HYDRO RISK ASS REPORT
SUB. NO. 10.

Noeleen Keavey

From: Licensing Staff
Sent: 23 March 2009 09:20
To: Noeleen Keavey
Subject: FW: W0231-01 - Fingal Landfill Project Hydrogeological Risk Assessment - Greenstar Submission
Attachments: Greenstar Submission on Hydrogeological Risk Assessment - 20th March 2009.pdf

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From: Morgan Burke [mailto:morgan.burke@greenstar.ie]
Sent: 20 March 2009 16:32
To: Licensing Staff
Subject: W0231-01 - Fingal Landfill Project Hydrogeological Risk Assessment - Greenstar Submission

Dear Sir/Madam,

Attached please find the submission of Greenstar regarding the Fingal Landfill Project Hydrogeological Risk Assessment submitted as part of waste licence W0231-01.

A copy of this submission has also been sent to the Agency in today's post.

Kind regards,
Morgan Burke

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23/03/2009

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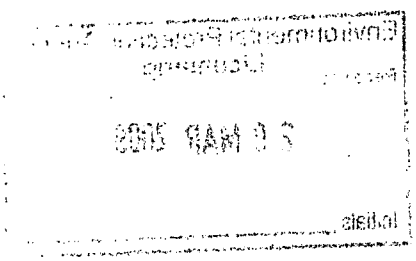

greenstar
setting the standard

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20th March 2009

Re: PD W0231-01 Proposed Landfill at Nevitt, Lusk, Co. Dublin – Submission on *'Fingal Landfill Project – Hydrogeological Risk Assessment'*.

To whom it concerns,

This document comprises the Greenstar submission on the February 2009 Fingal Landfill Project Hydrogeological Risk Assessment submitted as part of the waste licence application W0231-01.

The risk assessment in question applies *LandSim Version 2.5* and the Environmental Agency's *Contaminant fluxes from hydraulic containment landfills spreadsheet v1.0.*

Greenstar commissioned Golder Associates, authors of the LandSim software, to undertake an independent expert review of the Hydrogeological Risk Assessment and in particular to assess the accuracy of the modelling undertaken and the conceptual model upon which the modelling is based. The Golder report to Greenstar is attached to this submission.

Golder has identified several fundamental difficulties with the Hydrogeological Risk Assessment. The authors of LandSim outline significant concerns relating to the conceptual model upon which the modelling is based. For instance, there is uncertainty regarding the status of groundwater present in the overburden (as per the Groundwater Directive), its interaction with surface water courses, its hydraulic continuity with the underlying bedrock aquifer, and how it will be managed throughout the lifecycle of the landfill.

The groundwater in the clay subsoils is described as 'perched' in the risk assessment submission. However, the overburden watertable generally approximates with the bedrock aquifer piezometric surface, as described in the attached Golder report. This indicates that the overburden groundwater cannot therefore be perched. Furthermore, the Risk Assessment appears to view the groundwater in the overburden as a pathway and not a receptor.

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Directors: G. Bailey, G. Dennison, M. King, S. Cowman, E. Bolger (Secretary)
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The definition of 'groundwater' in the Groundwater Directive and the Water Framework Directive includes all water which is below the surface of the ground in the saturation zone and in direct contact with the ground or subsoil. The groundwater in the overburden at Nevitt satisfies this definition. This is very significant as the discharge of List I substances to groundwater is prohibited by the Groundwater Directive. Therefore, the overburden groundwater cannot be viewed as a pathway as is the case in the submitted risk assessment, as it is actually a receptor. This appears to be a fundamental flaw that undermines the whole risk assessment undertaken. According to Golder, these fundamental issues need to be resolved before any further consideration can be given to the modelling that has been undertaken to date comprising LandSim and the EA Diffusion model.

Notwithstanding this, Golder has undertaken a preliminary assessment of the modelling presented in the submission. It is firstly important to note that LandSim is a landfill performance package for site settings above the watertable. It is unclear from the Hydrogeological Risk Assessment submission, when during the anticipated landfill lifecycle, that the conditions will exist to match the fixed conceptual model output provided by the LandSim simulation in the submission. Furthermore, the modelling does not take into account engineering controls that will be applied during the lifecycle of each cell and some of the inputs utilised by both models require clarification.

On the basis of the advice from the authors of LandSim, Greenstar contends that the Hydrogeological Risk Assessment as presented is flawed and merits no further consideration or discussion.

Illegal Dump

In addition to the above points, it is noted that the Risk Assessment Submission briefly addresses the illegal dump that exists at the site and states at Section 2.2 on Page 4 that the illegal dump "*will be subjected to a separate risk assessment process using the Environmental Protection Agency's Code of Practice for Unregulated Waste Disposal Sites (and in line with any conditions in any Waste Licence issued by the EPA in respect of the site) to determine whether it can be remediated in-situ by construction of an engineered cap or whether excavation of material is required*".

Unfortunately the submission does not present a timeframe for the completion of this risk assessment, but the above statement infers that it may not be undertaken prior to receipt of the Agency's final determination of the Waste Licence Application.

It was clearly demonstrated in the evidence presented by Greenstar to the EPA oral hearing held in March 2008 that inadequate site investigation and assessment has been undertaken in the EIS and Waste Licence Application in respect of what is potentially one of the largest illegal dumps discovered to date in Ireland. The vertical and lateral extent of the waste, nature of the waste, and potential of the waste to generate landfill gas/leachate have not been adequately addressed, or in some cases not addressed at all.

A comprehensive site investigation and risk assessment should be immediately completed as part of the Environmental Impact Assessment (EIA) process and in advance of any determination by the Agency regarding the type of activity that could be licensed at the Nevitt location.

The approach adopted to date is contrary to Government Policy as set out in the Section 60 Direction issued by the Minister of the Environment in 2005 (Circular WIR: 04/05) that clearly states *"The primary obligation of a local authority or the Agency when illegal waste activity is discovered is to ensure that the waste is recovered or disposed of, in the shortest practicable time, without endangering the environment or human health...."* Almost three years have passed since the presence of illegally deposited waste was confirmed in the EIS, and a considerably longer timeframe since the Local Authority first became aware of the illegal dump at the site, and still no attempt has been made to comply with the Section 60 Ministerial Direction.

It should be noted that the 2006 EPA publication entitled *'Methodology for the Identification of Waste Disposal or Recovery Sites in Ireland'* states that the Section 60 Direction *"was part of the response of the Irish Government to the ECJ ruling in case C-494-01 in order to demonstrate that the necessary measures are now being taken in Ireland, in terms of the structure, legislation, and policy approach, to ensure the correct implementation of the provisions of the Council Directive 75/442/EEC of 15th July 1975 on waste as amended by Council Directive 91/156/EEC of 18th March 1991 and thereby fulfil the obligations under this directive."*

I would be grateful if you could please acknowledge receipt of this submission.

Yours sincerely,

Margaret Heavey

Head of Landfill Operations

For Greenstar

1 Attachment: Golder Associates Correspondence dated 19th/20 March 2009

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Golder Associates

Mr Morgan Burke
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20 March 2009
09507190340.L01.V1

Dear Morgan

FINGAL LANDFILL PROJECT

Introduction

This letter has been produced by Golder Associates (Golder) following a preliminary review of hydrogeology sections of the Environmental Impact Statement (EIS), dated April 2006 and prepared by RPS Consulting Engineers, to support the proposed Fingal Landfill Project. We have also reviewed the Hydrogeological Risk Assessment (HRA), dated February 2009 and prepared by RPS. Here we have focused on what we have identified and consider to be among the most significant issues, or potential weaknesses, relating to the integrity of the Water Impact Assessment elements of the submission. Items are presented on a bullet point basis. Effectively these issues may also be identified by the Planning Authority and/or also the Environmental Protection Agency (EPA) as requiring revision, further work or clarification.

Review comments provided relate to the conceptual model, including the source, pathway and receptor linkages, and the modelling approach and assumptions and selections made.

Conceptual Model

In respect to the conceptual model of the hydrogeological conditions in which the landfill will be developed our comments are as follows:

Pathways

- Conceptually the shallow overburden (drift) has been presented as having a perched water table, yet lateral flow gradients associated with this water table and within this unit do not appear to be discussed, nor the associated potential for provision of natural baseflow from this unit to streams that will neighbour the landfill. On this basis, the possibility for migration of List I & II substances within the drift to peripheral streams has not been assessed or excluded;

- Although individual groundwater dip readings were not observed in the submission, from estimating selected elevations from borehole hydrographs, it would seem that the shallow drift water table in general, approximates the underlying piezometric surface from the GravelBedrock aquifer (this applies to shallow drift holes (ER13, ES2, HR8, GS6, ASA2, GS2). At this stage, and given the data available, the only observed exception to this is for monitoring location ES8, where the shallow drift groundwater elevation can be in the order of 10 m above the hydraulic head in the underlying Gravel/Bedrock unit in the vicinity of this hole. It is suggested that the hydraulic interaction between the shallow drift and

underlying Gravel/Bedrock aquifer, and indeed the permeability of the shallow clay rich drift unit as a whole, would be better understood by further comparison of these levels across the site; and

- It would be beneficial to see all available drift water level data introduced to a Gravel/Bedrock groundwater contour plot across the site for comparison, together with several detailed hydrogeological cross-sections produced for the development area highlighting individual sand and gravel bands within the drift in particular. The potential implications are that the clay rich drift unit could be better described as a leaky confining layer rather than containing a perched water table. The former would suggest its saturation is influenced by the piezometric envelope provided by the Bedrock system and therefore its permeability, as a unit, may be greater than that described by the individual slug and clay sample testing presented (which in fact provides values of hydraulic conductivity of up to 5.3 E-6 m/s). Such arguments are considered key, and certainly if the groundwater in the vicinity of the proposed landfill footprint is not to enjoy 'Groundwater' status as recognised by the Groundwater Directive (see below).

Receptors

- Groundwater within the clay rich drift appears to be viewed as a pathway only within the submission and not as a receptor. The Groundwater Directive and Water Framework Directive state that 'Groundwater' means all water which is below the surface of the ground in the saturation zone and in direct contact with the ground or subsoil. The Directive also states that the discharge of List I substances to groundwater is prohibited. No justification has been observed/provided to support the fact that the 'perched' water table as it is described within the drift does not meet the above referenced specification, and therefore that List I substances can be legitimately discharged to this water. Concentrations were modelled and reported at the base of 10 m of clay drift and not just prior to the drift water table.

Consideration of Landfill Development

- There are four conceptual hydrogeological model scenarios presented for the landfill (Figure 5 of the HRA). These are not necessarily linked in a logical stepped manner to any expected lifecycle for each of the phases of the site development. However, the number and nature of the scenarios reflect a large range of conditions and potential pathways. This occurrence may be a reflection on a perceived emphasis on retaining 10 m of drift below the site floor, to achieve a suitable status in EPA landfill location matrices, rather than on obtaining a definitive conceptual hydrogeological model for the site (such as a confirmed sub water table setting) coupled with the likely site engineering and hydraulic controls;

- None of the scenarios deal with the likely consequence of the site design incorporating an under drain (below the liner). If drift boreholes are yielding groundwater levels above the proposed leachate elevation in the site (described in the HRA Executive Summary as 'generally expected'), it is fair to assume that a large excavation into the drift to allow for liner emplacement at least 2 m below this level (liner thickness plus 1 m leachate head) will require dewatering during early operations and filling at the site to ensure liner stability. During this time, any contamination leaking from the site will presumably be drawn out from the under drain and not enter the clayey drift as envisaged. No indication has been observed as to the likely water quantity or quality from the under drain or what will be done with this abstraction;

- Development of a high permeability under drain below the footprint may encourage contaminants to move laterally below the floor of the site and above the underlying less

permeable materials. This may be promoted not only by active dewatering sumps, but also by the reported natural lateral hydraulic gradient in the shallow drift, which perhaps drains to a peripheral stream. In either case, during filling of the landfill and when active dewatering of an under drain is expected, it is difficult to envisage that the landfill performance can be adequately simulated by migration through 10 m of clay underlying the site;

- When sub water table landfills become filled and liner stability can be assured, dewatering of groundwater on the outside of the liner is normally relaxed in a phased and controlled manner. Figure 3.18.7 of the EIS submission presents the leachate with the landfill as being hydraulically contained below both a shallow perched water table in the drift and the piezometric surface in the underlying Gravels/Bedrock. However, the Executive Summary of the subsequent HRA is less definitive (as detailed above); and

- Following termination of leachate management within the landfill, the HRA states that *'leachate levels would rise over-time and could potentially exceed perched groundwater levels within the clay..... Eventually a hydraulic equilibrium between leachate levels and perched groundwater would be established such that there would be no net hydraulic flux between the two and the main transport mechanism would be diffusion'*. We would expect that the final leachate level within the site (post active leachate management) would be predominantly influenced by the hydraulics of the landfill including the relative performance of the cap to allow for infiltration and the liner to release leachate. In our experience of modern membrane lined landfill hydraulics, and in particular due to the fact that this site appears to be at least partially hydraulically contained with a relatively shallow waste mass, leachate levels would be expected to accumulate following termination of control until they exceed the surrounding groundwater elevation. Thereafter, breakout via the cap is anticipated, perhaps to a surface water course. As such, diffusion would not be expected to be the main mechanism driving contamination from the site at this time, but rather advective flow down a hydraulic gradient across the liner or break out flows through the restored landfill surface into perimeter surface water drains.

Summary Comments on Conceptual Model

- Uncertainty remains regarding groundwater present within the drift in particular. This includes its status (as per the Groundwater Directive), its interaction with surface water courses, the degree of hydraulic interaction or continuity it has with the underlying deeper bedrock aquifer unit, and how it will be progressively managed throughout the lifecycle of the landfill. These are fundamental issues that support the conceptual model upon which the computer simulations are based. These issues need to be resolved before the modelling that has been carried out to date can be considered relevant and applicable to this landfill proposal. Indeed the modelling carried out thus far may not be relevant and applicable as described below.

Modelling

In respect to the modelling of the landfill performance our comments are as follows:

- The models that have been run include a LandSim model and an Environment Agency Diffusion model (SC0310 Hydraulic Containment Model). It is believed that there are some discrepancies between the two simulations undertaken and the four scenarios presented.

LandSim

- The LandSim model presented has been used to predict concentrations at the base of a 10 m thick clay drift column as a result of a 1 m leachate head on the basal liner driving leakage out of the site by advective flow. The 1 m leachate head is maintained in the model for 60 years following initial waste disposal (30 years following expected closure). Thereafter, LandSim can be used to determine the leachate level within the site based on its transient water balance capabilities and varying infiltration rates and leakage rates as a result of the assumed gradual degradation of the geomembrane in the base liner and in the cap over time and varying leachate heads. These future leachate head conditions (beyond 60 years) do not appear to have been reported on. In addition, it is not clear to us which of the scenarios presented on Figure 006 of the HRA is being simulated by LandSim; and

- LandSim has not been designed for a sub water table setting. The model determines leakage rate based on leachate head and liner properties, and no account is taken of any hydraulic head on the outside of the liner. Notwithstanding the above, it is unclear when and for what duration within the landfill lifecycle the above set of simulated conditions will occur. Clearly at some points during the life cycle the underdrain pumps and the leachate pumps in each cell will be turned off. The impact of having and not having these engineering controls has not been fully considered in the modelling.

SC0310 Hydraulic Containment Model

- Not all of the anticipated inputs required for the hydraulic containment model nor the actual print out from the model spreadsheets were observed in the submission for review (e.g. properties relating to the geomembrane). Some of the input selections discussed regarding LandSim above may also apply to this simulation, in both cases electronic copies of all models are necessary for further detailed comment. Output from this model again is reported at the compliance point taken as the base of the drift.

Summary Comments on Modelling

- It is unclear exactly when within the anticipated landfill lifecycle, the conditions will exist to match the fixed conceptual model output provided by the LandSim simulation in the HRA. LandSim is set up and marketed as a landfill performance package for site settings above the water table. The modelling needs to take into account the engineering controls that will be applied during the lifecycle of each cell. Until this is done it is not possible to say that the modelling is adequate and appropriate for the proposed landfill in Fingal; and

- Some inputs selected and utilised by both models require clarification and would benefit from site specific justification as opposed to literature values. In particular, these relate to the manner in which leachate will be managed and controlled within the landfill (including leachate treatment technology and the duration of head control), and selected contaminant degradation and retardation rates in certain pathways. Clarification is required if LandSim predicts cap breakout following termination of leachate head control, what the breakout rates and concentrations will be at the time, and if appropriate, what consideration has been given to this pathway in the submission.

The above provides for our preliminary review of selected elements of the Fingal Landfill submission. If you have any queries or concerns regarding our work do not hesitate to let us know.

Yours sincerely
GOLDER ASSOCIATES IRELAND LTD

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Senior Hydrogeologist

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Principal

SB/kmck

cc David Hall, Golder Associates (UK) Limited