Environment Agency permitting decisions

Bespoke permit

We have decided to grant the permit for Calvert Landfill (Pit 6) operated by FCC Waste Services (UK) Limited. The permit also includes a facility for the treatment of incinerator bottom ash.

The permit number is EPR/BP3637AF

We consider in reaching that decision we have taken into account all relevant considerations and legal requirements and that the permit will ensure that the appropriate level of environmental protection is provided.

Purpose of this document

This decision document:

- explains how the application has been determined
- provides a record of the decision-making process
- shows how all relevant factors have been taken into account
- justifies the specific conditions in the permit other than those in our generic permit template.

Unless the decision document specifies otherwise we have accepted the operator's proposals.

Structure of this document

- Permit Background
- Key Issues
- Aspects relating to the permit process
- Annex 1 the consultation, web publicising responses

Permit Background

The Calvert site is located off Brackley Lane, Calvert, Buckinghamshire and is a non-hazardous landfill site located immediately to the south east of the village of Calvert approximately 9km to the east of Bicester and 17 km north west of Aylesbury. The site abuts a railway to the north eastern boundary, Sheephouse Wood SSSI to the east and to the north western boundary is a residential development known as Calvert Green. To the south east and adjacent to Pit 6 is the Greatmoor Energy from Waste (EfW) plant that receives municipal waste from Gloucestershire.

This environmental permit application relates to the area of the Calvert landfill complex known as Pit 6 and was submitted alongside an application to surrender the Pit 6 part of the landfill permit EPR/BS8605IQ, which included the 'pre-operational' Pit 6 area. The purpose of this application is to separate Pit 6 from landfill permit EPR/BS8605IQ to create a separate permitted installation for the receipt of non-hazardous (low-biodegradable) wastes for the purpose of completing restoration of Pit 6 to a defined restoration profile. The landfill operation is for the disposal of non-hazardous (low-biodegradable) wastes within the mineral extraction void of Pit 6 which will be contoured to tie into the adjoining Pit 5 which has previously been landfilled with non-hazardous wastes and is subject to future over-tipping under its current environmental permit and planning consent.
The proposed non-hazardous (low-biodegradable) wastes for infilling of Pit 6 consist of excavation, construction/demolition wastes and similar industrial wastes.
At the south eastern end of the landfill adjacent to Pit 6 is the Greatmoor Energy from Waste (EfW) plant which is now operational with its own permit. The Incinerator Bottom Ash (IBA) produced from the EfW plant process will be brought onto the site to be processed in the IBA facility for treatment under this permit for Pit 6. This treatment is for the removal of ferrous and non-ferrous metals which are subsequently recovered. The treated IBA waste is then landfilled in Pit 6. The treatment process proposed in this application is accepted. Pit 6 is within a layer of Oxford clay and underlain by Kellaways Sand.

Groundwater in the Kellaways Sand aquifer beneath the Oxford Clay and under Pit 6 (and Pit 4 and Pit 5) is a receptor because it is classed as a Secondary A aquifer. Artesian pressure causes the groundwater in the aquifer to form a groundwater piezometric surface in the Oxford Clay, and Pit 6 is hydraulically contained by this in that the bases of cells are below the groundwater piezometric level. The groundwater piezometric level in the Oxford Clay varies across the area due to the dip of the aquifer from Pit 4 & 5 where it is at around 77m AOD to Pit 6, where it is around 66m AOD. Groundwater in the aquifer is a receptor for the purposes of assessing the risk of hazardous substances entering groundwater and pollution by non-hazardous substances at the site boundary.

Annex I Paragraph 3.3 of the Landfill Directive requires that a geological barrier, a sealing system and a leachate collection layer must be provided for non-hazardous landfills. The site will have the benefit of a continuous clay liner and geological barrier formed from the Oxford Clay acting as a single unit with a permeability of 7×10^{-11} to 1×10^{-9}. Beneath the site there is at least 2m of remaining Oxford Clay. This barrier will act as both the geological barrier and the artificial sealing liner. The barrier will utilise available on-site in-situ material (Oxford Clay) which has a natural permeability of less than $1x10^{-10}$ m/s.

Ordinarily we would have varied the existing permit for Calvert Landfill to reflect this operational change, however the Operator specifically requested that a separate permit is issued for Pit 6. There is a separate decision

document relating to the variation of the existing permit (reference EA/EPR/BS8605IQ/VO13). This explains what leachate head has been imposed for Pit 5 and the reasons why.

Requests for further information
The operator was given three opportunities to provide further justification to support its proposals as follows;

Schedule 5 Notice dated 05.01.2016 the response to which was dated 25/02/2016 and covered;

- HRA Modelling
- Existing leachate management infrastructure
- Leachate management in Pit 6
- Bund between Pit 5 and Pit 6
- Landfill Gas Management.

A further information request (FIR) dated 25/04/2016 the responses to which were dated 03/06/2016 and 13/06/2016 and covered;

- Conceptual Understanding (Pits 4, 5, 6)
- Bund between Pit 5 and Pit 6
- Leachate Collection in Pit 6

A final FIR dated 10/05/2016 the response to which was dated 03/06/2016 and covered;

- Additional IBA Treatment Facility technical detail

Key issues of the decision

Leachate Head

The Operator's proposals with regards to the absence of leachate limits such that leachate would build up to a level equivalent to the surface break out point at the top of the side wall lining system at around 75mAOD and to the top of the bund at around 86 mAOD in Pit 6 have been assessed by Environment Agency technical specialists in National Operations and Environment & Business. Whilst the Operator initially recognised the requirement to collect leachate by installing a collection well arrangement, it did not propose a basal drainage blanket with pipework connected to the wells. Subsequently in response to a Schedule 5 Notice the Operator proposed to install a basal collection system, and to collect leachate at surface break out level by means of passive drainage of leachate to a sub-cap perimeter drain. Even though these proposals would allow management of leachate the Operator did not propose any leachate head limits. The Operator's proposal to not have limits is not acceptable because if permitted the leachate heads would be higher than those permitted in Pit 5 could result in the risk of leakage from Pit 6 to Pit 5 over the bund between them and

through it in the PFA layer. This would mean that there would be no effective separation of the two areas and they would remain part of a single landfill.

Our assessment of all the information provided to us during this determination is that there is an unacceptable risk of emissions to Pit 5, and therefore inadequate separation of the two landfill installations, as explained below.

The Operator's original proposals for leachate collection were not compliant with the requirements of the Landfill Directive or our How to comply with your environmental permit - Additional Guidance for Landfill EPR5.02 in that it did not include a leachate drainage layer and had not adequately justified its removal. It proposed to monitor leachate only at a single well point, one in each of the sixteen cells, but in the absence of a basal drainage blanket system. This would have meant that the Operator would not have been able to control heads across each cell. It would also have meant leachate quality and levels monitored at each well would have been representative of the leachate at that point only, and not representative across the whole of the cell. In response to our requests for further information regarding the provision of a leachate collection system, the Operator proposed to install a system, incorporating a 300mm thick drainage blanket with pipework in the first cell. But it still did not propose to set leachate head limits, even though it would have the ability to collect leachate from the revised leachate collection system.

The Operator's proposal to not set leachate limits, and to allow leachate to rise towards the top of the sidewall lining systems, had we not refused these proposals would have meant that heads would have risen up to a maximum of around 20m above the groundwater piezometric head of groundwater in the Kellaways Sand Aquifer. Our refusal of these proposals is based on the following guidance and principles:

- the Operator's proposal is not in accordance with the principle of pollution control at hydraulically contained landfills that is effected by maintaining an inward hydraulic gradient throughout the life of the site by keeping the leachate head below the piezometric head, and
- is not in accordance with Environment Agency guidance "How to comply with your environmental permit - Additional Guidance for: Landfill (EPR 5.02)" such that unacceptable discharge/emission over the entire lifecycle of the landfill is prevented, and
- not in accordance with Paragraph 3.3 of Annex 1 to the Landfill Directive that specifies that the leachate collection and sealing system should ensure that leachate accumulation at the base of the landfill is kept to a minimum. Allowing the leachate heads to rise as proposed would not satisfy this requirement. Nor has it been demonstrated that this requirement should be reduced.

Specifically, we are not satisfied that the Operator's proposal to not minimise and not set leachate heads will allow the long term separation of Pit 6 from Pit 5 and indirectly from Pit 4, to be achieved. This is because of the risk of flow of leachate over and /or through the bund from the high leachate head proposed for Pit 6 to the low head set for Pit 5. That would mean that leachate

from Pit 6 could cross over to the Pit 5 side of the bund in the PFA layer where it could discharge through the base of the bund to groundwater on the Pit 5 side of the boundary between Pit 6 and Pit 5. Thus it would also result in it not being able to separately identify any impacts on groundwater caused by Pit 6 from those that may be caused by discharge from Pit 5.

Separation and leachate head related issues

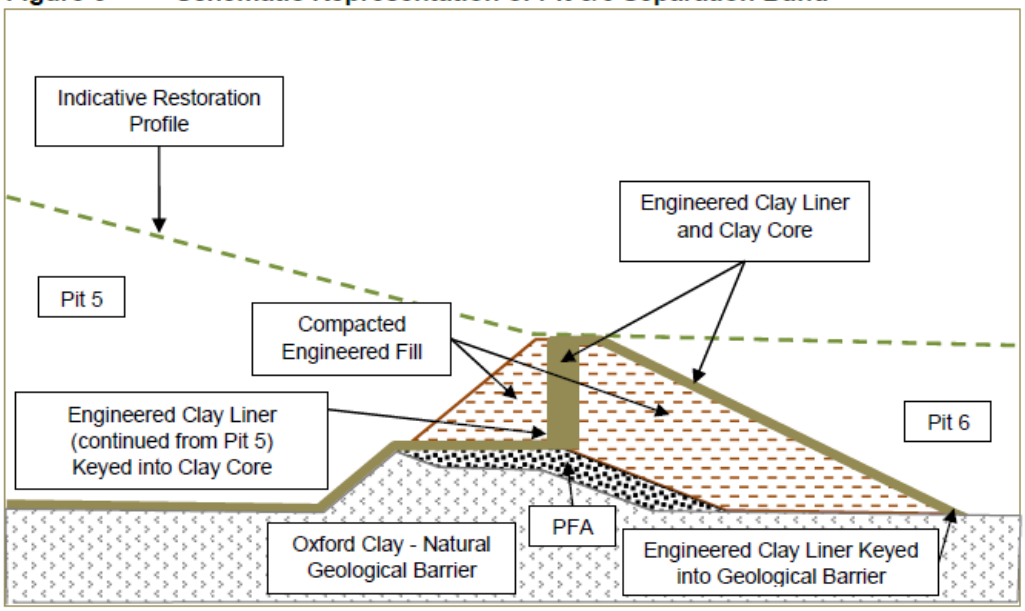
Based upon the information in the application we are satisfied with the Operator's containment engineering proposals, provided there is no significant prolonged imbalance of leachate heads either side of the bund, and leachate heads are kept below groundwater piezometric heads. The bund was partially constructed at the time when the permit variation and surrender and new bespoke applications were received. The Construction Quality Assurance Plan for the bund was approved prior to the receipt of the applications to vary the pre-existing permit, to part surrender the area covered by Pit 6, and for a new permit for Pit 6. Therefore the CQA Plan was approved and appropriate when Pits 4, 5 & 6 were all part of the same landfill and permit. To achieve separation between landfills there should be no movement of leachate or landfill gas across the engineered separation. To ensure this the clay core of the proposed bund should tie into the natural geological barrier provided by the Oxford Clay. Instead the bottom of the clay core is separated from the Oxford Clay by a layer of PFA. This PFA layer provides a pathway for leachate to move between pits 5 and 6. Even though the sidewalls of both cells 5 and 6 are considered to be landfill directive compliant, all liners leak over time. As demonstrated below there is scope for leachate to move between the 2 landfills over time. The only way to prevent that given the current design is to control leachate heads. If the proposed leachate head levels were to be allowed, it would result in a driving head between Pit 5 and Pit 6 if heads either side are not balanced, or a diffusive flux from Pit 5 to Pit 6 if high heads are allowed which are above groundwater piezometric head.

In particular the operator has not demonstrated if the leachate heads were to be allowed to be raised that;

a) there will be no significant flow of leachate through the PFA layer from a higher head on one side of the bund to a lower head on the other, and,
b) if the heads are balanced there will be no significant diffusion of substances through the PFA layer due to the differences in leachate source terms.

Information of the design of the bund presented by the Operator, states it consists of various materials and waste, as described in the response to the S5N of 25-02-16 Figure 6 (detailed below) which is a schematic representation of the bund.

Figure 6 Schematic Representation of Pit 5/6 Separation Bund



Importantly it contains an artificial geological barrier/ artificial sealing liner clay layer on either side slope. It also includes a partial clay core but underneath that there is a significant layer of PFA that straddles both sides of the permit boundary between Pits 5 and 6.
Assessment of the effects of effective porosity and permeability variations in the components of the bund, and the effects that such variations could have on flow of leachate and diffusion of substances through the bund, were not provided. Instead the operator has relied on an assessment of deformations in the bund to assert that there will be no significant flow from one side to the other. That assessment does not address the influence of the permeability of the PFA layer which is likely to have a markedly higher permeability than the other engineered components of the bund.

Information in the “PFA Quality Protocol: Chemical Risk Assessment on PFA/FBA/SINTERED PFA; Report to the Environment Agency from WCA Environment Limited July 2011” reported that
Peffer (1982) showed that PFA compacted to 95% maximum dry density can achieve a hydraulic conductivity of 1×10^{-7} m s^{-1}. Others report similar hydraulic conductivities for compacted PFA:

- 1.2×10^{-6} to 1.8×10^{-7} m s^{-1} (Martin et al. 1990)
- 1×10^{-6} to 1×10^{-8} m s^{-1} (GAI and USIFCAU 1993)
- 3.2×10^{-7} m s^{-1} (Wayne et al. 1991)
- 1×10^{-7} to 1×10^{-8} m s^{-1} (Goodwin 1988).

The Electric Power Research Institute (EPRI) (1992) reported that PFA hydraulic conductivity is a function of coal rank and cited the following range:

- Bituminous 1×10^{-6} to 1×10^{-9} m s^{-1}
- Sub-bituminous 1×10^{-7} to 1×10^{-8} m s^{-1}
- Lignite 9×10^{-8} to 1×10^{-9} m s^{-1}.

In the UK as a general rule bituminous coals are burnt with a few exceptions where anthracitic coals are used, meaning that permeability of the PFA at around $1x10^{-7}$ m/s in the bund is likely to be around several orders of magnitude greater than $1x10^{-9}$ m/s which was used by the Operator to calculate travel time through the clay part of the bund. The permeability of the PFA was not taken into account in the operator's HRA or SRA (see page 21 of the response dated 25-2-16 to the S5N). The influence of the PFA layer as a primary pathway for leachate to migrate from the Pit 5 side of the bund to the Pit 6 side, or vice versa, in this respect was not considered by the operator.

As a check on the effect of the PFA layer and its' likely permeability on the transmission of leachate through the bund from one side of the permit boundary to the other, we have taken the equations used by the Operator and input data presented on page 21 of the operator's response dated 25-02-16 to the S5N. However we used an average permeability of 1x10-7 m/s for the PFA, as presented in the data above. We have assumed in this calculation that once the leachate goes through the bund sidewall clay barrier, it would enter the PFA layer where it would travel through it rapidly in a direction from high head to low head. If we use the Operator's method of calculating travel time through the PFA layer in the bund and assume a PFA permeability of 1x10-7 m/s and a porosity of 0.2 is used in the equation the resulting travel time is of the order of several years through the PFA straddling both sides of the Permit boundary. This is two orders of magnitude less than the Operator's prediction which relates to the clay part of the bund only. Even taking into account the presence of the side slope geological barrier and engineered fill over the PFA layer on the Pit 6 side of the bund, once leachate enters the PFA layer it would flow through the PFA layer from the Pit 6 side of its' permit boundary to beyond its' boundary on the other side within the Pit 5 boundary.

Also, should there be a significant imbalance of leachate heads over a prolonged period of time there is the possibility that pore pressures in the core of the bund, particularly in the PFA layer, could build up. This could lead to deformation of the clay core and engineered geological barrier on the side slopes of the bund resulting in an increase in permeability and flow-through and in a loss of separation. By maintaining balanced leachate heads either side of the bund at a level below the groundwater piezometric head there will be no discernible flow through the bund.

Modelling Issues

If leachate heads in Pit 6 are maintained below groundwater piezometric head, which were modelled by the Operator using the hydraulic containment spreadsheet approach in their HRA, and in combination with maintaining the permitted leachate heads below groundwater piezometric head in Pit 5, there should be no discernible flow or diffusion of leachate through the PFA layer in the bund, therefore separating Pit 6 from Pit 5. Therefore the leachate head above the base of Pit 6 shall be maintained at a level just below the groundwater piezometric head, as modelled for the hydraulic containment scenario 1 in the operator's HRA. This also ties in with information presented in Figure 2 of "S5N response 25-02-16 Final" showing groundwater piezometric level variations in the Kellaways Sand Aquifer and the underlying Blisworth Limestone Aquifer system across the pits, but which presents a more complex picture than modelled. This information forms the basis for setting the leachate compliance limit of 65.9m AOD in cells 1, 2, 3 and 7.

However for Pit 6 the Operator's proposed long term solution was to allow leachate heads to rise to the top of the containment bund and sidewall barrier. Modelling of the proposed leachate heads above groundwater piezometric head by 6m in Pit 6 has been based on Landsim, which is not what it was designed to do. Landsim was designed to estimate the impact of leachate going through the basal lining system into groundwater for landfills that are above the water table or piezometric level. It cannot simulate leachate going through the base where the base is below groundwater piezometric level without first separately calculating the leakage and then adjusting the parameters in Landsim to account for the actual leakage or by assuming that all of the leachate head above base is acting on the base, and it cannot simulate leakage through the side walls and the bund. The results of that assessment cannot be relied on. Notwithstanding that, in the model the fixed head of 6m representing the head above piezometric level assumes that the head would be maintained at that level. This contradicts the Operator's assertion that it would not be able to control heads below the surface break out points because of the low permeability of the wastes. Although leachate monitoring and collection by way of a basal collection system is to be installed, and we consider that this would be capable of controlling leachate heads, the operator has also proposed a passive system whereby without leachate head limits the leachate would rise to the top of the sidewall lining system and be collected by a sub-cap perimeter drain. The top of the side wall elevation and top of the bund shown in Drawing 2077/1/008 indicate that the top of these are at around 75m AOD and 86 mAOD respectively. These elevations are 9m and 20m above piezometric level of around 66m AOD, and are much greater than the additional head modelled in Landsim. It has not been demonstrated that this additional head would be acceptable given the potential for leakage through the Oxford Clay under the site and/or for leakage into the bund and into groundwater beneath the bund, and that the leachate source could be more polluting than expected.

Groundwater under Pit 6 is a receptor, and it is clear the Operator's Landsim model predictions for the Operator's proposed leachate heads in Pit 5 point to

a discharge of over 400 mg/l Ammoniacal-N into the groundwater, and based on Environment Agency R&D conclusions regarding there being no attenuation of ammoniacal-N in groundwater, and without site specific evidence to counter this evidence, we consider the contamination would flow under Pit 6 and beyond. The effects this could have on regulating Pit 6 has not been considered by the operator, other than to adopt the compliance limits previously permitted, which in all likelihood would be breached due to the discharge from Pit 5. Given the compliance limits proposed for Pit 6 the proposed heads in Pit 5 are unacceptable.

Justification that groundwater under Pit 6 is a receptor is based on the fact the Kellaways Sand Aquifer that lies below Pit 4, Pit 5, and Pit 6 and the Oxford Clay, is classed as a Secondary A aquifer. Artesian pressure causes the groundwater in the aquifer to form a piezometric surface in the Oxford Clay, and Pit 6 is hydraulically contained by this in that the bases of cells are below the piezometric water level in the Kellaways Sand Aquifer. The piezometric level in the Oxford Clay varies across the area due to the dip of the aquifer from Pit 4 & 5 where it is at around 77m AOD to Pit 6, where it is around 66m AOD. Groundwater in the aquifer is a receptor for the purposes of assessing the risk of hazardous substances entering groundwater and pollution by non-hazardous substances. We do not agree with the operator's assertion that groundwater in the Kellaways Sand Aquifer is a pathway based on its' conclusion that it has no resource value.
The Groundwater Directive, and The Environmental Permitting (England & Wales) Regulations 2016 ('EPR') require us to protect groundwater. This is irrespective of whether it is in Principal, Secondary A, B or Unproductive strata. Groundwater is defined as "*all water which is below the surface of the ground in the saturation zone and in direct contact with the ground or subsoil*". An**y** attempts to "reclassify" groundwater from Secondary A to B or even to Unproductive Strata, as suggested by the Operator, is irrelevant to whether the groundwater is a receptor. These are groundwater *classifications*- on the availability and strategic purpose of groundwater. Re-classifying will not change the technical analysis of whether groundwater is present. Our technical view is that groundwater is present and so the formation must be considered a receptor and not a pathway. The Permit includes requirements to monitor groundwater levels and its quality which are compared to compliance limits at down gradient wells in accordance with proposals in the application, which implies the Operator has already agreed that the groundwater is a receptor.

Defra guidance

https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/69474/pb13555-ep-groundwater-activities-101221.pdf

….allows some discretion of deciding what is groundwater for the purpose of EPR:

> "*It will continue to be a technical decision for the Environment Agency to determine what is groundwater in certain circumstances for the purposes of the Regulations. For example, in very low permeability*

*strata such as clays, evaporites and dense crystalline rocks it may not be possible to define a zone of saturation because the water is bound to the rock or is relatively immobile.***"**

The fact a piezometric head is established and monitored across the landfill and the fact it is also designated a Secondary Aquifer nationally is clear evidence that groundwater is present in the Kellaway Sand Aquifer and so the Environment Agency's decision is that this formation contains groundwater.

Under Groundwater Directive (2006/118/EC) and EPR – "permanently unsuitable" is only considered in the context of the injection of water containing substances resulting from the operations for exploration and extraction of hydrocarbons or mining activities (for example "produced waters") and the injection of water for technical reasons. (EPR Schedule 22, para. 8(a)). This is different to the "old" Groundwater Directive (80/68/EEC) where "permanently unsuitable" had a wider application. Although this was not suggested by the Operator, any such proposal had it been put forward to argue "permanent unsuitability" would have been irrelevant in the case of a landfill.

The EPR requires the Environment Agency "must in exercising its relevant functions take all necessary measures" to prevent entry of hazardous substances and limit the input of non-hazardous pollutants to groundwater so as to ensure that such inputs do not cause pollution, unless they are excluded by the circumstances outlined in schedule 22 paragraph 3(3)(a)(b) or (c) (which in summary are accidents, where the concentration and quantity are so small as to be de minimis, where prevention would increase risks to human health and the environment or be disproportionally costly in contaminated ground) none of which apply in this case. Therefore the discharge of for example, ammoniacal nitrogen, as a non-hazardous substance from the activity should be "limited" so as to not cause pollution. Contrary to the Operator's assertion that no pollution would occur, the lack of site specific evidence in the HRA for Pit 5 regarding degradation of Ammoniacal-N in groundwater points to there being an unacceptable discharge of Ammoniacal-N into groundwater, and gives no conclusive site specific evidence that this substance would be attenuated or degraded to background levels before it crosses the permit boundary of Pit 5 into that of Pit 6. Thus without site specific evidence to point to the contrary the discharge from Pit 5 if the operator's proposals for raising leachate heads had been accepted would lead to a breach of the compliance limits for Pit 6 because of the deterioration of groundwater quality beneath it. But if leachate heads in Pit 5 are maintained below piezometric head no breaches of the compliance limits for Pit 6 are expected to be caused by a discharge from Pit 5.
If leachate heads were allowed to be raised in Pit 6 as per the Operator's proposals to not set limits, it has not demonstrated what the long term leakage from Pit 6 to Pit 5 would be and thus what effect it would have on the water balance. Also it has not demonstrated it would be able to determine whether any impacts on groundwater in the Kellaways Sand Aquifer if they were to occur, arose from an unacceptable discharge from Pit 5 and/or Pit 6 if the leachate quality in Pit 6 is not as expected.

Requirement for leachate collection

The permit application for Pit 6 proposed leachate collection could be achieved by means of a leachate well in each cell that could be used to extract leachate, but it did not include a basal drainage layer system to facilitate the flow of leachate to the well where it could be extracted. Effective collection of leachate without a basal drainage layer system cannot be achieved, because the drawdown of the leachate level around an abstraction well will be limited to a zone influenced by the various permeabilities of the wastes immediately adjacent to the well. Since these parameters for the emplaced waste types would be unknown the drawdown around each well would not be predictable with any confidence. Also the leachate quality from such a well would represent the waste immediately adjacent to the well, and not represent quality of leachate of the whole of the cell. A collection layer connected to wells is much more efficient at collecting leachate and providing a more representative sample of it than simply relying on a well alone. Therefore we asked the operator in a S5N to provide details of a leachate collection system that would meet the requirements of EA guidance.

This was required in order to demonstrate that the operator is able to operate the site in accordance with the Landfill Directive, in accordance with the requirements for leachate management in Environment Agency Guidance EPR5.02, and in line with findings in the Science Report SC0310/SR "Contaminant fluxes from hydraulic containment landfills – a review", and to confirm their own predictions in their application that the proposed operation does not result in any adverse impact to the environment, specifically that the leachate would have no unacceptable impact on groundwater and there would be effective separation from Pit 5.

Thus the operator's proposals in response to the S5N request to install a leachate collection system in Pit 6 were to incorporate a drainage blanket with pipework, graded towards leachate monitoring /collection wells. Specifically it proposed a 300 mm leachate drainage blanket with 180 mm pipework at 50 m spacing at a 1 in 50 fall. This system is the same design as approved for Pit 5 Cells 5E and 5G-5J onwards, and was what was originally proposed for pit 6 before the current applications were made. It is considered acceptable for the collection of leachate in Pit 6 cells.

In response to our request to install a basal collection layer system the Operator then proposed a basal collection system and that leachate could also be collected passively at the top of the body of waste in each cell by a sub-cap perimeter drainage system, yet proposing no leachate head limit. However the proposed inclusion of a sub-cap perimeter drain implies that the Operator's original proposal to not install a basal leachate collection layer on its own would not have been effective in controlling heads such that they would not overtop the lowest point of the landfill side wall. As such this sub-cap perimeter drain for leachate collection measure is not normal for new bespoke permitted landfills. The sub-cap perimeter drain is not a system that ensures the accumulation of leachate is minimised.

Leachate heads in Pit 5 and in Pit 6 need to be balanced in cells either side of the permit boundaries and below the groundwater piezometric head. This is to prevent a driving head in one direction or the other through the bund, to ensure effective separation of the permitted landfills. This will also prevent any outward flow of leachate from either pit 5 or pit 6. In order to maintain leachate heads at these levels, a leachate collection system is required in Pit 6.

Therefore the head of leachate in Pit 6 needs to be maintained at a level that is related to the groundwater piezometric level (66m AOD in the vicinity of Pit 6 cells 1, 2), and at a similar level as that in Pit 5 in the adjacent cells. This is to maintain hydraulic containment and to prevent advective flow from higher head to lower head through the bund between the two separate installations. When heads on either side of the bund separating Pit 5 and Pit 6 equalise there will be no advective flow in the bund from one side to the other. When these conditions are achieved, because of differences in leachate composition and strength between Pit 5 compared to Pit 6 (due to the different waste types) there may be a diffusion flux from Pit 5 towards Pit 6. But this should not be discernible under the prevailing conditions (i.e leachate heads are below groundwater piezometric head). Therefore under these conditions this would not prevent them being considered separate landfills. Even with the bund in place, monitoring of leachate levels and quality will be important on either side of the bund in the long term during the aftercare period.

For Cell 1, Cell 2, Cell 3 and Cell 7 a leachate head limit of 65.9 mAOD has been set based on the modelled hydraulic containment scenario in the HRA. Pit 6 leachate heads are set at below 66m AoD, which is the groundwater piezometric head at this location. Because the operator did not include an assessment of the possibility that slightly different leachate head limits may be needed on a cell by cell basis in Pit 6 due to the variation in groundwater piezometric heads across Pit 6 we have included additional conditions in the permit to address this. IC1 is included to determine if the limits in the cells other than cell 1 that are adjacent to the bund (2,3,7) need to be revised to maintain them below the groundwater piezometric level and in line as far as practicable with leachate head limits in Pit 5. Waste deposit in these cells remains subject to CQA validation. POM1 is included to review the leachate head limit in all the other cells in Pit 6 that are not adjacent to the bund and which may need to be different to 65.9 mAOD owing to the variable groundwater piezometric head across Pit 6. No waste can be deposited in these cells until both POM1 and subsequently the CQA validation has been agreed in writing with the Agency.
Long term physical separation of Pit 4&5 from Pit 6 is therefore dependent on the following features:

- Pit 6 immediately adjacent to Pit 5 is separated by a bund of construction fill, consisting of a geological barrier / artificial lining system tied into the basal system, a vertical clay core and engineered fill engineered to a maximum permeability of 1 x 10^{-8} m/s which will be built up vertically with outer slopes made from suitable materials to provide support to the clay

core, and underneath the clay core and behind the GB/ASL, there is a significant layer of PFA that straddles both sides of the permit boundary between Pit 5 and Pit 6, and

- management of leachate heads in the separate permitted landfills either side of the bund at a level below groundwater piezometric heads; this is to prevent a driving head from one side of the bund to the other through the PFA layer in the bund
- the sidewall lining which will be provided by the in-situ geological barrier
- Pit 6 is immediately adjacent to Pit 5 and is separated by a bund of construction fill, and includes a significant layer of PFA that straddles both sides of the permit boundary between Pit 5 and Pit 6. Pit 6 will be a separate installation permit to Pits 4 & 5. The bund will have a central clay core engineered to a maximum permeability of 1×10^{-8} m/s which will be built up vertically with outer slopes made from suitable materials to provide support to the clay core.
- the bund will be built up in phases to the full height of the post settlement waste restoration profile to separate the permitted installation areas and to enable the clay capping layers for each area to be tied in. However long term physical separation is also dependent on the management of leachate heads in the separate permitted landfills either side of the bund at a level below groundwater piezometric heads. The final capping system will consist of a 500 mm thick clay of permeability 1×10^{-8} m/s, covered with a layer of soil-forming materials and soils to a thickness of at least 1m over the cap.

In summary, a leachate limit of 65.9m AoD to maintain the leachate level below piezometric level has been set for leachate head levels in all monitoring points. Table 14 in the Calvert Pit 6 HRA (July 2015) states the leachate head that would need to be achieved on the Pit 6 side of the bund is 65.9 m AoD, to maintain it below the piezometric level of 66m AoD. This is also at a similar level that has been set for Pit 5 in those cells adjacent to the bund in order to maintain a balance in the long term.

Leachate Quality

Waste inputs to this site will be chosen, sampled and analysed where necessary using waste acceptance procedures and criteria that also contribute to the control of the risk of contamination to the site soil and associated groundwater.
Based upon the information in the application we are satisfied that the appropriate measures will be in place to monitor leachate quality.

Leachate quality will be monitored from the proposed leachate monitoring points LMP01 to LMP16, which will be constructed up from the base of the site.
The operator's proposed Leachate Monitoring Schedule for leachate quality has been agreed and this has been reflected in Schedule 3 Table S3.7.

Groundwater

Based upon the information in the application we are satisfied that the appropriate measures will be in place to monitor groundwater quality.

Table S3.3 in the permit sets compliance limits for groundwater in the Kellaways Sand Secondary 'A' Aquifer. This is required for the protection of groundwater. The site is located in the Oxford Clay and above the Kellaways Sand Secondary 'A' Aquifer. The site is not located within a Groundwater Source Protection Zone. Groundwater in the Kellaways Sand is artesian and in hydraulic connection with the regional groundwater, including the Blisworth Limestone beneath it. The site also is situated in a Surface Water Safeguard Zone. This surface water Safeguard Zone relates to protection of surface water from pesticides and therefore is not directly relevant to this application.

Within the HRA which includes up and down hydraulic gradient monitoring points. A monitoring regime has been proposed. Groundwater protection is dependent on the leachate heads in Pit 5 and Pit 6 being maintained below the groundwater piezometric level for hydraulic containment. It is intended to monitor groundwater quality to ensure that during the operational and post closure phases of the landfill no actual detrimental effects to the environment occur. The operator has proposed a groundwater action plan to mitigate any impact that may occur which is accepted. The groundwater monitoring proposed is also accepted and has been reflected under Schedule 3 Table S3.3 in the permit.

Surface Water

Based upon the information in the application and the conditions in the permit we are satisfied that the appropriate measures will be in place to control surface water management and monitor surface water quality. Appropriate emission limits for and monitoring of the discharges to protect surface water are included in Table S3.2, Schedule 3 of the permit.

Gas Management

Based upon the information in the application we are satisfied with the proposals for landfill gas management.

The operator submitted a landfill gas risk assessment including proposals for landfill gas monitoring and a landfill gas action plan. Following assessment of these document we have set appropriate monitoring requirements in the permit, this includes monitoring within the waste mass and external to the landfill to ensure any gas migration from the site is identified so that appropriate action can be taken. Pit 6 has existing external gas monitoring infrastructure, which was controlled by the original Calvert Landfill permit this has now been included in this permit.

Included in the application were proposals for the removal of the requirement to monitor carbon dioxide in landfill gas in external boreholes, which was a

requirement for the landfill gas monitoring around Pit 6 in the original Calvert Landfill permit. The ICoP (Industry Code of Practice) Position Statement on perimeter soil and gas (August 2011) has been used to justify the removal of perimeter gas compliance limits for Carbon Dioxide and replace these with action levels, which can be found in the Monitoring Management Plan. As already stated the existing monitoring boreholes around Pit 6 will be used for monitoring gas. Only those associated solely with Pit 6 are included in this permit. The compliance limits proposed for methane which take into account the background level are accepted and have been reflected in Schedule 3 table S3.4. methane compliance limits have been set at 1% above background.

POM9 remained outstanding from the previous permit and this is now reflected as IC2 as external boreholes CVGB0037 to CVGB0042 compliance limits have not yet been agreed. The Operator will need to submit a review of the monitoring data and propose suitable compliance limits for methane and assessment levels for carbon dioxide for approval.

A gas management action plan has been proposed by the operator and has been accepted. This has been developed to respond to any significant changes or trends in the monitoring data.
The LFGRA (Ref: 2077-R08) concludes that there is no requirement to install or operate any gas engines and we agree with this conclusion

Amenity

The operator has submitted an amenity risk assessment . This report was prepared in support of a permit for the disposal by landfill of non-hazardous wastes (with low organic content such as soil and stones, ash etc.) and inert. The risk assessment was undertaken using the H1 methodology. Reference was been made to the Environment Agency's Horizontal Guidance Note H1 – Annex (A). The H1 Annex (A) identifies a four step process, risk identification, risk assessment, appropriate control and presentation of assessment. All appropriate source-pathway-receptors were taken into account.
The following key amenity issues were assessed:

Odour

Based upon the information in the application we are satisfied that the appropriate measures will be in place to prevent or where that is not practicable to minimise odour and to prevent pollution from odour.

The wastes to be brought for disposal at the site are very unlikely to be a significant source of odour. Low organic content means low landfill gas generation and production of odorous leachate- is unlikely (although the fact leachate may not be odorous does not necessarily mean it will be as benign as the operator assumes). The waste acceptance procedures are in place to prevent any odorous wastes from being accepted for disposal at the site and to ensure wastes have low organic content and therefore negligible gas / odour potential.

An odour monitoring and action plan is in place. Regular olfactory monitoring will be conducted and will take account of meteorological conditions and potential impacts of odour on receptors. In accordance with their Environmental Management System (EMS) procedures, the operator will document all events or complaints received associated with odour. By recording all such odour events in combination with meteorological conditions, the operator will be in a stronger position to deal with odour issues effectively and instigate appropriate remedial action.

Noise

Based upon the information in the application we are satisfied that the appropriate measures will be in place to prevent or where that is not practicable to minimise noise and vibration and to prevent pollution from noise and vibration outside the site.

The risk of excessive noise and vibration associated with the proposed activity will be restricted primarily to movement and operation of site plant and mechanical screening equipment. The site will be located within an existing quarry void set substantially below the surrounding ground level. Once the level reaches near the landfill surface the site will still be protected by existing perimeter bunds and vegetation screening. On site speed limits are to be enforced and internal site roads will be maintained to minimise noise / vibration. Appropriate maintenance of site vehicles will be carried out and where practicable, engines to be switched off when not in use. Silencers will be used on vehicles and the operator has said that should it prove necessary alternatives to reversing bleepers on site vehicles will also be considered. Tipping will not be made from height to reduce noise and vibration.

Dust

Based upon the information in the application we are satisfied that the appropriate measures will be in place to prevent or where that is not practicable to minimise dust and particulates and to prevent pollution from dust and particulates outside the site.

On site vehicle speed limits are enforced to ensure that vehicle movements do not generate excessive dust. Dampening of site roads/surfaces will be carried out as necessary using a water bowser during dry periods. Stockpiles of materials are to be kept damp to prevent generation of dust. There will be daily visual inspection by site staff at suitable locations taking account of the prevailing wind direction. All vehicles will be required to use the wheel wash to prevent mud / dust being trailed onto adjacent roads.

Mud

Based upon the information in the application we are satisfied that the appropriate measures will be in place to prevent or where that is not practicable to minimise pollution from mud outside the site.

All vehicles will use the wheel wash to prevent mud / dust being trailed onto adjacent roads and creating a hazard / nuisance. The site access road (shared with the Greatmoor EfW) to the public highway is circa 5km in length which provides sufficient distance for any residual mud to fall from vehicle wheels before they access the main public highway. A mechanical road sweeper will regularly clean the site haul roads and the adjacent shared access and public highway as necessary. Any vehicles observed to be carrying mud on their tyres will be directed back through the wheelwash until the wheels are clean before leaving site. Monitoring of shared access and appropriate maintenance will form part of their EMS for the site

Accidents

Based upon the information in the application we are satisfied that appropriate measures will be in place to ensure that accidents that may cause pollution are prevented but that, if they should occur, their consequences are minimised.

The potential hazards associated with the proposed activity and potential accident scenarios have been assessed. Detailed operational procedures for the management of the site form part of the Site Management System (SMS).

In summary, the operator's amenity risk assessments and Action Plans are accepted.
Given the operational management procedures as detailed in the sites EMS along with mitigating controls, it is concluded that in this respect the installation will not present a significant risk to surrounding receptors.

The impact of fugitive emissions to ground water and surface water;
waste mass and engineering stability; and, generation of leachate and landfill gas were considered in separate risk assessments;
- Hydrogeological Risk Assessment (ref: 2077-R07);
- Stability Risk Assessment (ref: 2077-R09); and
- Landfill Gas Risk Assessment (ref: 2077-R08).

Waste Acceptance Procedures

Based upon the information in the application we are satisfied that the permitted waste types and waste acceptance procedures included in the permit are appropriate for a landfill of this type.

The installation will accept wastes as identified in the list of wastes types in permit Tables;
Table S2.1 Permitted waste types for disposal at a landfill for non-hazardous waste;
Table S2.2 Permitted waste types accepted for treatment at the IBA plant, and
Table S2.3 Permitted waste types for restoration.

The wastes will only be accepted following the waste acceptance procedures which have been clearly outlined in the report Waste Acceptance (Waste

Types and Leachate Source Term) Report No 2077-R09 and will take into account the waste acceptance criteria which identify waste types to be accepted and excluded.
Waste acceptance followed the structured hierarchy with appropriate points of control for the identification and robust validation of suitable wastes for disposal at the site as follows:

- Level 1. Basic characterisation
- Level 2. Compliance testing;
- Level 3. On-site verification.

The operator has applied for and has been permitted to accept only wastes for disposal that meet the requirements of The Landfill Tax (Qualifying Material) Order (LFTQMO).

The operator's waste acceptance procedures are accepted.

Aspects relating to Process

A claim for commercial or industrial confidentiality has not been made and we have not identified information provided as part of the application that we consider to be confidential.

The consultation requirements were identified and implemented. For this application we consulted the following bodies; Public Health England, Health and Safety Executive, Local Authority (Planning & Environmental Health Department) and the Sewage Undertaker. See Annex 1 for responses received and how these were taken into account.

We are also satisfied that the Operator is the person who will retain control over the operation of the facility after the grant of the permit. There is no known reason to consider that the operator will not have the management systems to enable it to comply with the permit conditions. Technical competency is required for the activities permitted and the operator is a member of an agreed scheme.

The financial provision arrangements are in place and continue to satisfy the financial provisions requirements. Relevant convictions were found and declared in the application. A post-conviction plan was submitted by the operator and assessed as satisfactory.

The operator has provided a plan which we consider is satisfactory, showing the extent of the site of the facility. The plan is included in the permit and the operator is required to carry on the permitted activities within the site boundary.
Planning consent is in place and a copy of the current planning consent 11/20000/AWD has been provided with a supporting statement.

The operator has provided a description of the condition of the site; Calvert Landfill Site Environmental Setting And Installation Design (ESID) Pit 6.

The application is within the relevant distance criteria of a site of heritage, landscape or nature conservation, and/or protected species or habitat. A full assessment of the application and its potential to affect three sites of Special Scientific Interest; Finemeer Wood, Grendon and Doddershall Woods and Sheephouse Wood has been carried out as part of the permitting process. Appendix 4 assessments have been made and we consider that the application will not damage the special features of any of these sites of Special Scientific Interest.

Annex 1: Consultation, web publicising responses

Summary of responses to consultation, web publication advertising and the way in which we have taken these into account in the determination process. (Newspaper advertising is only carried out for certain application types, in line with our guidance.)

Response received from
Public Health England
Brief summary of issues raised
Confirmed that that as long as the site is well managed there is little likelihood of emission to air and water. Acknowledged that the greatest risk would be from dust emissions. Confirmed that the H1 assessed the risks of dust nuisance and concluded that procedures will be in place to properly control dust emissions.
Summary of actions taken or show how this has been covered
The Agency is satisfied that dust emissions will be managed appropriately, appropriate measures are in place (see dust section above). The controls imposed through the permit will mean there is no significant pollution or harm to human health.
Response received from
Anglian Water
Brief summary of issues raised
Confirmed that the site does not benefit to a trade effluent discharge consent to foul sewer.
Summary of actions taken or show how this has been covered
Acknowledged. The permit does not include emissions to sewer. Leachate is discharged to surface water after treatment or tankered off site for disposal.