Schedule 5 Response (8/07/24) - Lower Hare Farm Application number: EPR/LB3502HT/A001

Controlled Waters Response

1. *Provide an updated HRA reflective of:*
    a) the current design of the site (geological barrier in Phase 1),
    b) the waste acceptance criteria for restoration soils
    c) including assessment of the pathway via lateral seepage from the site (toe of slope) to the surface water environment.
    d) Include assessment of risks to the abstraction located at West Town Farm located approximately 200m from site boundary.
    e) Consider the effect of the fault located along the western boundary.
    f) Provide a water balance for the site using the likely properties of the cohesive soils used for the geological barrier and the sensitivity of the water balance to this parameter.

    Reason: The HRA does not accurately reflect the current design of the site. There are discrepancies between reports with respect to the permeability of the underlying sediments such that additional pathways may exist. An assessment in line with the conceptual model is required to demonstrate the site can achieve compliance with Schedule 22 of the EPR.

1a) The existing HRA considered a site basal area of 6.45 ha, with a cell surface area of 6.72 ha. This area was indicated in Figure 2 of the HRA. Section 4.1 describes the source used in the HRA and states that

to add conservatism to this risk assessment it is assumed that all inert waste used in Phases 1 to 3 will constitute the source.

Therefore, no change is required to the size, or thickness of the area modelled in the HRA.

The landfill is modelled as one cell with a geological barrier, so a geological barrier has been modelled across all of Phases 1 to 3. The retardation properties of the geological barrier have been set to a half the value of those modelled for the unsaturated zone. This is to acknowledge that although the material is cohesive and compacted, it may not attenuate to the same degree as the in situ natural ground.

1b) Restoration soils comprise subsoil and topsoil. Subsoil will meet inert waste criteria as for the rest of the landfill and this is covered by modelling within the existing HRA. The uppermost restoration layer will include topsoil, which is not inert. The risks associated with the use of topsoil across the whole site have been assessed within the Restoration Plan submitted with the original application.

The Restoration Plan notes that chloride, sulphate and ammoniacal nitrogen are the three determinands most likely to be higher in concentration in topsoil than in inert waste. It is proposed that in order to prevent deterioration in surface water quality adjacent to the site, leaching criteria for topsoil should be limited as follows:

Determinand	Average leachability (mg/l)	95th percentile leachability (mg/l)
Chloride	113.32	339.96
Sulphate	104.68	314.04
Ammoniacal Nitrogen	4.6	13.8

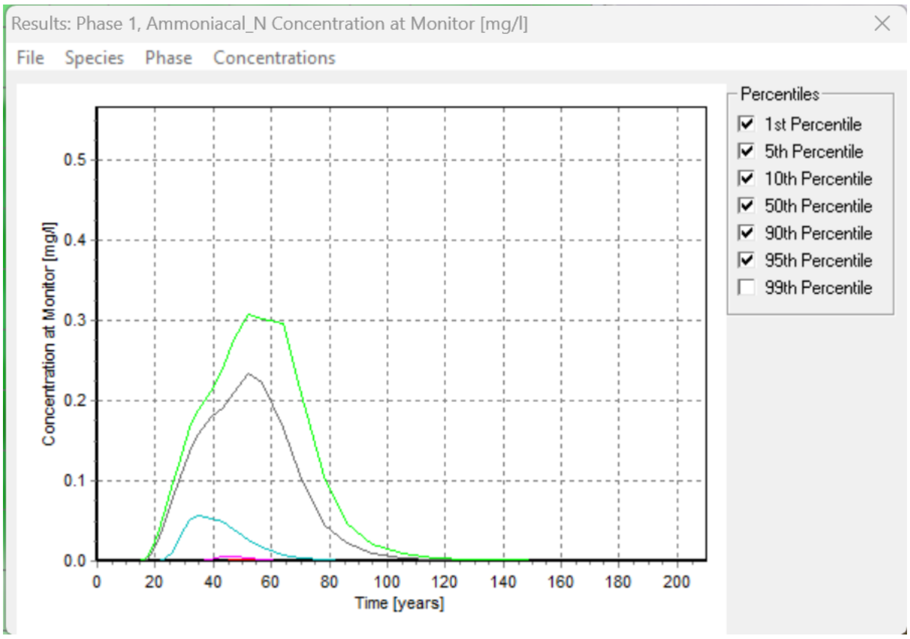
The source modelled in Landsim includes

- Chloride @ 460 mg/l (Co concentration)
- Sulphate @ Tri (100, 250, 400) mg/l, refer to section 5.8.2 of HRA

These modelled concentrations are greater than the average and 95th percentile for topsoil leachability and therefore, no further assessment is required.

The Landsim model has also been run with ammoniacal nitrogen added to the source concentration at Tri (0.02, 4.6, 13.8) mg/l. It is noted that this must be applied across the whole area and thickness of the waste deposit. This is very conservative as the topsoil will represent only the top 0.5m of the source material. The likelihood of impact in practice should be no greater than from agricultural activities in the surrounding fields.

Results indicate a maximum concentration of 0.3mg/l at the monitor well.



1c) Lateral seepage from the wastes requires a build up of leachate. See 1f. The water balance within the HRA does not indicate a build up of leachate. The HRA includes an assessment of emissions to surface water in section 5.9.

The Landsim modelling has indicated that there is unlikely to be exceedance of the EQS in the groundwater on the downgradient boundary of the site. If groundwater seepage enters the tributary stream there will be further dilution and therefore, the EQS is even less likely to be exceeded

A revised water balance, see answer to 1f) indicates that a build up of leachate at the base of the site is unlikely to occur at permeabilities of 1 x10^{-7} m/s as required for an inert landfill. The permeability of the basal liner would need to be lower than 1 x 10^{-8} m/s for infiltration to exceed basal seepage and then a head build up would increase the hydraulic gradient in turn increasing the rate of basal seepage and reducing the head. With a liner permeability of 5 x10^{-9} m/s leachate head is unlikely to build up more than 1m above the liner. Assuming conservatively that a 2m leachate head builds up and this acts on the downgradient landfill containment bund, Darcy's Law can be used to estimate the rate of seepage through the containment, which could then, if undetected, runoff into surface water.

Q=kia m3/s

Where

Q = seepage rate

k= permeability of the sidewall liner = 5 x10^{-9} m/s

i = head of leachate (2m) / horizontal thickness of containment bund (3m minimum)

a = length (L) of downgradient bund (m) x 2m seepage face

L is taken to be the 200m length on the western/downgradient landfill boundary where seepage could migrate across ground to the surface water without an intervening woodland area.

The resulting seepage Q = 1.33e^{-6} m^3/s.

If the permeability of the sidewall liner was 1 x 10^{-7} m/s the seepage rate Q would be 2.67e^{-5} m^3/s, however, a 2m head would be unlikely to build-up if the liner permeability was 1 x 10^{-7} m/s.

The flow in the tributary of the Alphin Brook that flows down the western boundary of the site is estimated as follows. The greenfield runoff rate for the area of the landfill is 24.9 l/s, refer to AAe 2022 Detailed Drainage Design. The area of the landfill draining to the permanent drainage pond is 11.5 ha. The landfill forms most of the downgradient portion of the wider catchment area contributing to the tributary of the Alphin Brook. The full catchment area is 45 ha, therefore the landfill area contributes a quarter of the flow to the tributary of the Alphin Brook. The flow in the tributary upgradient of the landfill (monitoring location SW1) can, therefore, be assumed to have three quarters of the catchment flow, which would equate to 74.7 l/s.

With seepage from the toe of the landfill estimated to be $2.67e^{-5}$ m^3/s as a worst case, this gives a rate of dilution of 2800. This gives more than sufficient dilution to ensure that seepage into the watercourse would result in concentrations less than 10% of the EQS. There would also be attenuation within the side wall liner further reducing concentrations.

1d) The well at West Town Farm is on the opposite side of the tributary to the Alphin Brook. The type of abstraction is listed as a well, not a borehole, which can indicate a shallower construction than boreholes in the same area. There is no record held by the British Geological Survey (BGS), so details are unknown. Details of boreholes over 15m in depth are generally required to be reported to the BGS. This could indicate that the well is less than 15m depth.

The National Grid reference given in the Envirocheck report is 285600 93000, which looks to be on the north side of the main farm building. The use is given as general agricultural use.

The ground elevation of the well appears to be around 90 – 95m AOD and the ground falls to around 80 to 75m AOD at the level of the brook. The base of the well is likely to be similar to the base of the brook. The brook acts as a divide between groundwater catchments and as such any seepage from below the landfill will not migrate westwards towards the farm.

1e) Consider the effect of the fault located along the western boundary.

Faults can be zones of higher flow, as the brecciated material will enhance the permeability of the rock through which it cuts. In places faults can be barriers to flow, as high permeability units are juxtaposed against those of low permeability. Alternatively, permeable units from different stratigraphical levels can be juxtaposed, connecting previously unconnected horizons. In the case of Lower Hare Farm, the HRA notes that local faults also correspond to surface watercourses. The fault zones have been preferentially eroded into valley features, suggesting that the fault zones are more permeable than the surrounding bedrock geology.

The presence of the fault to the west of the proposed landfill is likely to limit flow to the west of the watercourse and cause groundwater to flow to the south. The fault is further to the west of the limit of fill than the default receptor in the Landsim model, therefore, if groundwater quality is compliant at the default receptor, it will be compliant further downgradient.

1f) A water balance is attached that considers variable rates of rainfall infiltration and variable values of permeability for the basal liner. This indicates that if the permeability of the geological barrier was 1×10^{-8} m/s, or lower, there is the potential for a leachate head to begin to form at the base of the landfill. This in turn increases the rate of infiltration through the base. A leachate head of more than 1m is unlikely to be sustainable if the permeability of the liner is 5×10^{-9} m/s or higher.

Point source discharge

9. Provide a surface water risk assessment.

Reason: this is not included in the H1 risk assessment.

A Surface Water Risk Assessment report is provided.

10. Detail how the attenuation ponds give a point of control prior to direct discharge to the tributary of Alphin Brook and consider whether monitoring of these prior to discharge could achieve this.

A penstock will be fitted to the outlet from the permanent lagoon. This will enable retention of waters in the event that monitoring indicates that concentrations of determinands exceed those in the Surface Water Risk Assessment.

Attachments

1. Landsim model: LHF Scenario 1 NH4
2. Water balance