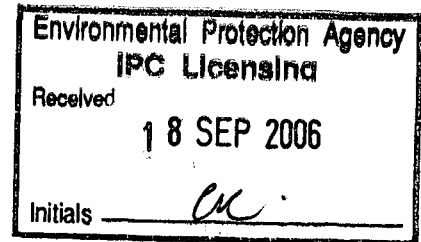


Licensing Unit,
Office of Licensing & Guidance,
Environmental Protection Agency.
Johnstown Castle Estate,
County Wexford



Sliding Rock,
Blackglen Road,
Sandyford,
Dublin 18.

13-9-2006



Re: Waste Licence Application W 0231-01 Fingal Landfill

Submission by Kevin Cullen.

Dear Sirs,

The main elements of the Applicant's conceptual hydrogeological model are outlined in Section 3.6 of Volume 5 of the Environmental Impact Statement (EIS).

A key element of the Applicant's conceptual model is the transmissivity (or groundwater potential) of the bedrock underlying the development site.

The Applicant reports that the transmissivity of the underlying bedrock has been determined from the results of pumping tests carried out on 3 wells located on the development site. The resulting transmissivity values are recorded in Table 5 of Volume 5 and also in Table 3.18.1 in the Main Report Volume 2 of the EIS.

The Applicant goes on to state at;

3.5.3.2 Pumping Tests (Volume 5)

'Overall, the transmissivity values obtained are low to moderate. This is consistent with the GSI aquifer classification, i.e. a locally important bedrock aquifer which is 'generally moderately productive' (Lm).'

and at;

3.6 Conceptual Model (Volume 5)

'Transmissivity within the bedrock aquifer was found to be low to moderate (10-76m²/day), based on pumping tests and were generally significantly lower than those found within the Bog of the Ring groundwater body'

and at;

3.18.3.5 Study Area (Landfill) Hydrogeology (Volume 2)

'Overall, the Transmissivity values obtained are low to moderate. This is consistent with the GSI aquifer classification, i.e. a locally important bedrock aquifer which is 'generally moderately productive' (Lm). The transmissivities obtained were generally significantly lower than those

found within the Bog of the Ring groundwater body as reported by GSI which is to be expected as the groundwater is derived from two separate aquifers.'

The Applicant's transmissivity data does not in fact support either conclusion due to the;

- shallow depth of the pumping wells (see Table 1 below),
- short screened sections in the pumped wells (see Table 1 below) and the
- fracture flow nature of the underlying bedrock aquifer.

The permeability values for the bedrock sections tested by the Applicant's pumping tests are actually within the range of permeability values for the Bog of the Ring wells as reported by the Geological Survey of Ireland (GSI) in Table 5 of the GSI's Source Protection Report of March 2005.

It can therefore be reasonably concluded that the groundwater resources beneath the development site may be of similar potential as those found in the bedrock aquifer at the Bog of the Ring.

This conclusion is readily supported by the Applicant's results from the upper part of the underlying bedrock aquifer and by the many high yielding wells from the surrounding townlands of Man'oWar, Ballyboghil, Lusk, Malheney, & Loughshinny all of which were drilled to c.90 and deeper and where similar bedrock conditions are reported by the published geological map of the area, Sheet 13.

Pumping Well Details

The 3 pumping wells PW1,2 and 3 used by the Applicant to measure the bedrock transmissivity were drilled to depths of 36.4m, 31.5m and 34.9m respectively. Of equal importance is the fact that the screened lengths in the 3 wells varied from only 4m in PW1 to 9m in both PW's 2 & 3.

In contrast, the pumping wells recorded by the GSI i.e. PW2, PW3 and PW5 in the Bog of the Ring area are generally much deeper with saturated screened lengths of 36m, 39m and 43m respectively.

Shallow wells with limited screen lengths in fractured bedrock aquifers only sample the productivity of the upper section of the aquifer. Deeper wells with longer screen lengths are required to measure the overall productivity of a fractured bedrock aquifer. The longer screen lengths allow groundwater from all the intersected water bearing fractures to access the well chamber.

Clearly, a shallow well will not intersect deeper water bearing fractures and so the measured transmissivity and potential yield from such a well will be less than from a deeper well at the same location.

Applicant's Analysis of Pump Test Data

The Applicant's transmissivity values for the bedrock aquifer beneath the development site are recorded in Table 5 of Volume 5 of the EIS. These values are arrived at through the application of standard analytical techniques which assume homogeneous conditions to be present in the aquifer. In particular, for partially penetrating wells it is assumed that deeper groundwater can access the pumping well.

This is not the case in the fractured bedrock aquifers that lies beneath the development site and the Bog of the Ring.

The Applicants transmissivity values therefore only reflect the productivity of the tested depths of the aquifer at the development site and particularly only over the screened lengths of the pumped wells. In the same way, the permeability values derived from the transmissivity values (where $T = kd$) only relate to the screened lengths of the bedrock and not the notional aquifer thickness of 50m as applied by the Applicant in this case.

The transmissivity values recorded by the Applicant at the development site should not be applied over the deeper bedrock without pump testing the full rock profile, which the Applicant has chosen not to undertake.

To accept the Applicant's extension of the shallow transmissivity values to the whole rock column (say to 80-90m) would suggest that a shallow well in a fracture flow aquifer would have the same capacity as a deeper well regardless of the number of additional fractures intersected by the deeper well.

Such a proposal does not agree with the general experience of groundwater development in fracture flow aquifers.

Comparison with GSI's Analysis of Test Pump Data

The GSI present an analysis of pump test data from the Bog of the Ring using the same general analytical techniques used by the Applicant for the transmissivity determinations at the development site. Table 5 of the GSI's Source Protection Report of March 2005 in demonstrates how representative permeability values for the fracture flow aquifer are then derived from the calculated transmissivity values by dividing the transmissivity by the saturated screen length.

The GSI's Table 5 indicates that the permeability of the tested depth of the bedrock aquifer at the Bog of the Ring at the PW2, PW3 and PW5 sites is in the range 3.1m/d to 4.2m/d for the drawdown stages of the tests and between 6m/d to 8m/d for the recovery stages. Applying the same approach as used by the GSI to the Applicant's results provides a range of permeability values for the pumping wells on the development site of 3-4m/d at PW1, 7.3-8.4m/d at PW2 and 1.1-4.2m/d at PW3.

These permeability values reflect the bedrock conditions over the screened sections of the Applicants 3 pumped wells.

It is possible to now apply these permeability values to the deeper rock at the development site for the average (39m) screened length used at the Bog of the Ring wells. This exercise indicates the likely groundwater potential of the deeper bedrock at the development site in the event that the groundwater flow conditions encountered in the upper part of the bedrock continue downwards to the same depths as tested at the Bog of the Ring.

Table 1 provides some well details and the results of applying the GSI's analytical approach to the test pump data collected at the landfill development site.

| Development Site | Depth (m) | Screen Length (m) | Permeability m/d | Transmissivity (m ² /d) |
|------------------------|--------------|----------------------|---------------------|---------------------------------------|
| PW1 | 36.4 | 4 | 3-4 | 117-156* |
| PW2 | 31.5 | 9 | 7.3-8.4 | 284-327* |
| PW3 | 34.9 | 9 | 1.1-4.2 | 39-180* |
| Bog of the Ring | | | | |
| PW2 | c.80 | 36 | 3.9-4.2 | 139-152** |
| PW3 | c.50 | 39 | 3.6-3.8 | 141-149** |
| PW5 | c.80 | 43 | 3.1 | 133** |

* New Screen Length = 39m, ** Screen Length = as reported by GSI.

Table 1. Application of GSI Analytical Methodology to Applicant's Pumping Wells.

The resulting transmissivity values for the pumping well sites on the development site are 117-156m²/d at PW1, 284-327m²/d at PW2 and 39-180 m²/d at PW3. These transmissivity values are within the range recorded by the GSI at the Bog of the Ring.

Conceptual Model Extent

The Agency might also wish to enquire of the Applicant how the diagram summarising the various components of the conceptual model is described in 3.18.4 Conceptual Site Model, Volume 5 of the EIS as;

'Figure 9 is a sketch of the Conceptual Site Model for the immediate vicinity of the landfill footprint area.'

while at 3.18.4 Conceptual Site Model in the Main Report (Volume 2) the same drawing is described as;

'Based on the proceeding sections which present regional and local hydrogeology, a hydrogeological conceptual site model was determined for the proposed landfill area within a radius of 5km and is summarised in Figure 3.18.7'

No supporting information is provided by the Applicant to indicate how the conceptual model for *'the immediate vicinity of the landfill footprint'* in Volume 5 could be possibly extended to describe hydrogeological conditions *'within a radius of 5km'* from the development site in Volume 2.

Such a wide area would include Bog of the Ring, Man'o War, Malheney and Ballyboghil where the underlying bedrock aquifer has been shown to be particularly productive. This would be at variance with the Applicant's description of the low groundwater potential of the bedrock aquifer in the conceptual model.

Summary

It can be reasonably concluded from the foregoing analysis of the Applicant's pumping test data that the groundwater resources beneath the development site may be of similar potential as those found in the bedrock aquifer at the Bog of the Ring.


This conclusion is readily supported by the Applicant's results from the upper part of the underlying bedrock aquifer and by the many high yielding wells from the surrounding townlands of Man'o War, Ballyboghil, Lusk, Malheney, & Loughshinny all of which were drilled to c.90 and deeper and where similar bedrock conditions are reported by the published geological map of the area, Sheet 13.

I respectfully suggest that the Agency request the Applicant to address the comparison of the transmissivity values determined on the development site with those produced by the GSI from the Bog of the Ring as reported by the Applicant in Volumes 2 and 5 of the EIS.

I respectfully suggest that no useful comparison can be made between the transmissivity data from the bedrock aquifer beneath the development site with transmissivity values from the Bog of the Ring bedrock aquifer without similarly deep wells being tested on the development site.

The absence of such deep wells in the fracture flow aquifer found beneath the development site continues the uncertainty as to the overall potential of the groundwater resources beneath the proposed landfill site. However, the above analysis of the available data indicates that significant groundwaters are probably located in the bedrock aquifer underlying the Nevitt -Tooman area.

Yours Sincerely,



EurGeol Kevin T. Cullen PGeo.