# Lillyhall Landfill

## Transboundary Impact Assessment

25 January 2021

TIA 5156325-302-0001

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# Contents

# Introduction

The Lillyhall Landfill Site is an existing landfill site, which operates under an Environmental Permit (CD7914) granted by the Environment Agency (EA). An assessment of the potential environmental impacts arising from the disposal of wastes to the site was prepared as a basis for this permit and demonstrates that the current permitted environmental impact of the site is acceptable. The Site was granted a variation to its permit in 2011 to dispose of High Volume - Very Low Level Waste (HV- VLLW) which have activity less than 4 Becquerels per gram (Bq/g). FCC Recycling (UK) Ltd is applying for a subsequent variation to the Lillyhall Landfill Site permit (CD7914) to allow radioactive wastes from a wider range of activity concentrations to be disposed of at the site. As part of the current variation process a document was submitted to the department of Business, Energy & Industrial Strategy In 2019 representing an Article 37 Annex V Standard Form Submission which seeks to demonstrate that the modification to the current plan does not impact a member state. Due to a legislative change a Transboundary Impact Assessment is now required to replace the Annex V assessment. The new Transboundary Radioactive Contamination (England) Direction 2020 requires that a Transboundary Impact Assessment be provided for the purpose of ensuring that the Environment Agency considers whether plans to dispose of radioactive waste are liable to result in the radioactive contamination, significant from the point of view of health, of water, soil or airspace of notifiable countries. This document represents the Transboundary Impact Assessment which seeks to demonstrate that the modification to the current plan does not impact a member state. The Environmental Safety Case (ESC) (Atkins SNC Lavalin, 2020) developed as part of the recent application to vary the site permit has demonstrated that the site will not have a significant impact locally. This has formed the basis of the submission to demonstrate there will be no wider impact as consequence of the increased site disposal limits.

# 1. Site Information

## 1.1. Location

The Lillyhall Landfill Site is situated in west Cumbria at Joseph Noble Road, Lillyhall, Cumbria CA14 4JH (OS Grid Reference NY026247). The landfill is situated near to the Lillyhall industrial estate, approximately 1 km northwest of the nearby centre of population of Distington village and 4 km south southeast of the centre of Workington. The site is within the currently consented planning permission boundary and occupies approximately 47 hectares. A location map is included in Appendix A.

## 1.2. Site Surroundings

The north-eastern, north-western, south-eastern and south-western boundaries of the landfill are bordered by woodland which is to be extended in the south west as part of the final site restoration scheme. The landfill gas flare, leachate treatment plant, and landfill site boundary are fenced (1.8m). A gated site entrance is in place which is locked outside of operating hours.

The north of the site is bounded by a minor road which runs in an approximately east to west direction, beyond this is agricultural land drained by a tributary to Wythemoor Sough. To the west the site is bounded by FCC's Lillyhall Waste Treatment Centre (WTC) and Materials Recycling Facility (MRF), beyond which are Joseph Noble Road and Lillyhall Industrial Estate. To the east of the site is the former Potato Pot opencast coal mine which has been restored to agricultural use. Immediately to the south of the site lies Distington Landfill site, which is separated from the site by a slag bank from the former Distington Iron Works. The nearest residential dwelling to the Site is Wythemoor Head located some 350 m to the south of the landfill boundary. Other residential properties are located circa 500 m north-east of the Site (Wythemoor House and Gale House).

The nearest designated site to Lillyhall is the River Derwent and Bassenthwaite Lake, which are both Special Area of Conservation (SAC). This designation also covers the River Marron, a tributary of the River Derwent. The River Marron (as a tributary of the River Derwent) is also designated a Site Special Scientific Interest (SSSI). The River Marron at it closest point to the Lillyhall Landfill site is 2.5 km to the east as the river flows through the village of Branthwaite.

# 2. Planned Modifications

## 2.1. Modification Detail

The Lillyhall Landfill Site is an existing landfill site, which operates under an Environmental Permit (CD7914) (Environment Agency, 2011) granted by the EA. An assessment of the potential environmental impacts arising from the disposal of wastes to the site was prepared as a basis for this permit and demonstrates that the current permitted environmental impact of the site is acceptable.

The Site was granted a variation to its permit in 2011 to dispose of HV-VLLW which have activity less than 4 Bq/g. FCC Recycling (UK) Ltd is applying for a subsequent variation to the Lillyhall Landfill Site permit (CD7914) to allow radioactive wastes from a wider range of activity concentrations to be disposed to the site.

Low Activity- Low Level Waste (LA-LLW) falls between the two categories for Low Level Waste (LLW) and Very Low Level Waste (VLLW). Low Level Waste Repository Ltd (LLWR) define LA-LLW as those wastes with a total radioactivity of less than 200 Bq/g arising from within the nuclear industry (LLWR, 2011). This category includes wastes defined as HV-LLW which have activity less than 4 Bq/g. This definition of LA-LLW has been used because it encompasses those wastes that have been demonstrated as able to be disposed of in facilities other than the LLW Repository (LLWR, 2011).

It is proposed to increase the site limits at Lillyhall Landfill to receive LA-LLW, with a proposed maximum average consignment activity limit of 200 Bq/g for a single waste stream. Cells 7 to 10 encompass the remaining capacity of the Lillyhall Landfill site. Waste from the previous landfill cells will be overtipped in order to reach the approved restoration contours, adjacent cells will therefore comprise of the waste that overtips cells 4B, 5, 5A and 6A. The proposed application requires the entire remaining capacity for cells 7 to 10 to be permitted for disposal of LA-LLW as well as cells 4B, 5, 5A, and 6A for restoration purposes.

The calculated non-engineered remaining site void space of these cells is 891,053 m3; equating to a total remaining capacity of ca.1.60 million tonnes of waste, assuming a waste density of 1.8 te/m3 (1800 kg m3). In practice, the actual space utilised for LA-LLW will be less than this maximum capacity figure due to void space and additional daily coverage of the waste. the maximum radioactive inventory for the site has been calculated as 36 TBq, assuming the density provided above and disposal of roughly 100,000 m3 of radioactive materials.

The disposed waste streams are likely to be varied, but will typically comprise concrete, rubble and metals from decommissioning activities on nuclear licenced sites, soils contaminated with low levels of radioactivity, operational wastes from nuclear licenced sites and non-nuclear sector radioactive waste.

## 2.2. Environmental Safety Case.

An Environmental Safety Case (ESC) (Atkins SNC Lavalin, 2020) has been developed as part of the recent application to vary the site permit, the ESC demonstrates that the site will not have a significant impact locally. The ESC has formed the basis of the Transboundary Impact Assessment to demonstrate there will be no wider impact as consequence of the increased site disposal limits.

The ESC that has been prepared in support of that application demonstrates to the EA that the proposed activity will meet all requirements for the radiological protection of people and the environment. The ESC contains a detailed radiological assessment of the dose to the public from disposals of LA-LLW radioactive waste to the site. This radiological assessment looks at the behaviour of radionuclides in the landfill, considers ways that radionuclides can enter the local environment and the timescale over which this may occur.

The results of the radiological assessment calculations were used to determine the quantity (total activity) of each radionuclide that would meet the health protection standards specified by the EA if it was disposed of at the Lillyhall Landfill site. These quantities are used to limit the disposal of LA-LLW that will be specified in the revised Permit. The assessment approach is very conservative and inevitably overestimates the doses that may occur from disposal of each radionuclide. Using the conservative calculations will set a lower limiting quantity for the waste that can be disposed of.

The ESC also demonstrates that via careful control of the activity and quantities of waste disposed, use of best practice design, the existence of a sound environmental management culture, and ongoing environmental monitoring will provide confidence that any radioactive emissions will be low and consistent with the health protection standards specified by the EA. The assessments and controls detailed within the ESC provide assurance that the proposed disposal of LLW will be managed appropriately and will give rise to radiological impacts well within relevant regulatory criteria.

# 3. Previous European Commission Opinion

As part of the previous permit variation process to receive and dispose of HV-LLW up to 4 Bq/g at the Lillyhall Landfill Site a submission was prepared and submitted to the European Commission on 1 September 2010 in accordance with Article 37 of the Euratom Treaty.

On 10 March 2011 an opinion was received (Commission, 2011) on the submission associated with the 2011 variation to permit CD7914 which concluded:

"In conclusion, the Commission is of the opinion that the implementation of the plan for the disposal of radioactive waste in whatever form arising from the Lillyhall Very Low-Level Radioactive Waste Disposal Facility in the United Kingdom, during its normal operational life and after its final closure, as well as in the event of an accident of the type and magnitude considered in the general data, is not liable to result in the radioactive contamination of the water, soil or airspace of another Member State."

As discussed in Section 2.1 the current application seeks to increase disposal limits to accept LA-LLW up to 200 Bq/g, as part of the variation process a document was submitted to the department of Business, Energy & Industrial Strategy In 2019 representing an Article 37 Annex V Standard Form Submission which seeks to demonstrate that the modification to the current plan does not impact a member state. Due to a legislative change a Transboundary Impact Assessment is now required to replace the Annex V assessment.

The new Transboundary Radioactive Contamination (England) Direction 2020 requires that a Transboundary Impact Assessment be provided for the purpose of ensuring that the Environment Agency considers whether plans to dispose of radioactive waste are liable to result in the radioactive contamination, significant from the point of view of health, of water, soil or airspace of notifiable countries.

# 4. Transboundary Impact Assessment

The ESC developed as part of the recent application to vary the site permit has demonstrated that the site will not have a significant impact locally. This has formed the basis of the submission to demonstrate there will be no wider impacts on a larger geographic scale as consequence of the increased site disposal limits.

## 4.1. Dose Assessments

The submitted ESC (Atkins SNC Lavalin, 2020) considered scenarios involving exposure to waste during normal operations, scenarios involving the expected site evolution and a range of scenarios involving unexpected exposure resulting from disposal of LA-LLW. The range of scenarios were selected via a risk assessment screening process to ensure that, for all reasonably foreseeable circumstances, doses or risks are properly controlled through employment of sound science and management to limit potential dose impacts to a minimum, with regards to the relevant guidance levels. Trigger levels will be set so that if any waste stream were identified as contributing more than ten percent (10%) of the maximum total radiation dose for any scenario, or if the cumulative impact of all waste streams accepted were to reach one third of the total radiation dose for any scenario, the Environment Agency would be consulted and the assessment discussed.

The NS-GRA (Environment Agencies (EA, NIEA, SEPA), 2009) specifies dose constraints for members of the public for the period of authorisation (Requirement 5):

> *"During the period of authorisation of a disposal facility for solid radioactive waste, the effective dose from the facility to a representative member of the critical group should not exceed a source-related dose constraint and a site related dose constraint. The UK Government and Devolved Administrations have directed the environment agencies to have regard to the following maximum doses to individuals which may result from a defined source, for use at the planning stage in radiation protection:*
>
> • *0.3 mSv/y from any source from which radioactive discharges are made; or,*
> • *0.5 mSv/y from the discharges from any single site."*
> *(Environment Agencies, 2009), para 6.3.1 and 6.3.2*

For assessment purposes the Lillyhall Landfill Site was considered to be a source from which radioactive discharges occur. Based on the model radionuclide inventory; predicted activity concentration data in leachate, and in abstracted groundwater doses to a variety of receptors (representative persons) were assessed. The

assessment used several precautionary modelling approaches and data assumptions to give upper bounding (worst-case) estimates of annual effective dose with subsequent uncertainty analysis where required.

### 4.1.1. Assessment Scenario

Discharges from the site (leachate, groundwater and gases) have the potential to carry radioactivity and may allow for migration of contamination across borders. The relevant scenarios assessed as part of the ESC (Atkins SNC Lavalin, 2020) are discussed in greater detail below.

Leachate collected from the Lillyhall landfill site is treated biologically onsite to ensure consistency with United Utilities requirements, discharged to sewer and treated at the United Utilities Whitehaven (Parton) Wastewater Treatment Works (WwTW). This practice is expected to continue throughout the period of authorisation (i.e. up to 2090). However, it is important to note that leachate arisings after disposal operations have finished, i.e. no open cell is being worked, will be much lower.

The treatment works receives flows from both the Whitehaven and Maryport catchments. Treatment works flows are lifted via pumps to the inlet works where they are screened, settled and treated through batch reactors and returned to an outlet well for discharge via the 1 km long-sea outfall. During storm events, flows spill directly from the inlet works to the outfall outlet well. Due to the relatively low elevation of the works, the discharge of final effluent from the well to the sea is tidally constrained. Under mid- to low-tidal conditions, flows are discharged by gravity. However, pumps are required to provide additional head at high tides.

For assessment purposes it was cautiously assumed that treated sewage solids from the WwTW are used to improve agricultural land in the area.

Rainwater ingress into a cell containing radioactive waste will mobilise some of the radioactivity into the leachate and its subsequent transfer to the WwTW. There are three potential exposure scenarios associated with this leachate transfer:

- Exposure of WwTW operators. They receive external exposure from radioactivity in sewage media and internal exposure via inadvertent ingestion and inhalation of sewage media. There is no potential for transboundary impact in relation to this pathway, as the WwTW will likely always be situated within the local area.

- A farming family who work land to which treated sewage solids are applied. They receive external exposure from radioactivity in treated sewage solids applied to the land and internal exposure from radioactivity in foods produced on the land and via inadvertent ingestion and inhalation of radioactivity in treated sewage solids applied to the ground. Although in the ESC (Atkins SNC Lavalin, 2020) it was assumed that this farming family were local to site, in theory this sewage sludge could be exported, resulting in impacts to the soils or agricultural community of other notifiable countires.

- Coastal fisherman. They receive external exposure from radioactivity in treated sewage effluent discharged to sea that may accumulate in environmental media such as intertidal sediments and via consumption of fish that have accumulated radioactivity from the seawater. Discharging leachate into the Irish Sea has the potential to cause transboundary impacts by effecting the seawater quality, fish stock or coastal fisherman of other notifiable nations.

Additionally, there are other pathways which have the potential to cause a transboundary impact. These include:

- Contaminated leachate could infiltrate through defects in cell containment, through the unsaturated zone and reaching the Secondary A Aquifer underlying the site. The ESC (Atkins SNC Lavalin, 2020) assessed this scenario by estimating the annual dose of to a member of public which consumed contaminated groundwater from a well installed at the site boundary. A plume of groundwater

contamination may migrate off-site with the potential to cross borders or discharge into the Irish Sea (effecting coastal fisherman similar to leachate discharge).

- Degradation of organic wastes within the cells may result in the generation of potentially radioactive landfill gases such as carbon dioxide or methane containing C-14, or radon from radioactive decay. During the operation of the site, this gas is collected and flared, which allows for this gas to be vented and discharged to the atmosphere. Landfill gas the potential to migrate through advection and dispersion across borders toward other notifiable countries. The ESC (Atkins SNC Lavalin, 2020) assessed the potential impact of landfill gas by estimating the annual dose to a member of the public who resides in a residential structure built directly on top of a landfill cell (following the period of authorisation, and thus there is no active gas management at the site), in which landfill gas can accumulate.

### 4.1.2. Dose Assessment Results

Doses predicted are compared to the annual effective source constraint of 0.3 mSv (300 µSv) associated with planned discharges (leachate disposal) and the 0.02 mSv (20 µSv) annual effective dose guidance level associated with leachate migration into groundwater. Dose assessment results relative to the dose criterion described above are shown in Table 1 below:

Table 1: Dose Assessment Results

| Exposure Pathway | Receptor | Predicted Total Annual Effective Dose (µSv) | Relevant Annual Effective Dose Criterion (µSv) |
|---|---|---|---|
| Period of Authorisation – Expected to Occur | | | |
| Leachate processing off-site | Farming family | < 25 µSv | 300 |
| | Fisherman | < 0.1 µSv | 300 |
| Release to groundwater | Member of public | 0.8 µSv | 20 |
| Period of Authorisation – Not Certain to Occur | | | |
| Dropped load | Worker only | 7.45E-08 µSv | 1,000 |
| Fire | Worker only | 23 µSv | 1,000 |
| After Period of Authorisation – Expected to Occur | | | |
| Release to groundwater | Member of public | 2.5 (with a risk <1E-06) | Risk of 1E-06 (20 µSv where risk of exposure is one) |
| Release of radioactive gas | Local resident | 0.05 (with a risk <1E-06) | Risk of 1E-06 (20 µSv where risk of exposure is one) |

In all scenarios considered, the annual effective doses are less than the source constraint of 300 µSv and the 20 µSv annual effective dose guidance level.

The representative person is a member of a hypothetical farming family who applies sewage solids to agricultural land, works on that land and consumes produce produced on it. Their annual effective dose rate was initially assessed as 25 µSv, which is within the source constraint of 300µSv. When more likely sludge

application rates and radionuclide partitioning between sludge and sewage plant effluent are considered, dose rates could be an order of magnitude lower. The most effected age group is that of an infant.

The results of the ESC assessment indicate there will be no impact to the environment or human health in the immediate vicinity of Lillyhall Landfill. As such it is considered that plans to dispose of radioactive waste are not liable to result in the radioactive contamination, significant from the point of view of health, of water, soil or airspace of notifiable countries. The estimated annual to local workers, treatment works, farming families and has been assessed as within criteria set out in EA guidance (Environment Agencies (EA, NIEA, SEPA), 2009), and therefore, with consideration to the much greater distance to receptors and potential for further attenuation, potential impact to possible receptors in bordering countries will be negligible.

## 4.2. Reference Accident Assessment

### 4.2.1. Reference Accident Scenario

The reference accident and exposure scenario identified as part of the ESC (Atkins SNC Lavalin, 2020) is a dropped load, being that a waste package is dropped on arrival/during emplacement which results in dose via dust inhalation. Package types will be compliant with relevant regulations and guidance for the transport of radioactive material, and these will be controlled via the site Waste Acceptance Criteria (WAC). Package movements are controlled via operational procedures and the situation giving rise to a dropped load is most likely to occur during emplacement to the cell where by loose material such as soil within the cell would be displaced via the dropped load, the resuspended dust would then be inhaled by a site worker. The assessment is based on the average consignment limit of 200 Bq/g total activity concentration.

The ESC includes an assessment of worker dose undertaken using Mercurad Modelling Software v6.3 (MMS). To assess the inhalation dose rate associated with a dropped load the same methodology was followed as per the worker dose assessment with the airborne fraction increased by 10% to account for resuspended dust. To account for annual exposure, it has been assumed that 10 dropped loads per annum occur. Other factors such as skip volume, maximum number of skips per day, breathing, and occupancy rates were also taken into account.

Assumptions were made that the waste activity is distributed evenly over the total cell area and that a worker would be exposed to a point source with activity only within a 2 $m^3$ volume, during normal operation at the edge of the cell. A conservative annual occupancy rate resulting in an annual exposure time of 1 hour per dropped load was used.

### 4.2.2. Assessment Results

The maximum dose rate is estimated to be 7.45E-05 µSv if a worker is exposed to dust inhalation for 1 hour per dropped load. These are low doses and the calculations are very conservative. In terms of dust inhalation from a dropped load, the annual effective dose to workers is below the annual source constraint of 1000 µSv. This is based on conservative parameter assumptions; operational reality is that a worker is unlikely to be exposed to 10 dropped loads per working year.

**Table 2: Dropped Load Assessment Results**

| Exposure Scenario | Total Annual Effective Dose (µSv) | Annual Effective Dose Criterion (µSv) | Requires Further Assessment |
|---|---|---|---|
| Worker only | 65.8 | 1,000 | No |

## 4.3. Impact Assessment Conclusion

The assessed doses within the immediate vicinity of the landfill and those occurring from the refence accident scenario have been assessed to be within regulatory constraints, it has therefore been demonstrated that the proposal is not liable to result in the radioactive contamination, significant from the point of view of health, of water, soil or airspace of notifiable countries as doses.

# 5. References


Atkins SNC Lavalin, 2020. *Lillyhall Landfill Environmental Safety Case - 5156325-301-0003,* s.l.: s.n.

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# Appendices

# Appendix A. Location Map