# Surface Water Risk Assessment

Meece 1 Landfill

Report No. 14-K6094-ENV-R003

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Biffa Waste Services Limited

# Document Control

**Project**

Meece 1 Landfill

**Client**

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# [1] Introduction

## [1.1] Background

Ayesa (ByrneLooby Partners (UK) Limited) have been commissioned by Biffa Waste Services Limited (Biffa) to produce a Surface Water Risk Assessment in support of a Permit variation application to enable the discharge of a treated leachate effluent to surface water from the Meece 1 Landfill (the Site).

Meece 1 Landfill is operated by Biffa under Environmental Permit ref. EPR/BV4967IW along with a hazardous Soils Treatment Facility (STF) which has been developed within the eastern part of the permitted area. The site is operated by Biffa, which is hereafter referred to as the Operator.

The site is located at Swynnerton, Cold Meece, Stone, Staffordshire, ST15 0QN. Landfilling at the site commenced prior to 1996 with the site to date developed as twelve cells (Phase 0 to Phase 7 and 13A). Meece 1 was mothballed in 2008 following the completion of Phase 7. The eastern part of the site (Phases 8, 11, 12, 13B and 14) therefore remains as available permitted void space and is undeveloped.

A Permit variation application for the Meece 1 Landfill was submitted by ByrneLooby Partners (UK) Limited (ByrneLooby) in December 2022 which sought to allow Biffa to discharge trade effluent associated with the permitted operations to sewer. The proposals were supported by an environmental risk assessment (H1 assessment)[1] which considered the impact of the consented discharge on the River Sow following treatment at the Eccleshall and Sturbridge WwTW.

The application documents were then updated and re-submitted in December 2023 to update the Permit in accordance with the recommendations set out within the Hydrogeological Risk Assessment produced in June 2023 by Swan Environmental Limited.

**Proposed Changes**

The application is queued with the Environment Agency and has not yet been duly made. Whilst the application has been queued, further consideration has been given by Biffa to long-term leachate management options for the site to increase capacity for leachate removal and disposal. Biffa are therefore seeking a further amendment to the Permit to enable the operation of a Reverse Osmosis (RO) Leachate Treatment Plant (LTP) at the Meece 1 landfill. This will provide two routes for disposal:

(1) up to 100m$^3$/day of untreated leachate and other trade effluent directly to the sewer (where the TEDC limits are met)

(2) up to 150m$^3$/day of treated leachate via the RO plant to the Meece Brook

The dual discharge route is required because the TEDC volumetric limit is insufficient for the site's needs and there is no availability at the receiving works for the site's effluent demands.

This report has been prepared to assess the potential environmental impact of the proposed discharge on the receiving waters *i.e.* the Meece Brook. A Surface Water Risk Assessment has been produced in accordance with the Environment Agency's online guidance on '*Surface water pollution*

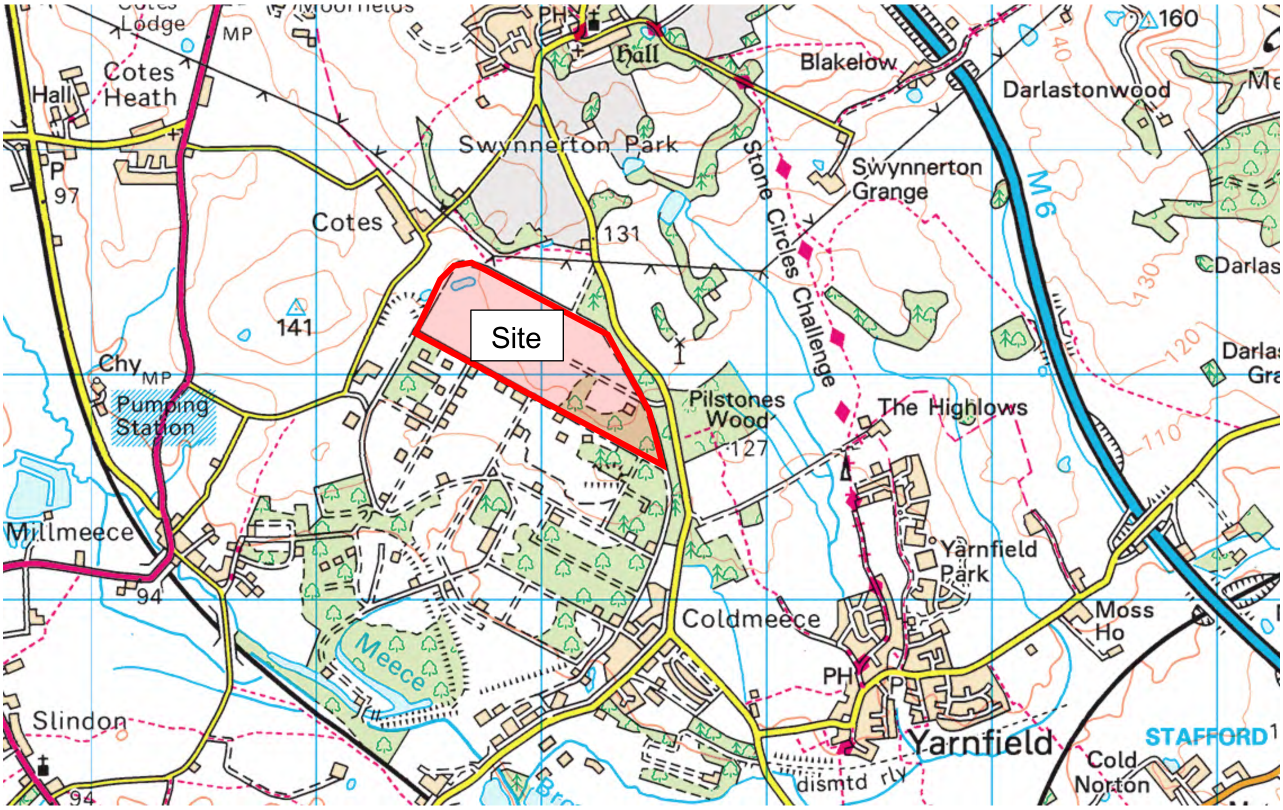
[1] ByrneLooby (2022) Surface Water Risk Assessment, Meece 1 Landfill, Report 14-K6094-ENV-R002

*risk assessment for your environmental permit'*[2]. This report briefly summarises the site context and subsequently outlines the source-pathway-receptor framework for assessment.

## [1.2] Site Location and Development

Meece 1 Landfill is located at National Grid Reference (NGR) SJ 384960 334104 and is situated in a predominantly rural area comprising small villages, wooded areas and agricultural fields. The site is bound to the south by the Swynnerton Training area, a Ministry of Defence site, and to the east by Swynnerton Road. To the north of the site are agricultural fields and ~300m to the west lies the village of Cotes. The site location and surrounding features are illustrated on Figure 1.

**Figure 1 – Site Location and Surrounding Features**




Meece Landfill was developed on the northeast part of a Royal Ordnance Facility 'filling factory' which was originally developed in 1939. The earliest areas of Meece Landfill were operated by Staffordshire Council as a co-disposal site from 1986 until 2004. Following the implementation of the Landfill Directive Meece 1 was permitted as a non-hazardous landfill and continued to receive appropriate waste. Meece 2 is authorised under a separate Permit (Reference EPR/BW0096IJ) for the receipt of hazardous wastes. However, to date landfilling in Meece 2 has not commenced and the landfill site is currently mothballed.

A hazardous soils treatment facility (STF) is operated on the eastern part of the landfill complex (*i.e.* across the undeveloped Phase 11 and 12 footprints) and this activity is authorised under Environmental Permit ref. EPR/BV4967IW, *i.e.* the Meece 1 non-hazardous landfill Permit. A

[2] Environment Agency (2016) Guidance: Surface water pollution risk assessment for your environmental permit. Accessed via https://www.gov.uk/guidance/surface-water-pollution-risk-assessment-for-your-environmental-permit. Last updated 25 February 2022

separate Permit (Ref. EPR/EB360FM) has also been issued for an Aggregate Treatment Recycling Facility (ATRF) at the site which processes street cleaning residues and other similar waste streams.

The treatment plant comprises of a series of RO membranes (spiral wound membrane modules) housed within a container and is intended to be placed at National Grid Reference SJ 85070 34353 on the northern boundary of the Meece landfill site (Figure 2). The proposed location of the RO plant is currently outside of the Permitted area. Therefore, a change to the Permit boundary will be required as part of the Permit variation application.

**Figure 2 – Proposed RO Plant Location**


# [2] Source Term

## [2.1] Proposed Activity

It is proposed that a Reverse Osmosis (RO) plant with a design capacity of 150 tonnes per day (150m$^3$/day) to treat excess waters which cannot otherwise be managed. The RO plant would accept a combination of landfill leachate from the Meece 1 landfill and other aqueous wastes from the permitted activities on site including contaminated surface water.

It is expected that when operating at full capacity the RO plant would produce some 50m$^3$/day of concentrate which would be managed off-site, with the remaining 100m$^3$/day discharged through the existing surface water management system. It is thought that the existing surface water system was originally developed when the site was part of the larger ROF Swynnerton and as such the discharge is offsite into drains on the MOD site which then discharge into the Meece Brook. The discharge from Meece landfill utilised by the RO plant will be at discharge/sampling location 88902104 'Meece Avenue' demarcated on the site's Monitoring Plan appended to this report as drawing ref. M4180107-2022.

## [2.2] Treatment Technique

RO treatment aims to extract clean water from the aqueous solution of organic and inorganic contaminants that constitute the landfill leachate. The RO process is capable of separating even small sodium and chloride ions from solution, hence its use in potable water purification applications. The process is therefore the most effective mechanism for guaranteeing a high-quality effluent. However, due to high energy costs and the production of a concentrated waste stream, RO systems are typically only employed when a drinking water supply is required from a saline source or where off-site tankering is unsustainable and there are no other alternative options available.

RO treatment utilises a high-pressure system to force the leachate through a combination of an ultrafiltration membrane to remove biosolids, small particulates and colloids and then a chemically charged membrane which is designed to reject dissolved ions.

The liquid is forced through the pores of the membrane to produce an effluent (the permeate). Any rejected liquor (the retentate) which does not pass through the membrane and contains the rejected dissolved constituents is re-circulated back into the system for re-processing. The process gradually results in a concentrated liquor which is disposed of on a batch basis via off-site tankering.

Reverse Osmosis membranes are designed to reject a specific particle/ ionic size range using the mechanism of electro-static rejection in the order of 0.0001 – 0.003µm and is an ideal process for removing:

- Monovalent ions;
- Metal ions;
- Acids;
- soluble salts;
- hydrocarbons;
- solvents;
- natural resins;
- residual paint; and
- other low molecular weight species and for selective separations.

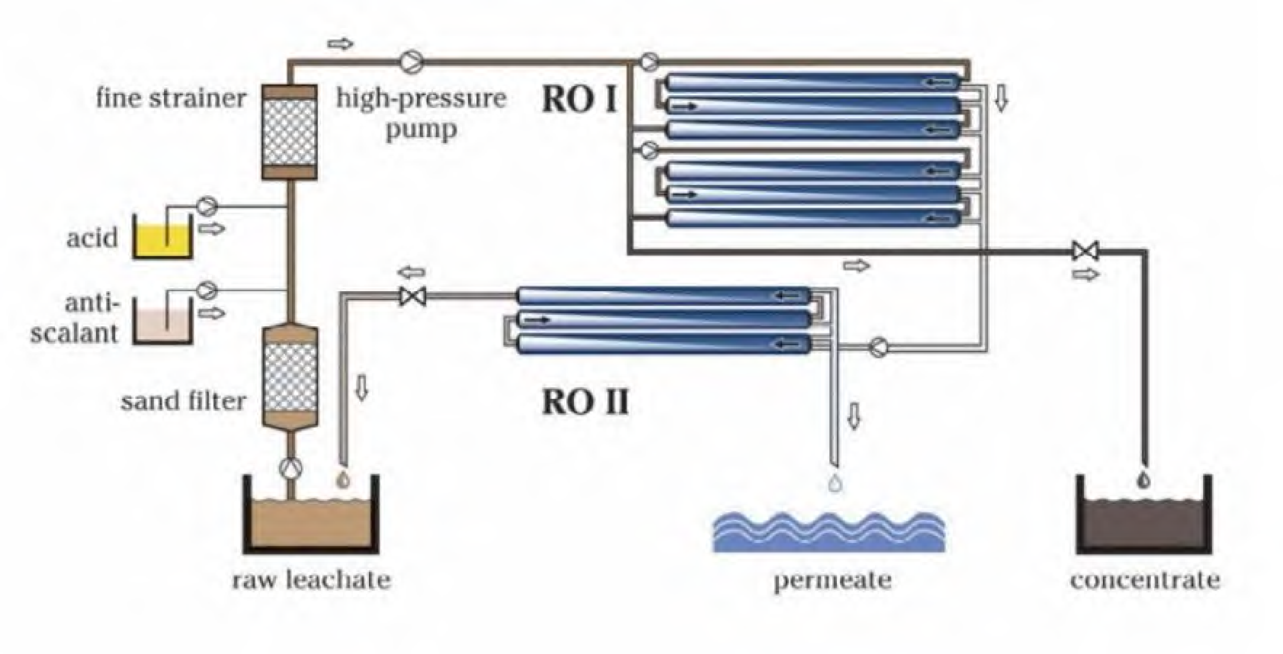
For some leachates, up to 95% of the influent volume can theoretically be 'purified' to a standard suitable for a surface water discharge. All leachate constituents are then concentrated into the remaining 5% of the leachate volume which is disposed of by off-site tankering. However, if there is the possibility of extensive biofouling of the membrane which results in reduced efficiency of the process, then rejectate volumes can be up to 40% of the influent volume.

RO plants as a physical process are often an effective alternative to biological treatment systems due to their treatment reliability and being less prone to process instabilities caused by feed quality variations. They can also meet more stringent discharge quality limits for substance not treated biologically and are therefore often selected when the discharge is directly to a surface water system as opposed to the public sewer system.

## [2.3] RO Plant Design

The proposed RO plant is based on a reverse osmosis process that 'cleans' the leachate primarily and then 'polishes' the permeate further in subsequent stages. A typical arrangement for a 2-stage RO plant is illustrated in Figure 3 nb the Meece plant will have at least 3 stages. Following the final stage, the permeate will be processed through a carbon dioxide stripping tower to achieve a more neutral pH. Specification details for the RO plant are provided in Appendix A.

**Figure 3 – Typical Reverse Osmosis process for leachate treatment**




The plant will use an artificial, semi-permeable membrane manufactured from a thin film composite material that has been optimised with very high physical and chemical durability for use with landfill leachate. The membrane modules are mounted within pressure tubes on racks, complete with interconnecting pipework and recirculation/transfer pumps. The recirculation pump maintains a leachate feed of sufficiently high velocity to effectively 'overflow' and fully saturate the membrane surface at a velocity that inhibits precipitation and preventing concentration polarisation and fouling that would impact on efficiency.

The outputs from the RO treatment process include:

- a permeate (treated effluent) which will be discharged to the site's surface water management system and ultimately to the environment at Meece Brook; and
- a rejectate or concentrate that is collected and in this case intended to be transported by tanker to a suitably licenced facility for off-site treatment/disposal.

## [2.4] RO Influent and Effluent

### [2.4.1] Overview

The RO plant is expected to achieve a ~99% reduction in the COD, BOD and ammoniacal-N. As the RO plant is not yet operational there is no information available on the actual treated effluent composition from the treatment plant. As noted above, one of the benefits of the RO technology is the high reliability and efficiency. Hence, it is considered reasonable to assume that the RO plant will achieve a similar discharge quality to other RO plants treating landfill leachate.

This section therefore summarises the influent and expected effluent quality based on similar treatment plants.

### [2.4.2] Influent Quality

The RO plant will primarily receive landfill leachate from the Meece 1 landfill. However, surface water collected in the ATRF lagoon may also be directed to the RO plant (where necessary). The ATRF lagoon collects rainfall and runoff from around the site weighbridge and the recycled water from the ATRF process. As noted above, the ATRF is a separately permitted activity. The landfill leachate quality is summarised in Table 1 to Table 4, whilst a summary of the ATRF lagoon water quality is provided in Table 5. The raw data is provided in Appendix D.

The leachate at Meece Landfill is generally consistent with expectations for a non-hazardous leachate, *i.e.* an ammoniacal-N rich sodium-chloride bicarbonate solution with significant potassium and insignificant sulphate (Table 1). Total oxidised nitrogen and nitrate are typically negligible in the leachate and reported below the limit of detection at <0.7mg/l.

**Table 1 – Meece Landfill Leachate Matrix Summary (March 2020 to January 2024)**

| Location | | pH | EC | $NH_4$-N | COD | BOD | Ca | Mg | Na | K | Cl | $SO_4$ | Alk |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | µS/cm | mg/l | mg/l | mg/l | mg/l | mg/l | mg/l | mg/l | mg/l | mg/l | mg/l |
| In-waste wells | Avg | 7.3 | 16,433 | 830 | 1,558 | 157 | 487 | 104 | 1,756 | 874 | 4,187 | 150 | 3,452 |
| | $95^{th}$ %ile | 8.0 | 44,400 | 3,530 | 6,221 | 505 | 1,500 | 155 | 5,270 | 2,570 | 15,200 | 487 | 13,800 |
| | Max | 8.1 | 80,600 | 5,250 | 1,120 | 3,580 | 7,800 | 933 | 12,300 | 6,880 | 27,700 | 1,720 | 15,400 |
| Leachate Tank 1 | Avg | 7.8 | | 2,200 | 3,800 | | | | | | 8,030 | 56 | |
| | $95^{th}$ %ile | 8.0 | | 2,504 | 4,657 | | | | | | 9,583 | 101 | |
| | Max | 8.0 | | 2,570 | 4,850 | | | | | | 9,760 | 105 | |
| Leachate Tank 2 | Avg | 7.2 | | 247 | 869 | | | | | | 1,545 | | |
| | $95^{th}$ %ile | 7.2 | | 372 | 1,419 | | | | | | 2,288 | | |
| | Max | 7.2 | | 386 | 1,480 | | | | | | 2,370 | 57 | |

There is a limited priority metal inventory within the leachate (Table 2). Mercury is consistently reported below the limit of detection and has not been identified as present within the leachate. Mercury is therefore environmentally insignificant, and no further assessment of this substance is required. Arsenic is also low and often below the 50µg/l EQS. Hence there is unlikely to be any environmental significance to the arsenic following discharge to the environment after treatment of the landfill leachate.

The non-hazardous metal content is consistent with expectations for a landfill leachate and primarily comprises of chromium, nickel, and zinc. However, the percentile distribution demonstrates significant outliers (*e.g.* for copper and zinc) which will be in a colloidal or particulate type form which can be removed by an UF membrane. These are not expected to pass through to the RO membranes.

**Table 2 – Meece Landfill Leachate Priority Metals (March 2020 to January 2024)**

| Location | | Hg (total) | Pb (total) | As (total) | Cd (total) | Cr (total) | Cu (total) | Ni (total) | Zn (total) | Fe (total) | Mn (total) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | µg/l | µg/l | µg/l | µg/l | µg/l | µg/l | µg/l | µg/l | mg/l | mg/l |
| In-waste wells | Avg | <0.2 | 10 | 13 | 1 | 92 | 111 | 96 | 284 | 13 | 2 |
| | 95th %ile | <0.2 | 59 | 45 | 6 | 560 | 447 | 315 | 870 | 38 | 7 |
| | Max | <0.2 | 60 | 150 | 7 | 651 | 6,690 | 904 | 6,900 | 362 | 16 |

Note no heavy metal data collected for holding tanks

The recent organics screens (Table 3) have identified a limited number of substance present above the limit of detection. The most abundant substances are the BTEX substances (i.e. benzene, toluene, ethylbenzene and xylene) and substituted BTEX which are reported on average at 2 – 13µg/l. These are degradation by-products and are continuously released into both the landfill gas and the leachate whilst the organic content of the waste stabilises.

Some phenolic substances have also been identified within the leachate. Phenolic substances are hydrolysis products from putrescible waste that are rapidly released under acetogenic conditions. These are only present at significant concentrations up until a methanogenic microbial population can develop within fresh wastes. Consequently, as the methanogenic microbial population in the waste mass develops these substances are degraded as rapidly as they form and provide a feedstock for the methanogens. Therefore, there is a limited to negligible permanent presence within the leachate. Acetogenic leachate can be recirculated into the more mature waste cells to optimise landfill gas to energy recovery.

Phenolic substances are generally identified within the Meece landfill leachate at low concentrations (1 – 79µg/l) which is consistent with the establishment of methanogenic conditions across the majority of the site. Higher values (2 – 5mg/l) are reported for LW22 in Phase 6 which contains the relatively younger wastes where methanogenic conditions are not fully established. However, in accordance with the above, the concentrations reported at LW22 are unlikely to be sustained and are unrepresentative of the expected leachate quality for the wider Meece landfill or that to be processed through the RO plant.

The only other organic substance identified within the leachate at a significant concentration is the non-hazardous acid herbicide mecoprop which is reported at up to 47µg/l but on average is below the 18µg/l annual average EQS. Mecoprop is also permanently below its 187µg/l 95$^{th}$ percentile concentration EQS.

The organic substances screens have also identified several other substances at lower concentrations which are on average below the 10µg/l leachate screening threshold including naphthalene, several chlorinated solvents, 2,6-dichlorobenzonitrile, MTBE, dichlorprop and 2,3,6-TBA.

**Table 3 – Meece Landfill Organic Substances (March 2020 to January 2024)**

| Description | | Ave | 95th | Max |
|---|---|---|---|---|
| **BTEX and substituted BTEX** | | | | |
| Benzene | µg/l | 2 | 4 | 5 |
| Toluene | µg/l | 7 | 20 | 22 |
| m and p-xylene | µg/l | 13 | 30 | 36 |
| o-Xylene | µg/l | 3 | 12 | 19 |
| Ethylbenzene | µg/l | 8 | 19 | 23 |
| 1,2,4-Trimethylbenzene | µg/l | 8 | 22 | 32 |
| iso-propylbenzene | µg/l | | | 2 |
| n-propylbenzene | µg/l | 2 | 3 | 3 |
| p-isopropyltoluene | µg/l | 8 | 20 | 23 |
| **Polyaromatic Hydrocarbons** | | | | |
| Naphthalene | µg/l | 7 | 11 | 11 |
| **Phenolic Substances** | | | | |
| Phenol * | µg/l | | | 8 |
| 2-methylphenol * | µg/l | 11 | 24 | 28 |
| 3 & 4-methylphenol * | µg/l | 8 | 29 | 46 |
| 2,4-dimethylphenol | µg/l | 9 | 21 | 79 |
| 4-chlorophenol | µg/l | | | 1.4 |
| 2,4,6-trichlorophenol | µg/l | | | 1.1 |
| **Chlorinated Substances** | | | | |
| Dichloromethane | µg/l | | | 5 |
| Chloroethene | µg/l | 3 | 6 | 7 |
| Chlorobenzene | µg/l | 6 | 13 | 15 |
| 1,4-Dichlorobenzene | µg/l | 2 | 3 | 4 |
| 1,2,3-trichlorobenzene | µg/l | 0.03 | 0.05 | 0.05 |
| **Herbicides and Pesticides** | | | | |
| Mecoprop | µg/l | 14 | 36 | 47 |
| Dichlorprop | µg/l | 0.8 | 1.4 | 1.4 |
| 2,3,6-TBA | µg/l | | | 0.3 |
| **Other** | | | | |
| 2,6-Dichlorobenzonitrile | µg/l | 0.02 | 0.05 | 0.06 |
| MTBE | µg/l | 1.3 | 1.5 | 1.5 |

*Data for LW22 removed – see text for justification. No data collected for holding tanks

In addition to the organics, the annual screens have identified several inorganic substances which are present within the leachate and these are summarised in Table 4.

**Table 4 – Meece Landfill Other Substances (March 2020 to January 2024)**

| Location | | Sb | Mo | Se | B (total) | CN (free) |
|---|---|---|---|---|---|---|
| | | mg/l | mg/l | mg/l | mg/l | mg/l |
| | **EQS** | **0.005** | **0.070** | **0.010** | **2** | **0.001** |
| In-waste wells | Avg | 0.041 | 0.027 | 0.001 | 3.1 | 0.030 |
| | Max | 0.310 | 0.152 | 0.002 | 12.8 | 0.140 |

No data collected for holding tanks
In absence of EQS, DWS used for Se and WHO health standard used for Mo

The ATRF lagoon water is tested for a reduced suite of substance which are summarised in Table 5. The ATRF lagoon water contains lower ammonium, COD and chloride. Sulphate is of a similar concentration to that found within the Meece Landfill leachate. Hence, any input from the ATRF is expected to generally dilute the overall influent to the RO plant.

**Table 5 – Meece Landfill ATRF Drainage Lagoon Matrix Substances Summary (September 2020 - August 2023)**

| | pH | $NH_4$-N | COD | Cl | $SO_4$ | Sus. Solids |
|---|---|---|---|---|---|---|
| | | mg/l | mg/l | mg/l | mg/l | mg/l |
| Ave | 7.5 | 44 | 553 | 1,699 | 107 | 312 |
| 95th %ile | 8.0 | 79 | 1,189 | 4,120 | 298 | 536 |
| Max | 8.0 | 96 | 1,370 | 4,380 | 414 | 680 |

### [2.4.3] Effluent Quality Expectations

The proposed RO plant is not in operation and therefore site specific treated effluent quality is not available. However, the RO plant manufacturer has advised that a 99% concentration reduction in the COD, BOD and ammonium is expected.

RO plants are routinely used at other landfill sites across the UK to treat landfill leachate. In accordance with the Best Available Techniques (BAT) Reference Document for Waste Treatment[3], RO treatment is considered to be BAT. Performance data for RO leachate treatment plants demonstrates that concentrations of 1 – 9mg/l ammoniacal-N and 1 – 15mg/l of BOD[4] are usually achieved. A summary of the expected permeate (effluent) concentration based on existing plants is provided below:

- pH – 6.5 – 8.5
- Ammoniacal-N – 1 to 9mg/l
- BOD – 1 – 15mg/l
- Calcium, magnesium, sodium, potassium, chloride and sulphate – 10mg/l
- Lead, arsenic, cadmium, chromium, copper, nickel, zinc, iron and manganese – 1 – 5μg/l

[3] A. Pinasseau et al. (2018) Best Available Techniques (BAT) Reference Document for Waste Treatment

[4] Environment Agency (2007) Sector Guidance Note IPPC S5.03. Guidance for the Treatment of Landfill Leachate (withdrawn)

- Phenols – 1 - 5mg/l

The final effluent quality will be dependent on the treatment objectives required by the risk assessment. The RO plant will be designed to meet the desired effluent quality.

# [3] Receiving Water

## [3.1] Overview

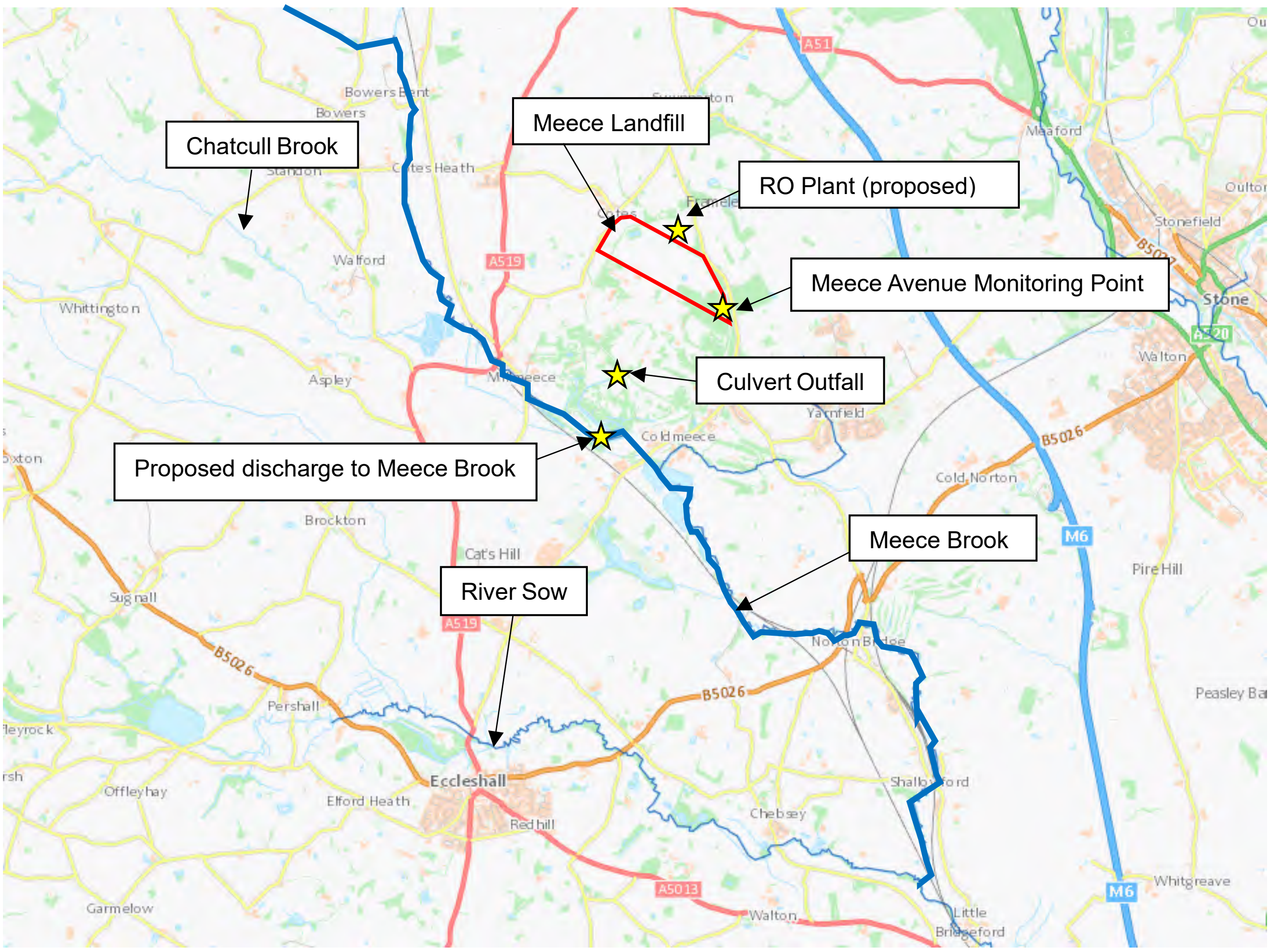
The treated effluent from the RO plant is to be discharged to the Meece Brook which is the closest 'Main River' to the site. The Meece Brook flows from north-west to south-east and is located approximately 1.4km to the south-west of the site at its closest point. Upstream of the site, the Chatcull Brook converges with the Meece Brook at NGR SJ 82848 33606, directly north of Heronbrook Fishing Pools. The Meece Brook joins with the River Sow some 5.8km to the south-east of the Meece Landfill at NGR SJ87384 28201 (Figure 4).

The treated effluent will be discharged via the existing drainage ditch network (which discharges via monitoring point 88902104 'Meece Avenue' as illustrated on Biffa Drawing M4180107) to the Meece Brook. The existing drain captures run-off from the north-east catchment of the site and was in place prior to the development of the landfill site. The drain therefore takes combined flows from both the landfill and other off-site sources.

The flow from the LTP will therefore be 'buffered' by other surface water prior to being discharged to the Meece Brook.

The combined surface water and treated effluent mixture will be discharged to the Meece Brook via a culvert which passes through the Swynnerton Training Area to the south of the site. The culvert is understood to outfall at NGR SJ 84478 33093, with the ultimate discharge point to the Meece Brook at NGR SJ 84388 32477 (Figure 4).

**Figure 4 – Nearby surface watercourses and proposed discharge route**




## [3.2] Meece Brook

### [3.2.1] Receiving Water Flow Rates

The nearest gauging station to the site for the Meece Brook is 28079 - Meece Brook at Shallowford positioned just upstream of the confluence between the Meece Brook and the River Sow (Figure 5). The gauging station is located at NGR SJ 87476 29067 and data for this collected over the period 1981 to 2022 provides a mean flow rate of 0.625$m^3$/s and low flow (Q95) of 0.134$m^3$/s.

In addition to this, river flow monitoring data has been modelled by WHS Limited[5] for the Meece Brook upstream of the proposed discharge point at NGR SJ 83706 32818 (Figure 5). The modelling data indicates a mean annual flow rate of 0.539$m^3$/s and low flow (Q95) of 0.169$m^3$/s. The data for both actual and modelled flow rates is therefore comparable. The flow modelling report is provided in Appendix B.

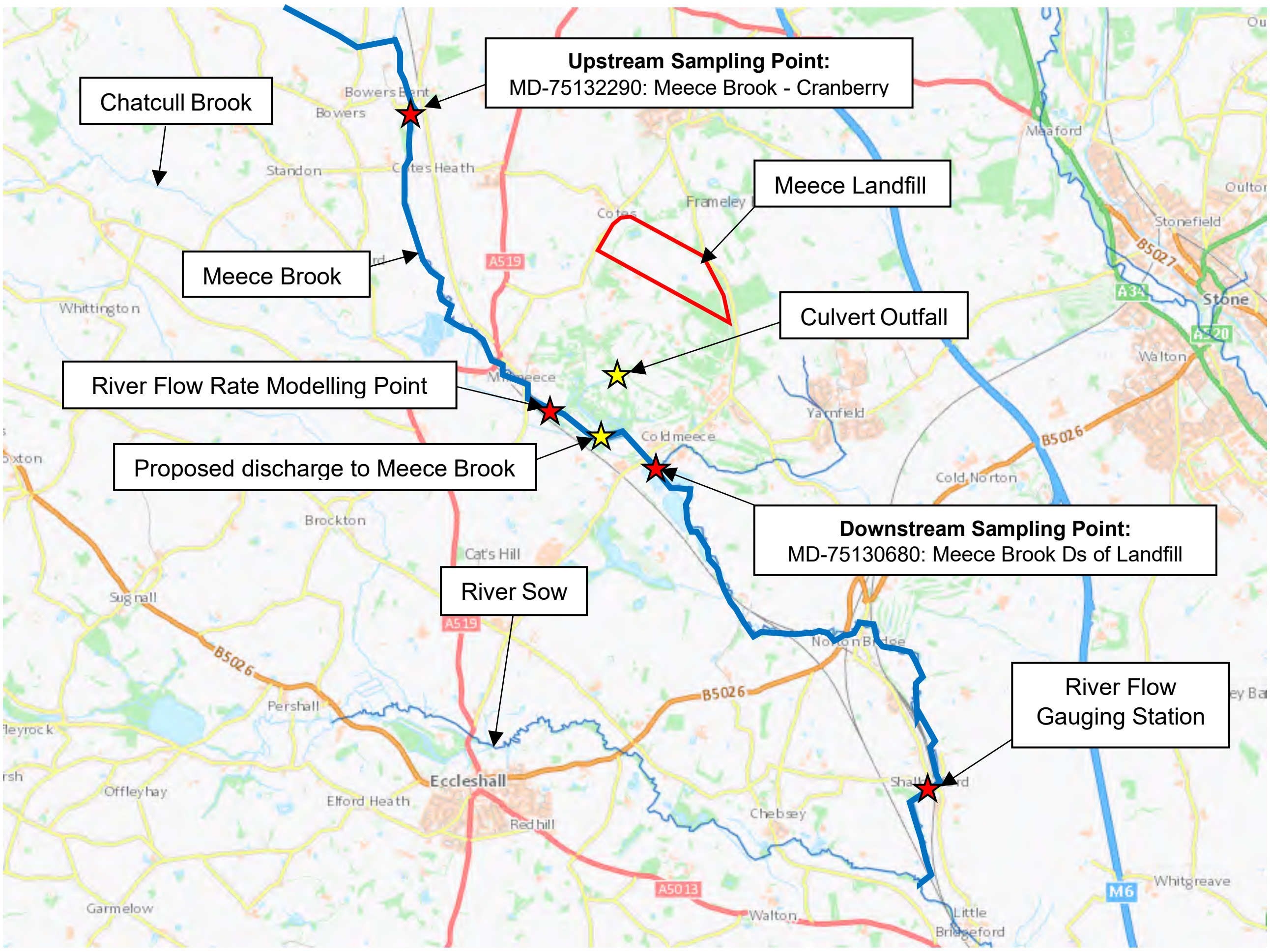


[5] WHS (2024) Flow Estimate for Meece Brook at NGR: 383700, 332850, report ref. Qube Report Q969/24

## [3.2.2] Receiving Water Quality

Water quality data has been obtained for the Meece Brook from the Environment Agency[6] both upstream and downstream of the proposed discharge point (NGR SJ 83706 32818). The locations of the Environment Agency monitoring points are shown on Figure 5.

**Figure 5 – Location of Meece Brook Monitoring Points and Proposed Discharge**




Monitoring upstream of the site is routinely carried out by the Environment Agency on a monthly basis, whilst at the downstream location monitoring is reduced to quarterly (four times per year). The data is summarised in Table 6 below.

Monitoring of the Meece Brook both upstream and downstream of the proposed discharge has also been carried out by Biffa. However, the suite of determinands analysed for is limited and has therefore been excluded. The data is summarised in Table 7. The data is comparable to that reported by the Environment Agency.

[6] https://environment.data.gov.uk/water-quality

**Table 6 - Meece Brook Water Quality Summary (Jan 2017 – Dec 2023), Environment Agency**

| Substance | Unit | Upstream (EA Ref. MD-75132290) | | | Downstream (EA Ref. MD-75130680) | | |
|---|---|---|---|---|---|---|---|
| | | Min | Ave | Max | Min | Ave | Max |
| Temperature | °C | 4.2 | 10.6 | 21.3 | | | |
| Oxygen, dissolved | mg/l | 6.8 | 9.5 | 11.9 | | | |
| pH | pH units | 7.5 | 7.8 | 8.1 | 7.5 | 7.8 | 8.2 |
| Electrical Conductivity | µS/cm | 335 | 561 | 673 | | | |
| Dissolved Organic Carbon (DOC) | mg/l | | | | 0.9 | 6.2 | 12.0 |
| Biological Oxygen Dissolved (BOD) | mg/l | 1.1 | | 1.90 | | | |
| Ammoniacal-N | mg/l | 0.03 | 0.15 | 1.70 | | | |
| Total Oxidised Nitrogen (as N) | mg/l | 3.7 | 7.8 | 11.0 | | | |
| Nitrite | mg/l | 0.03 | 0.06 | 0.16 | | | |
| Orthophosphate, reactive as P | mg/l | 0.06 | 0.14 | 0.31 | | | |
| Calcium | mg/l | | | | 55 | 104 | 146 |
| Magnesium | mg/l | | | | 14 | 26 | 35 |
| Alkalinity | mg/l | 140 | 195 | 230 | | | |
| | | | | | | | |
| Lead (dissolved) | µg/l | | | | 0.10 | 0.13 | 0.24 |
| Lead (bioavailable) | µg/l | | | | 0.01 | 0.02 | 0.05 |
| Nickel (dissolved) | µg/l | | | | 0.50 | 0.97 | 1.90 |
| Nickel (bioavailable) | µg/l | | | | 0.08 | 0.27 | 0.40 |
| Zinc (total) | µg/l | | | | 5.0 | 7.4 | 12.9 |
| Zinc (dissolved) | µg/l | | | | 1.9 | 4.2 | 7.7 |

**Notes:** Blank cells = no data
No data for upstream monitoring point during March 2017 to March 2019 and September 2021 to March 2023.
No data for downstream monitoring point during February 2020 to April 2023

**Table 7 - Meece Brook Water Quality Summary (Oct 2017 – Jan 2024), Biffa**

| | Unit | Upstream | | | Downstream | | |
|---|---|---|---|---|---|---|---|
| | | Min | Ave | Max | Min | Ave | Max |
| pH | pH units | 7.6 | 8.0 | 8.4 | 7.6 | 8.0 | 10.4 |
| Electrical Conductivity | µS/cm | 308 | 637 | 3620 | 309 | 665 | 954 |
| Ammoniacal-N | mg/l | 0.06 | 0.21 | 1.56 | 0.06 | 0.22 | 1.92 |
| Chloride | mg/l | 16 | 29 | 57 | 16 | 32 | 49 |
| Cadmium (Total) | µg/l | 0.1 | 0.5 | 2.2 | 0.1 | 0.5 | 0.7 |
| O-Xylene | µg/l | 0.1 | 0.1 | 1.0 | 0.1 | 0.1 | 1.0 |
| 2,4-Dimethylphenol | µg/l | 0.1 | 0.5 | 20.0 | 0.1 | 0.5 | 20.0 |

# [4] Risk Assessment

## [4.1] Overview

The risk assessment has been carried out to assess the impact of the proposed discharge on the receiving watercourse with reference to the following Environment Agency guidance:

- Environment Agency (2014) LIT 10419 Modelling: surface water pollution risk assessment risk assessment[7];
- Environment Agency (2014) H1 Annex D2. Assessment of sanitary and other pollutants within Surface Water Discharges[8];
- Environment Agency (2016) Guidance: Risk assessments for your environmental permit (updated 21st November 2023)[9]; and;
- Environment Agency (2016) Surface water pollution risk assessment for your environmental permit (updated 25th February 2022)[2].

The assessment does not take into account water from the sites wider surface water management system or that which enters the historic system from the north of the site.

The assessment has been carried out in accordance with the Environment Agency's online guidance on 'Surface water pollution risk assessment for your environmental permit'. This guidance sets out the following steps for assessing a potential discharge:

1. Evaluate and assess any hazardous chemicals (specific substances) and elements you plan to release into surface water.
2. Carry out screening tests on these substances to check if they're a risk to the environment also known as a 'specific substances assessment'. The methodology for completing the screening tests is set out in more detail in Section 0 below.
3. If your screening tests show there's a risk to the environment *i.e.* substances do not pass the initial screening tests, then further modelling may be required.
4. Additional screening is required for all priority hazardous pollutants, even if the pollutants were screened out during the specific substances assessment. This additional screening involves a comparison of the annual limit of pollutants you discharge with the 'significant load limit' set by the Environment Agency. The methodology for completing the significant load assessment is set out in more detail in Section [4.1.2] below.

[7] Environment Agency (2014) LIT 10419 Modelling: surface water pollution risk assessment risk assessment
[8] Environment Agency (2011) Horizontal Guidance Note H1 – Environmental Risk Assessment for Permits. Annex (d) Surface Water Discharges (basic) with Environment Agency (2014) H1 Annex D2. Assessment of sanitary and other pollutants within Surface Water Discharges; and the 2016 update accessed at https://www.gov.uk/guidance/surface-water-pollution-risk-assessment-for-your-environmental-permit
[9] Environment Agency (2016) Guidance: Risk assessments for your environmental permit accessed at https://www.gov.uk/guidance/risk-assessments-for-your-environmental-permit

### [4.1.1] Specific Substances Assessment Methodology

The risk assessment process is a mechanism which applies a series of steps to screening and determining the significance of a potential emission taking into account the loading of individual substances onto a receiving water course, background water quality, flow and mixing within the receiving watercourse. The objective of the risk assessment is to identify where an emission of a substance would have an unacceptable impact (measured against EQS).

The risk assessment consists of up to 4 tests or steps that assess whether or not the effluent is a risk to the environment. Each step is designed to screen out substances which are not considered to pose an environmental risk and these substances are not then carried forward to the next step.

**Test 1**

The initial step (Test 1) is to assess whether the concentration of the pollutant in the discharge is more than 10% of the Environmental Quality Standard (EQS). If the discharge concentration is less than 10% of the EQS, then the substance is not considered to be a risk to the environment. If the pollutant is present at a concentration greater than 10% of the EQS, you must carry out test 2.

**Test 2**

The second step (test 2) introduces the dilution available in the receiving water. It involves checking if the process contribution (diluted concentration) of the pollutant is more than 4% of the EQS. The process contribution is calculated using Equation 1 below:

$$PC = \frac{EFRxRC}{EFR+RFR} \qquad \text{(Equation 1)}$$

The process contribution calculation provides a methodology for estimating the concentration in the receiving surface water course independent of other contributions, whether agricultural, industrial or municipal. The environmental significance of the release can therefore be established by a direct comparison with relevant Environmental Quality Standards (EQS). A process contribution of <4% of a substances EQS level will have a negligible contribution to the environmental quality of a receiving watercourse. If the PC is 4% or less of the EQS, further assessment is not required.

**Test 3**

The third step is to check whether the discharge increases the concentration of the pollutant in the river downstream of the discharge by more than 10% of the chemicals EQS value. This is calculated by adding the PC (process contribution) to the BC (background concentration) in order to calculate the PEC (predicted environmental concentration). Where the discharge is larger (>10% of river flow rate) the PEC is calculated using Equation 2 below:

$$PEC = \frac{(RFRxBC) + (EFRxRC)}{EFR+RFR} \qquad \text{(Equation 2)}$$

If the difference between BC and PEC is less than 10% of the EQS, you should proceed to carry out test 4.%

**Test 4**

The final step is to check whether the PEC (predicted environmental concentration) is higher than the EQS. If it is, further modelling will be required.

### [4.1.2] Significant Load Assessment

The Environment Agency's guidance sets out the following approach for assessing 'significant loads' of hazardous substances:

- Calculate the significant load by
  - multiplying the average discharge concentration (mg/l) by the average flow (litres per day) to derive a mg/day value followed by
  - dividing the result by 1,000,000,000 to convert mg/day to kg/day
  - multiplying the result by 365 to give kg/year
- If the calculated load is less than the significant load limit for the substance and the substance passed the screening tests then no further assessment is required.
- If the calculated load is more than the significant load limit[2] for the substance then the assessment is repeated using cleaned up data.

**Methodology for 'cleaning up' data**

To 'clean up' the data, the number of samples in assessment period which have exceeded the minimum reporting value (MRV) is reviewed. If a minimum number (as set out by the Environment Agency) of samples do not exceed the MRV, the pollutant is not a risk to the environment and assessment is not required.

The Environment Agency also recommend that the following steps are taken:

- Check whether there are significant changes in the data over a period of time;
- Select a time period which reflects the current discharge quality even if this means using less than 3 years' data (a minimum of 12 samples should however be used);
- Consider uneven spread *e.g.* seasonality.
- Check your data for 'outliers'.

## [4.2] Specific Substances Assessment (Screening Tests)

### [4.2.1] Substances to be assessed

The leachate treatment plant has not yet been installed. However, information on the expected discharge quality is readily available from existing plants and is summarised in Section [2.4] above. To determine the risk-based emission limits for the proposed effluent, the screening assessment has been carried out to 'back calculate' a worst-case concentration which needs to be achieved to meet Test 3 and hence is considered to be insignificant.  This levels have then been used to specify the treatment requirement for the RO plant.

In order to carry out this assessment, representative substances have been used and justification for the use of these is summarised in Table 8 below. Utilising these representative substances will ensure that the watercourse is protected against significant contributions from all substances which may be present within the treated effluent.

**Table 8 - Representative substances to be assessed**

| Representative substance | Justification |
|---|---|
| Ammoniacal-N | Ammoniacal-N is expected to be reduced to less than 10mg/l. Given the ammoniacal-N is expected to be above the 0.6mg/l EQS for a good water quality within the discharge, an assessment of this substance is required. |
| BOD | BOD is expected to be reduced to less than 15mg/l. Given the BOD may be above the 5mg/l EQS for a good water quality within the discharge, an assessment of this substance is required. |
| Chloride and sulphate | Calcium, magnesium, sodium, potassium, chloride and sulphate are expected to be reduced to environmentally insignificant concentrations and there will be no potential for these substances to have a discernible influence on the receiving watercourse.<br><br>Given that chloride and sulphate are the only substances with Environmental Quality Standards (EQS) assigned, these have been included within the assessment. |
| Mercury | Mercury is consistently reported below the limit of detection (LOD) and has not been identified within the raw leachate. Therefore, further assessment of this substance is not considered necessary as it could not be identified at discernible concentrations following treatment and then discharge.<br><br>Nevertheless, it has been included within the screening tests to provided further confidence. |
| Lead | Lead (total) is typically reported below the limit of detection within the leachate which varies between <0.3µg/l and <6µg/l. Lead (total) has been identified above the limit of detection on 19 occasions of 81 visits over the period 2020 to 2023.<br><br>The most recent screen in December 2023 demonstrated that lead (total) was below the limit of detection across the site (at <3µg/l). Hence, lead is unlikely to be environmentally significant within the discharge; particularly given that the EQS for this substance relates to the bioavailable fraction and not the 'total' concentration. Therefore, further assessment of this substance is not considered necessary.<br><br>Nevertheless, it has been included within the screening tests to provided further confidence. |
| Arsenic | Arsenic (total) is reported in the raw leachate at a 95$^{th}$ %ile conc. of 45µg/l which is below the annual average EQS. Arsenic is therefore unlikely to be present at environmentally significant concentrations within the treated leachate. Therefore, further assessment of this substance is not considered necessary.<br><br>Nevertheless, it has been included within the screening tests to provided further confidence. |
| Cadmium | Cadmium is reported in the raw leachate at a 95$^{th}$ %ile conc. of 0.1µg/l which is below the annual average EQS. Cadmium has only been identified above the limit of detection on 9 occasions of 81 visits and is unlikely to be present at environmentally significant concentrations within the leachate. Therefore, further assessment of this substance is not considered necessary.<br><br>Nevertheless, it has been included within the screening tests to provided further confidence. |
| Chromium, copper, nickel, zinc, iron and manganese | Chromium, copper, nickel, zinc, iron and manganese are all present within the raw leachate but are expected to be reduced to low concentrations (1 – 5µg/l) following treatment. All of these substances have all been included within the screening assessment. |
| Antimony, boron and free cyanide | Antimony, molybdenum, selenium, boron and free cyanide have all been identified within the raw leachate but are expected to be reduced to environmentally insignificant concentrations following treatment within the RO plant. |

| Representative substance | Justification |
|---|---|
| | Given that tin, boron and free cyanide are the only substances with Environmental Quality Standards (EQS) assigned, these have been included within the assessment. |
| Benzene, toluene, ethylbenzene, xylene, phenol, naphthalene and mecoprop | The organic substances screens have identified a range of substances identified at low concentrations within the raw leachate which are typically (on average) below 10µg/l.<br><br>Representative substances from each grouping have been included within the screening assessment; namely benzene, toluene, ethylbenzene, xylene, phenol, naphthalene and mecoprop. |

### [4.2.2] Calculation of Predicted No-Effect Concentration for Bioavailable Metals

The EQS values for copper, nickel, zinc, manganese and lead relate to the bioavailable concentration. The UK Technical Advisory Group (UKTAG) for WFD[10] note that the EQS values for many metals were developed based on the biotoxicity of those metals, which was at the time thought to be controlled primarily through the hardness of the water. It is now known that a number of other water quality parameters control the biotoxicity and bioavailability of metals within the water, namely pH and dissolved organic carbon (DOC).

The UKTAG have therefore developed a tool (MBAT – Metal Bioavailability Assessment Tool) for calculating a site specific EQS value for some of these substances based on the pH, DOC and calcium concentrations of the waterbody. The M-BAT reports this as a Predicted No-Effect Concentration (PNEC), which is the Biotic Ligand Modelled concentration derived from ecotoxicological data and site-specific data.

PNEC values have been derived using the m-BAT tool for copper, nickel, zinc, lead and manganese within the Meece Brook and these are presented in Table 9 below. These PNEC values have been utilised within the screening assessment.

**Table 9 –m-BAT Calculated Metal PNEC for Meese Brook**

| Determinand | Meece Brook dissolved PNEC (µg/l) | Annual Average Bioavailable EQS (µg/l) |
|---|---|---|
| Lead | 7.44 | 1.2 |
| Copper | 24.20 | 1 |
| Nickel | 14.42 | 4 |
| Zinc | 32.19 | 10.9 |
| Manganese | 323.36 | 123 |

[10] WFD-UKTAG 2014, UKTAG River and Lake Assessment Method Specific Pollutants (Metals): Metal Bioavailability Assessment Tool (M-BAT)

The PNEC values have been calculated using the downstream water quality data summarised in Table 6 *i.e.*:

- pH at 7.8
- DOC at 6.2mg/l
- Calcium at 104mg/l

The m-BAT tool for copper, nickel, zinc, lead and manganese is provided in Appendix C.

### [4.2.3] Screening Approach and Results

The screening assessment calculations are based on the following conditions:

- A discharge rate to surface water of 0.0017$m^3/s$ (150$m^3$ per day), which represents the maximum discharge throughput through the leachate treatment system;
- An annual low flow (Q95) rate of 0.134$m^3/s$ which is the lower value of the measured and modelled flow rates for the Meece Brook; and
- Typical (average) background concentrations of substances within the Meece Brook (Table 6) or 10% of the EQS if no data is available.

This gives a dilution factor of 78. The screening approach is considered to be conservative as the permeate discharge volume will be considerably lower (circa. 100$m^3$/day) and the RO plant will discharge all year round (*i.e.* across all flow conditions). The risk assessment is therefore considered to be more conservative than the realistic 'worst-case' scenario.

The back calculated 'maximum allowable concentrations' (MAC) to meet Test 3 are set out in Table 10 and Table 11. The MAC values below establish the effluent quality requirements for the proposed RO plant. The H1 screening assessment calculations are provided in Appendix C.

**Table 10 – Surface Water Risk Assessment Back-calculation Results for Matrix and Other Priority Metals under Meece Brook low flow (Q95) conditions**

| Substance | MAX RC (mg/l) | BC (mg/l) | PC (mg/l) | PEC (mg/l) | EQS (mg/l) | Test 1 | Test 2 | Test 3 |
|---|---|---|---|---|---|---|---|---|
| **Major Components** | | | | | | | | |
| Ammoniacal-N | 4.80 | 0.15 | 0.06 | 0.21 | 0.6 | 800% | 10% | Pass |
| BOD | 39 | 0.5 | 0.5 | 1.0 | 5 | 780% | 10% | Pass |
| Chloride | 1,970 | 29 | 26 | 54 | 250 | 788% | 10% | Pass |
| Sulphate | 3,150 | 40 | 41 | 80 | 400 | 788% | 10% | Pass |
| **Metals** | | | | | | | | |
| Mercury (AA EQS) | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| Mercury (MAC EQS) | 0.0006 | 0.00001 | 0.00001 | 0.00001 | 0.00007 | 786% | 10% | Pass |
| Cadmium (AA EQS) | 0.0019 | 0.00003 | 0.00002 | 0.00005 | 0.00025 | 760% | 10% | Pass |
| Cadmium (MAC EQS) | 0.012 | 0.00015 | 0.00015 | 0.0003 | 0.0015 | 767% | 10% | Pass |
| Chromium (AA EQS) | 0.037 | 0.0005 | 0.0005 | 0.0009 | 0.0047 | 787% | 10% | Pass |
| Chromium (MAC EQS) | 0.250 | 0.0032 | 0.0032 | 0.0064 | 0.032 | 781% | 10% | Pass |
| Copper (dissolved) | 0.190 | 0.0024 | 0.0025 | 0.0048 | 0.0242 | 785% | 10% | Pass |
| Nickel (dissolved) | 0.113 | 0.0010 | 0.0015 | 0.0024 | 0.0144 | 784% | 10% | Pass |
| Lead (dissolved) | 0.058 | 0.0001 | 0.0008 | 0.0009 | 0.0074 | 780% | 10% | Pass |
| Zinc (dissolved) | 0.254 | 0.0042 | 0.0033 | 0.0074 | 0.0322 | 789% | 10% | Pass |
| Manganese (dissolved) | 2.5 | 0.0323 | 0.0324 | 0.0639 | 0.3234 | 773% | 10% | Pass |
| Iron | 7.8 | 0.1000 | 0.1011 | 0.1985 | 1 | 780% | 10% | Pass |
| **Other** | | | | | | | | |
| Antimony | 0.039 | 0.0005 | 0.0005 | 0.0010 | 0.005 | 780% | 10% | Pass |
| Molybdenum | 0.550 | 0.0070 | 0.0071 | 0.0139 | *0.070 | 786% | 10% | Pass |
| Selenium | 0.078 | 0.0010 | 0.0010 | 0.0020 | *0.010 | 780% | 10% | Pass |
| Boron | 15.7 | 0.2000 | 0.2034 | 0.3983 | 2 | 785% | 10% | Pass |
| Cyanide (free) (AA EQS) | 0.008 | 0.0001 | 0.0001 | 0.0002 | 0.001 | 760% | 10% | Pass |
| Cyanide (free) (MAC EQS) | 0.039 | 0.0005 | 0.0005 | 0.0010 | 0.005 | 780% | 10% | Pass |
| Orthophosphate | 1.0 | 0.1400 | 0.0130 | 0.1510 | 0.12 | 833% | 11% | Pass |

Notes: MAX RC = Calculated Maximum allowable release concentration required to pass Test 3 under low flow conditions
AA EQS = Annual Average Environmental Quality Standard used
MAC EQS = Maximum Allowable Concentration Environmental Quality Standard used
BC = background concentration OR if no background data available then 10% of EQS used (as per guidance)
*In absence of EQS, DWS used for Se and WHO health standard used for Mo

**Table 11 – Surface Water Risk Assessment Back-calculation Results for Organic Substances under Meece Brook low flow (Q95) conditions**

| Substance | MAX-RC (µg/l) | BC (µg/l) | PC (µg/l) | PEC (µg/l) | EQS (AA) (µg/l) | Test 1 | Test 2 | Test 3 |
|---|---|---|---|---|---|---|---|---|
| Benzene | 78 | 1.0 | 1.0 | 2.0 | 10 | 780% | 10% | Pass |
| Toluene | 580 | 7.4 | 7.5 | 14.7 | 74 | 784% | 10% | Pass |
| Ethylbenzene | 580 | 7.4 | 7.5 | 14.7 | 74 | 784% | 10% | Pass |
| Xylene | 234 | 1.0 | 3.0 | 1.0 | 30 | 780% | 10% | Pass |
| Phenol | 60 | 0.8 | 0.8 | 1.5 | 8 | 779% | 10% | Pass |
| Naphthalene | 15 | 0.2 | 0.2 | 0.4 | 2 | 750% | 10% | Pass |
| Mecoprop | 140 | 1.8 | 1.8 | 3.6 | 18 | 778% | 10% | Pass |
| | | | | | EQS (MAC) (µg/l) | | | |
| Benzene | 390 | 5.0 | 5.1 | 9.9 | 50 | 780% | 10% | Pass |
| Toluene | 3000 | 38.0 | 38.9 | 75.9 | 380 | 789% | 10% | Pass |
| Ethylbenzene | 3000 | 38.0 | 38.9 | 75.9 | 380 | 789% | 10% | Pass |
| Xylene | n/a | n/a | n/a | n/a | n/a | n/a | n/a | Pass |
| Phenol | 360 | 4.6 | 4.7 | 9.1 | 46 | 783% | 10% | Pass |
| Naphthalene | 1020 | 13.0 | 13.2 | 25.9 | 130 | 785% | 10% | Pass |
| Mecoprop | 1450 | 18.7 | 18.8 | 37.0 | 187 | 775% | 10% | Pass |

Notes: MAX-RC = Maximum allowable release concentration to pass Test 3 under low flow conditions
EQS (AA) = Annual Average Environmental Quality Standard used
EQS (MAC) = Maximum Allowable Concentration Environmental Quality Standard used
BC = background concentration OR if no background data available then 10% of EQS used (as per guidance)

A comparison of the typical raw leachate quality and required effluent quality to meet Test 3 of the Environment Agency's 'specific substances assessment' is set out within Table 12. This comparison demonstrates that the majority of substances identified within the raw leachate are at concentrations which do not pose a significant risk to the Meece Brook, even without prior treatment. Hence, there is not a requirement to set Permit limits for these substances.

Permit limits are however recommended for ammoniacal-N, BOD, chloride, chromium, iron and free cyanide. Permit limits are set out within Section [5] below along with justification for these limits.

### Table 12 – Comparison of Leachate Quality, required Effluent Quality and EQS

| Substance | Average Leachate Quality (mg/l) | MAX-RC to Pass Test 3 (mg/l) | EQS (mg/l) |
|---|---|---|---|
| Ammoniacal-N | 830 | 4.8 | 0.6 |
| BOD | 157 | 39 | 5 |
| Chloride | 4,187 | 1,970 | 250 |
| Sulphate | 150 | 3,150 | 400 |
| Mercury | <0.0002 | 0.0006 | 0.00007 |
| Cadmium | 0.001 | 0.0019 | 0.00025 |
| Chromium | 0.092 | 0.037 | 0.0047 |
| Copper | 0.111 | 0.190 | 0.0242 |
| Nickel | 0.096 | 0.113 | 0.0144 |
| Lead | 0.010 | 0.058 | 0.0074 |
| Zinc | 0.284 | 0.254 | 0.0322 |
| Manganese | 2 | 2.5 | 0.3234 |
| Iron | 13 | 7.8 | 1 |
| Antimony | 0.041 | 0.039 | 0.005 |
| Molybdenum | 0.027 | 0.550 | 0.070 |
| Selenium | 0.001 | 0.078 | 0.010 |
| Boron | 3.1 | 15.7 | 2 |
| Cyanide (free) | 0.030 | 0.008 | 0.001 |
| Orthophosphate | - | 1.0 | 0.120 |
| Benzene | 0.002 | 0.078 | 0.010 |
| Toluene | 0.007 | 0.580 | 0.074 |
| Ethylbenzene | 0.008 | 0.580 | 0.074 |
| Xylene | 0.016 | 0.234 | 0.030 |
| Phenol | 0.011 | 0.060 | 0.008 |
| Naphthalene | 0.007 | 0.015 | 0.002 |
| Mecoprop | 0.014 | 0.140 | 0.018 |

Notes: MAC is for annual average EQS, apart from mercury which is assigned a MAC only.
Shaded cells are substances for which the raw leachate concentration is lower than or equivalent to the MAC at source and hence there is not considered to be a risk to the Meece Brook following treatment
For bioavailable metals, the leachate quality is reported as Total whilst the MAX-RC and EQS relates to the dissolved fraction

## [4.3] Significant Loads Assessment

The significant load assessment applies to all priority hazardous substances (PHS) which are expected to be present within the effluent discharge. The annual significant load limits for priority hazardous substances are summarised in Table 13.

Of the PHS substances listed, only cadmium has been identified as being present within the leachate and therefore could be identified within the discharge. No other PHS with a specified load limit have been identified within the leachate.

**Table 13 – Annual significant load limits**

| Pollutant | Annual significant load limit in kg |
|---|---|
| Anthracene | 1 |
| Brominated diphenyl ether | 1 |
| Cadmium | 5 |
| Chloroalkanes C10-13 | 1 |
| Dioxins | 0.0001 |
| Endosulphan | 1 |
| Hexachlorobenzene | 1 |
| Heptachlor | 1 |
| Hexachlorobutadiene | 1 |
| Hexachloro-cyclohexane | 1 |
| Mercury and its compounds | 1 |
| Nonylphenol (4-Nonylphenol) | 1 |
| Pentachlorobenzene | 1 |
| Polycyclic aromatic Hydrocarbons (PAHs) | 5 |
| Tributyltin compounds (Tributylin-cation) | 1 |

A forward and back calculation has also been undertaken to determine a significant load limit from the threshold, and then compare that with the site's actual leachate content.

In order for the cadmium annual significant load limit of 5kg to be exceeded a concentration of 0.091mg/l would need to be discharged at the proposed discharge rate:

- Discharge Rate = 150 $m^3$/day or 54,750,000 L/annum
- Cadmium Load Limit = 5kg or 5,000,000mg
- Cadmium concentration Limit = 54,750,000 / 5,000,000
  = 0.091mg/l (or 91µg/l)

This is some 90x more than is currently identified within the raw leachate (0.001mg/l on average). Hence, cadmium does not pose a risk to the Meece Brook.

# [5] Proposed Surface Water Discharge Emissions Limits

In order to protect the Meece Brook it is proposed that the Permit limits set out in Table 14 are applied to the discharge at NGR SJ 85075 34335. This is the treated effluent sampling point prior to discharge into the surface water management system.

The Permit limits are set at a level above which the discharge could be considered as not insignificant with regards to the impact on the Meece Brook. The Permit limits are the MAX-RC concentration under low flow conditions as detailed in Section [4.2.3] of this report. A flow limit of 150m$^3$/day will also be required.

**Table 14 – Proposed Permit Limits at NGR SJ 85075 34335**

| Substance | Proposed Permit Limit under low flow conditions |
|---|---|
| | mg/l |
| Ammoniacal-N | 4.8 |
| BOD | 39 |
| Chloride | 1,965 |
| Chromium | 0.037 |
| Iron | 7.8 |
| Free Cyanide | 0.008 |
| Orthophosphate | 1.0 |
| Suspended Solids | 60 |
| Visible Oil and Grease | None visible |

It is proposed that a monthly spot sample is carried out at the discharge point to confirm that the discharge meets the above permit limits. The inputs to the RO plant are well characterised and the RO process is expected to produce a consistent effluent quality. Hence, the increased frequency of daily for several substances, as set out within the European Commission's 2018 Best Available Techniques Reference (BREF) Document[11], is not considered necessary. The BREF document states that '*monitoring frequencies may be reduced if the emission levels are proven to be sufficiently stable*'.

Further details on monitoring arrangements are set out within the accompanying Best Available Techniques (BAT) assessment[12].

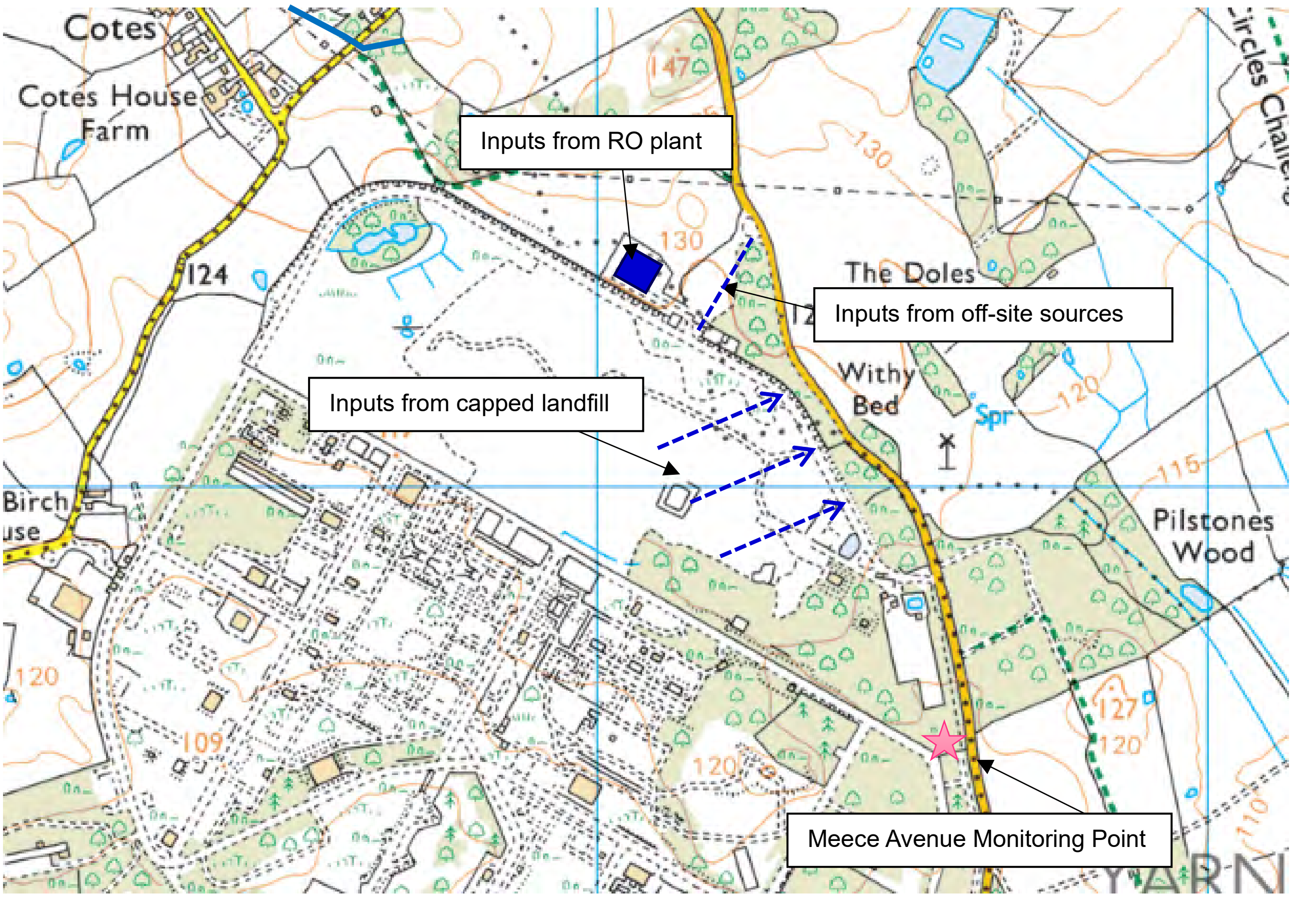
In addition to the above, changes are required to Permit Table S3.2 which sets out point source emissions to water (other than sewer). Permit Table S3.2 sets out permit limits for emissions points

[11] A. Pinasseau et al. (2018) Best Available Techniques (BAT) Reference Document for Waste Treatment https://eippcb.jrc.ec.europa.eu/sites/default/files/2019-11/JRC113018_WT_Bref.pdf
[12] Ayesa (2024) Meece RO Plant BAT Assessment. Report ref. K6094-ENV-R004

2100 (SW discharge), 2101 (Birch House Road), 2102 (Coats Avenue), 2103 (Horsley Way) and 2104 (Meece Avenue).

However, monitoring point 2104 (Meece Avenue) will receive a combination of waters comprising of surface water run-off from the capped landfill, treated effluent from the RO plant and surface water from offsite sources (Figure 6). Hence, the existing permit limits are not considered appropriate and should be removed.

**Figure 6 – Location of Meece Avenue Monitoring Points and Contributions**



# [6] Summary

Biffa are proposing to implement a RO treatment at Meece Landfill in order to improve their leachate and contaminated surface water run-off management capacity. The RO plant will allow the Operator to produce a treated effluent which can be discharged directly to the environment (*i.e.* the Meece Brook). There will be no environmental benefit to discharging the treated effluent to the sewer network via the on-site connection as this would offer no further treatment and increase stress under the receiving works, particularly under higher flow conditions at the receiving works.

There is a sewer connection on site however the existing TEDC is too restrictive to be used to discharge untreated leachate due to a limited capacity at the works. Hence, there is a dual benefit to implementing RO treatment as it would allow for two routes for disposal. However, given that wastewater treatment works are currently struggling for capacity nationwide, and the RO plant will achieve a better final effluent quality, then it would seem environmentally beneficial to discharge the treated effluent to the nearby Meece Brook.

This assessment has been carried out to determine the potential impact on the Meece Brook from the proposed treated discharge and potential specification requirements. The assessment demonstrates that there are a limited number of substances present within the leachate at Meece Landfill which have the potential to cause a discernible impact on the watercourse following treatment.

Permit limits have been proposed for ammoniacal-N, BOD, chloride, chromium, iron and free cyanide to prevent significant deterioration of the receiving water. These are based on a back-calculation to meet Test 3 of the Environment Agency's specific substances "H1" assessment methodology.

# Appendix A. Reverse Osmosis Plant Specification and Drawings

## Appendix B. LowFlows Modelling Report



# Appendix C. Surface Water Screening Tests

# Appendix D. Leachate Monitoring Data