collection taking place. The sensitivity of receptors is deemed to be relatively low given the topography in the area, the nature of the area and the distance (and direction) of the receptors. The waste stream itself is primarily metals and plastics and unlikely to be an odour source; as the activity is therefore inherently non-odorous, odour is not deemed to be a problem and the information provided here and in the qualitative environmental risk assessment is considered sufficient.

With regards to noise, the potential noise sources, the pathway for propagation, and the sensitivity of the receptors have been considered in the qualitative risk assessment and deemed not to warrant a full noise assessment or management plan. The information provided in the qualitative environmental risk assessment is considered sufficient.

Section 3.3 of EPR S5.07 identifies the key potential emission sources from clinical waste sites as being: pathogenic micro-organisms; chemicals and pharmaceuticals; and bodily fluids.

Potential pathways leading to an emission include a breach of packaging during manual handling, treatment processes in particular the shredding of untreated waste, and cleaning and disinfection of mobile rigid containers.

Throughout this BAT document, details have been provided for control measures that are to be put in place for the proposed treatment plant. These are confirmed as follows:

- Waste is never manually handled directly. Bulked waste is moved to the treatment plant in lidded skip containers and the repackaged sharps waste is also in lidded skip containers (lined) for safe handling. The containers are subject to regular checks to ensure their integrity and fitness for use.
- Waste is tipped into the shredder using an automated bin lifter. The shredder is fully enclosed to prevent waste spillage from this activity; it will not operate with the doors open. The shredder also has active air extraction which draws air away from the hopper entrance and which is served by both a HEPA filter and a carbon filter. Both filters are subject to maintenance in accordance with the manufacturer's guidelines to ensure removal efficiency is retained, and pressure differentials measured across the filter to identify when exchange is required. The HEPA filter will prevent bioaerosol emissions from the shredder.
- Cleaning of the shredder is only when required, for example prior to access to carry out maintenance, repair or service. Effluent generated through the cleaning process is collected in the sump and pumped into an IBC for transfer to a recovery facility. The IBCs are stacked in a dedicated area within the building, away from any vehicle movements. Storage of full IBCs is limited to 30 at any one time and in a dedicated area which is clearly marked with the quantity and hazardous characteristics of the effluent stored there. This area will be bunded to hold 7500 litres (25% of the total storage capacity of the IBCs) and will be impermeable to the contents. It

will be subject to regular inspection and in the event of a spillage, will be pumped out to retain capacity.

- The floc will be transferred to R1 status energy from waste plants, ensuring that any small pharmaceutical contamination is destroyed by the combustion process.
- The effluent will be transferred to an incinerator plant (either in the UK or in Europe), ensuring that any small pharmaceutical contamination is destroyed by the combustion process.
- Discharge to sewer from the area of the treatment activity is regulated under the existing discharge consent which sets a number of limits.
- Monitoring will be undertaken of emissions of bio-aerosols from the treatment process, specifically around the shredder plant where the waste will be physically treated prior to sterilisation.
- Waste classified as pharmaceutical waste is not processed in the treatment plant. Pre-acceptance processes will identify if there is the potential for significant pharmaceutical contamination in any of the permitted waste streams for treatment and will enable the operator to divert this from the treatment plant.

5 Options Appraisal

Five treatment technologies were considered when determining BAT. These are as follows:

- Option 1 – Chemical treatment using sodium hypochlorite for disinfection
- Option 2 - Chemical treatment using CaO to achieve an exothermic disinfection
- Option 3 – Microwave treatment
- Option 4 – High temperature steam injection
- Option 5 - Autoclaving

A comparison of the five options has been carried out and detailed in the sections below.

5.1 Option 1 NaOCL Treatment

This option comprises the disinfection (rather than sterilisation) of the waste with sodium hypochlorite. The use of a chemical treatment option was discussed with the EA during pre-application communication and it was deemed less preferable to more conventional treatment options due to the fact that it is unproven in the UK for this sector and the equipment is not available 'off the shelf'. For this reason, there is also limited confidence in the availability of spare parts in the event of breakdown. The disinfection efficiency is very dependent on operational conditions and only the surface of intact solid waste would be disinfected.

This option requires the storage and handling of the (hazardous) dosing chemical which poses health and safety concerns for the operatives but also risks in relation to storage and transportation with respect to impacts on the environment. This option also results in the generation of a hazardous effluent that then requires further treatment. The generation of a large volume of hazardous effluent also poses risks with respect to the storage of it at the facility and the transportation of it to the ultimate disposal site.

For these reasons, this option was discounted.

5.2 Option 2 CaO Treatment

This option comprises the exothermic disinfection (rather than sterilisation) of the waste with calcium oxide. As for Option 1, the use of a chemical treatment option was discussed with the EA during pre-application communication and it was deemed less preferable to more conventional treatment options due to the fact that it is unproven in the UK for this sector and the equipment is not available 'off the shelf'. For this reason, there is also limited confidence in the availability of spare parts in the event of breakdown. The disinfection efficiency is very dependent on operational conditions and only the surface of intact solid waste would be disinfected.

The benefit of this option over Option 1 is that, being exothermic, there is no liquid effluent generated. However this option also requires the storage and handling of the hazardous dosing chemical which poses health and safety concerns for the operatives but also risks in relation to storage and transportation with respect to impacts on the environment.

For these reasons alone, this option was discounted.

5.3 Option 3 Microwave

This option comprises the sterilisation of the waste via microwaves. Unlike Options 1 and 2, this technology is proven and in use in the UK. It converts the waste into a dry non-hazardous material without the need for pressurisation or the use of water, and there is no liquid effluent.

The applicant has however received confirmation from the manufacturer that this technology is not ideally suited to the treatment of sharps waste. This is primarily because of the waste feed system which is usually a screw auger and which is prone to blocking and damage, but also due to the high proportion of metals in the waste which can prove difficult to blend in order to achieve sufficient homogeneity and therefore thorough sterilisation.

Energy use is limited to the electrical energy required to power the plant.

Whilst there is confidence in the availability of spare parts, a concern relating to the maintenance of the screws and belts in this system is the potential for sharps residues to be present. This poses a health and safety risk.

This option was tabled for further consideration.

5.4 Option 4 High Temperature Steam Injection

This option comprises sterilisation of the waste via high temperature steam injection. This is very similar to Option 3 in that this technology is proven and in use in the UK but is not ideally suited to the treatment of sharps waste for the same reasons relating to the waste feed system and the level of metals in the waste. It is also similar to Option 5 in that it is sterilising the waste based on the exposure of the shredded waste to high temperature, high pressure steam.

Whilst there is confidence in the availability of spare parts, a concern relating to the maintenance of the screws and belts in this system is the potential for sharps residues to be present. This poses a health and safety risk.

Energy use is limited to gas for firing the boiler to meet the steam demand, and electricity for the plant operation. There are no direct emissions to air as process steam is condensed to liquid effluent. Raw material use is limited to water and small quantities of chemicals to clean the shredder unit.

This option was tabled for further consideration.

5.5 Option 5 Autoclave

This option comprises the disinfection of the waste via autoclave. This is the most prevalent technology that is in use for the alternative treatment of clinical waste in the UK, although it is acknowledged that the current infrastructure in England does not process sharps waste. It is however proven technology and for that reason the availability of spare parts is good, and this process is deemed acceptable for the safe treatment of sharps in Scotland.

The design of the treatment plant is such that the three parts (shredding, autoclaving, and compaction) can each operate in isolation. This enables the operator to carry out maintenance or repair works on any one part of the plant whilst the other parts can continue to operate.

Two residues are generated, floc and effluent, both of which can be received at an energy from waste plant (the former one with R1 recovery status). Energy use is limited to gas for firing the boiler to meet the steam demand, and electricity for the plant operation. There are no direct emissions to air as process steam is condensed to liquid effluent. Raw material use is limited to water and small quantities of chemicals to clean the shredder unit.

5.6 Shortlist Comparison

This option was the applicant's preferred option following initial options appraisal, but to confirm this a quick comparison of the shortlisted three options was carried out. This is presented in **Table 1**.

Table 1: Shortlist Option Comparison

Shortlisted Option	Advantages	Disadvantages
Option 3 - Microwave	• Good disinfection efficiency under appropriate operating conditions • High reduction in waste volume • Environmentally sound • No water use • No liquid effluent	• Relatively high investment and operating costs • Potential operation and maintenance problems • Possible emission of microwaves in the event of plant failure • Not ideally suited to the treatment of sharps waste • H&S risks of maintenance/service of auger
Option 4 – Steam Injection	• Relatively low investment and operating costs • Good sterilisation efficiency • High reduction in waste volume • Environmentally sound	• Operation requires qualified technicians • Not ideally suited to the treatment of sharps waste • H&S risks of maintenance/service of auger • Generates a liquid effluent
Option 5 - Autoclave	• Relatively low investment and operating costs • The best sterilisation efficiency of the three options • High reduction in waste volume • Environmentally sound	• Operation requires qualified technicians • Generates a liquid effluent

6 Conclusion

On the basis of the assessment above, which addresses compliance with sector guidance as well as considering the chosen technology against the other available options, it is deemed that the chosen option of autoclaving appropriately fulfils the definition of BAT.

It offers the best level of sterilisation of the three, utilises a waste feed system that presents a lesser health and safety risk for maintenance, is in use across the UK for healthcare waste so is proven and parts are available, and the resultant liquid and solid residues can be used to generate energy in waste to energy facilities. It is already in use, for the treatment of sharps waste, in Scotland.

It is acknowledged that a concern of the regulator is the potential for sharps to have a level of pharmaceutical contamination which could lead to undesirable emissions to air and/or water. It is confirmed that pure pharmaceuticals will not be processed through the treatment plant; these will continue to be transferred off site via the current transfer activity. Whilst there is the potential for pharmaceutical contamination in the infectious waste types proposed, this is likely to be <5% and will not impact the ability of the waste to energy plants to accept the resultant floc or effluent.