W0231-01
Sub 48

ENVIRONMENTAL PROTECTION AGENCY
08 NOV 2006

Sliding Rock,
Blackglen Road,
Sandyford,
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Licensing Unit,
Office of Licensing & Guidance,
Environmental Protection Agency.
Johnstown Castle Estate,
County Wexford

7-11-2006

Re: Waste Licence Application W 0231-01 Fingal Landfill

Objection By: Kevin Cullen

Dear Sirs,

A review of Geological and Hydrogeological Sections (Vol. 5) of the EIS accompanying the above licence application indicates that there are a number of significant omissions and inaccuracies in the published document.

These inaccuracies and omissions can only be properly addressed through the publication of a revised EIS.

I am confident that a revised EIS will clearly demonstrate the proposed Nevitt landfill will compromise a significant groundwater resource that could be readily developed in association with the nearby Jordanstown reservoir located just 1km to the east of the development site.

I am equally confident that a revised EIS will demonstrate that the proposed Nevitt landfill is an unsustainable development and would, if allowed to proceed, prevent future generations using the groundwater resources now proven to exist at the Nevitt site.

In these circumstances the proposed landfill at Nevitt should not be allowed to proceed.

The inaccuracies and omissions identified in the Geological and Hydrogeological Sections (Vol. 5) of the EIS are generally as follows.

Section 3.2 .1 Bedrock Geology

i) Absence of Local Bedrock Geological Map

The Applicant has chosen to rely completely on the Geological Survey of Ireland (GSI) map of the region, Geology of Meath Sheet 13 and published in 1999 at a scale of 1:50,000, as the basis for the geological and hydrogeological interpretation of the collected data sets at the development site.

Figure 4, which is a reproduction of part of the GSI Sheet 13 is presented in the EIS as describing the bedrock geology for the Nevitt site. No other geological map for the Nevitt site is included in the EIS.

Figure 4 is an enlargement of the original GSI published map. The enlargement of the GSI map to a scale of 1:25,000 is misleading as it might suggest that additional geological data has been used to enhance the original GSI boundaries and fault lines.

In fact, none of the geological information gathered from the 102 boreholes completed during the Nevitt project have been used to update the geology of this part of Fingal or the development site.

This omission is important as the Memoir accompanying Sheet 13 announces that the Sheet 13 is;

'constructed from information recorded at surface outcrops and from boreholes and geophysical information where available.'

However, on page 5 of the Memoir the GSI cautions about relying on the map in areas of thick overburden;

> *'Using structural measurements such as strike and dip of bedding, position of fold axes and faults, geologists have extrapolated from exposed into unexposed ground. Uncertainty grows with increasing distance between outcrops, and where rock outcrops are few and far between, for example in areas of thick Quaternary glacial deposits, the map is an intelligent guess.'*

The development site and the Applicants study area are both characterised by thick overburden. The exact bedrock geology of the development site and surrounds can only therefore be provided through the interpretation of borehole and geophysical information.

The Applicant completed over 100 boreholes at and around the development site together with numerous geophysical surveys. The information gathered from these boreholes and geophysical surveys should have been used to enhance the geological picture or 'intelligent guess' provided on Sheet 13 for the development site.

The Applicant should have presented in the EIS a geological map based on the recent drilling results of the bedrock geology of the development site at a scale of 1:10,000.

Conclusion: A revised EIS should be published with a detailed geological map at a scale of 1:10,000.

ii) Absence of Detail Cross Sections

No detailed geological cross sections are included in the EIS. The cross sections presented in Appendix a1 are regional in nature, inaccurate and do not portray the geological conditions actually found at the development site.

Section A-A' does not pass through the landfill footprint as suggested in Appendix A1.1. As shown in Figure 4 of the EIS Section A-A' passes mostly to the west of the footprint.

The Loughshinny Formation is shown as only 10m thick on Section A-A' while to the north and east of the development site it is shown as being many 100's of metres thick. No such thinning of the Loughshinny Formation is indicated on the GSI Sheet 13.

Detailed and site specific geological cross sections through the development site should have been included in the EIS.

Conclusion: A revised EIS should be published with a series of north-south and east west cross sections through the landfill footprint with a horizontal scale of 1:10,000.

Section 3.2.2 Study Area Bedrock Geology

i) Bedrock Lithologies

The EIS states that the 'Lithologies encountered were limestones , siltstones and mudstones inferred to be of the Balrickard, Loughshinny, Lucan, Naul and Walshestown Formations.'

This Loughshinny, Naul and Lucan Formations are defined on both lithological and biostratigraphic grounds. Prior to the publication of Sheet 13 by the GSI, the monotonous dark coloured and lithologically similar limestone and shales found in north Dublin and neighbouring County Meath were grouped together within a single bedrock unit referred to as the Calp Limestone unit. Advances in biostratigraphy in the mid 1990's using conodonts and foraminifers allowed the Calp Limestone unit to be subdivided into a number of identifiable formations with specific ages within the Dinantian biozone.

The Loughshinny Formation is of Brigantian age while the Naul and Lucan Formations are of Chadian to Asbian age .

As the Loughshinny Formation is very similar lithologically to the older Lucan and Naul Formations it is necessary to carry out biostratigraphic studies to establish the presence and exact distribution of each of these components of the Dinantian biozone.

The exact distribution of the various formations needs to be completed as there appears to be poor correlation between the published Sheet 13 and some of the bedrock descriptions given in the EIS. For instance, boreholes SHR1, SHR2 and ER9 all return thick successions of mudstone while supposedly being collared in the Loughshinny, Naul and Lucan Formations respectively as per the GSI Sheet 13. Also, borehole BRC1 is shown of Section AA (see Apendix A1.1 of Volume 5) as being located in the Balrickard Formation which consists of sandstones. However, the log for borehole BRC1 records only limestone.

No biostratigraphic studies appear to have been carried out during the detailed site investigations. This work would have enhanced the geological picture published by the GSI without the benefit of this wealth of geological information.
In the absence of this information, the geological picture presented in Sheet 13 provides the most recent picture of the distribution of the various formations found in the Nevitt area.

Figure 4 of Volume 5 of the Applicant's EIS indicates how the landfill footprint is reportedly partly underlain by the Loughshinny Formation, which is the geological unit supplying the Bog of the Ring well field.

While the Sheet 13 'intelligent guess' shows the Loughshinny Formation underlying only the northern part of the footprint the exact situation remains uncertain. In fact, in the absence of the major displacement of the Loughshinny Formation proposed by the GSI the whole of the landfill footprint could be underlain by the Loughshinny Formation.

Conclusion: A revised EIS should be published with a map at a scale of 1:10,000 showing the distribution of the bedrock Formations derived from an analysis of the cores collected during the Nevitt drilling programme.

ii) Bedrock Structure

No attempt was made in the EIS to establish the distribution of faults beneath the development site rather the EIS relies wholly on the structural picture presented in regional Sheet 13 which, as stated above, was constructed without the benefit of borehole data in the Nevitt area.

Nor has the Applicant presented in the EIS a detailed interpretation of the collected geological data for the development site by way contoured plans of the bedrock surface.

The accompanying Figure 1 shows that a deep north – south trending trough or buried channel is present in the bedrock surface within and beyond the Applicant's study area.

This buried channel feature is also highlighted by the depth to bedrock contours shown in Map 2b of the Final Geophysical Report provided in the supporting documents to Volume 5. In fact the base of the trough is given as close to sea level below the southern part of the landfill footprint.

This bedrock trough or buried channel feature is generally coincident with the postulated major north south fault shown by the GSI Sheet 13 as traversing this part of north county Dublin. The bedrock depression probably reflects a weakening or weathering of the bedrock here as a result of the structural deformation associated with the faulting.

The N-S trending bedrock depression is likely to be primarily structurally related as bedding strike is east west in this region generally.

The accompanying Figure 1 also shows how the trace of this postulated structural break is associated with a very broad fault zone which extends beneath the landfill foot print. The exact location of the GSI fault remains uncertain as it might define either the eastern or western edge of the bedrock escarpment or be located in the intervening graben like feature.

For example, at borehole SHR3 in the west of the landfill footprint there is at least a 15m change in the elevation of the bedrock surface between this borehole and the nearby borehole SHR3a.which is located approximately only c.60m away.

However, the fault zone presented in the accompanying Figure 1 is more likely to be composed of numerous fault like features and which together account for the structural displacement of the Loughshinny Formation described on the GSI's Sheet 13.

The Loughshinny Formation at the Bog of the Ring well field is similarly in close proximity to a major fault feature as shown on Sheet 13 as indicated on the Applicant's section A-A' in Apendix A1.1 of Volume 5. It is postulated that the productivity of the Loughshinny Formation at the Bog of the Ring is related to the structural deformation that would be associated with the near by fault.

A similar increase in the groundwater productivity in the Loughshinny Formation could reasonably be anticipated at Nevitt due to the proximity of the major N-S fault feature.

Conclusion: A revised EIS should be published with a map at a scale of 1:10,000 showing the contours of the bedrock surface together with the proposed fault lines and Formation boundaries.

Section 3.3.2 Study Area Quaternary Geology

The EIS fails to describe the presence of the major sand and gravel deposit that extends from the Bog of the Ring well field south wards to beyond the Nevitt site.

The accompanying Figure 2 indicates the likely extent of this sand and gravel deposit at Nevitt as derived from the borehole logs presented with the EIS. It is obvious from the accompanying Figure 2 that this unit is continuous, very thick in places and open in extent both to the north and south.

Figure 2 shows how the deep bedrock valley outlined on the accompanying Figure 1 is infilled with sands and gravels and which predate the deposition of the overlying glacial till deposits. Figure 2 also indicates that much of the landfill footprint is underlain by the sand & gravel deposit.

The sand and gravel deposits found at Nevitt are a continuation of similar sand and gravels found further north at the Bog of the Ring. The full extent of the sand and gravel deposit remains to be established as the northern and southern ends remain open. The sand and gravel deposits found at the Bog of the Ring well field are understood to be an integral part of the groundwater system that supplies the production wells.

The gravel deposits found at Nevitt and the Bog of the Ring also constitute an important groundwater resource in their right. For example, a trial well (TW9) completed by Dublin Co. Co. in these gravels was test pumped at a rate of 1,200m^3/day in 1993. TW 9 is located between Nevitt and the Bog of the Ring well field. Similarly, the pumping test conducted by the Applicant at borehole ASA2 in the gravels yielded 623m^3/day with a screen length only over half the aquifer thickness at that location.

It would be expected that the sand and gravel deposits at Nevitt would play a similar bedrock transmissivity enhancing role as the sand and gravel deposits do in the Bog of the Ring abstraction and which is noted on page 34 of Voume 5 of the EIS.

Conclusion: A revised EIS should be published with a map at a scale of 1:10,000 showing the distribution of the extensive sand and gravel deposit found at Nevitt.

Section 3.4.4

The EIS selectively quotes from the ERBD Final Characterisation Report to suggest that the beddrock aquifer found at Nevitt is being over abstracted. The EIS fails to present or analyse the data on which the ERBD findings were based and fails to reflect the actual artesian and flowing conditions reported from wells drilled during the Nevitt project.

1. The ERBD report for Fingal indicates that no water bodies are under hydrological pressure.
2. There are no EPA monitoring wells in the groundwater body on which to support the over abstraction scenario.
3. The EIS reports artesian and flowing conditions in the vicinity of the Nevitt site.
4. The EIS notes that the Bog of the Ring abstraction has no impact whatever on groundwater levels in the nearby Nevitt area

There is no factual evidence whatever and none is presented in either the ERBD report or the EIS to suggest that the bedrock aquifer found in north Fingal is being over abstracted.

In fact all the available evidence indicates the opposite picture which is that the aquifer is full up and overflowing.

Conclusion: A revised EIS should be published without the suggestion that the Nevitt bedrock aquifer is being over abstracted.

Section 3.5.2 Groundwater levels, flow direction and recharge.

The EIS fails to relate the groundwater flow pattern to the distribution of faulting in the underlying bedrock. In particular, the EIS fails to identify areas of increased permeability beneath the landfill footprint as indicated by the groundwater flow pattern.

The accompanying Figure 3 superimposes the fault zones derived from the analysis of depth to bedrock presented in the accompanying Figure 2.

It is clear that the fault zone is seen to impart a major control on the bedrock groundwater flow patterns presented in the EIS by the Applicant in Appendix A5 of Volume 5. Note also the dramatic change in the groundwater gradient in the south west of the planned footprint area which coincides with the western edge of the fault zone.

Clearly, the proposed fault zone represents an area of increased permeability as demonstrated by the preferential flow of groundwater in the bedrock to and along this zone.

Note how the fault zone is acting as a regional conduit for groundwater movement. The fault zone collects groundwater from both the east and west and then channels the groundwater to flow both to the north and south of borehole HR13b.

Conclusion: A revised EIS should be published with a map at a scale of 1:10,000 showing the distribution of zones of high permeability at Nevitt and an analysis of how these zones control the groundwater flow patterns beneath the landfill footprint.

Section 3.5.2.2 Groundwater Recharge

The EIS uses hydrographs collected from a number of monitoring wells to suggest that the recharge to the bedrock aquifer is low. This conclusion is incorrect as the analysis in the EIS fails to take account of the position of the groundwater levels in relation to the top of the aquifer at each of the monitoring wells.

In fact, groundwater levels quickly rise to the top of the aquifer where and when the aquifer is capable of accepting recharge after which time any additional infiltration is rejected.

Rejected recharge has been an accepted characteristic feature of Irish aquifers for the past 20 years.

For example, in the monitoring borehole BRC2 the hydrograph shows the groundwater level falling below the top of the aquifer which is at 51.65mOD in May 2005. In this situation the aquifer is unconfined and can readily accept recharge when it is available and which it does after October 2005. The groundwater level quickly responds to recharge until it again reaches the top of the aquifer at 51.65mOD. After this time any additional recharge is rejected until the groundwater level again falls below the top of the aquifer.

The picture is different in most of the other monitoring wells as the aquifer remains confined and artesian during the entire monitoring period.

The aquifers, i.e. both the bedrock and the overlying sand and gravel deposit at Nevitt are generally full up and incapable of accepting additional recharge. This is evident from Table1 below which shows that in all of these monitoring boreholes the aquifers are confined and artesian. Any additional recharge could only be accommodated at these locations through an expansion of the aquifer.

Borehole No.	Aquifer Type	Top of Aquifer mOD	Groundwater Level mOD	Aquifer Condition
BRC5	Bedrock	34.89	>40	Artesian
ER3	Bedrock	26.2	>50	Artesian
HR1A	Bedrock	17.7	>30	Artesian
HR4	Bedrock	54.47	>60	Artesian
SHR2	Bedrock	14.97	>29	Artesian
HR1B	Gravel	32.4	>30	Artesian
ASA2	Gravel	22.76	>29	Artesian

Table 1. Aquifer conditions at monitoring borehole sites.

Conclusion: A revised EIS should be published with a corrected analysis of the groundwater patterns displayed on the monitoring well hydrographs and without the suggestion that recharge to the aquifer is low.

Section 3.5.3 Aquifer Characteristics

The EIS incorrectly projects the transmissivity values determined from the shallow pumping wells completed at Nevitt to the entire bedrock column and suggests that based on these results that the bedrock aquifer at Nevitt is less productive than at nearby Bog of the Ring.

Such a projection is not possible as the Nevitt limestone aquifer is fracture controlled.

A suggestion that the output from a shallow well in a fracture controlled aquifer will establish the yield from the whole rock column is incorrect. Experience indicates that wells in the order of 90 to 120m deep are required to test most shallow aquifers and that well yields will be greater where the bedrock is preferentially fractured in the proximity of fault zones. The test pumping wells at Nevitt were drilled to only c.35m.

Also, maintaining a long screen section ensures that the well can accept inflows over the entire saturated rock column and minimises well loss in the pumping well. The screen lengths used at Nevitt were between 4 and 9m long compared to over 35m at the Bog of the Ring wells.

Applying the permeability values derived at the Nevitt data over the same screen lengths used at the Bog of the Ring clearly indicates that the transmissivity values of the limestones at Nevitt are

Development Site	Depth	Screen Length	Permeability	Transmissivity
	(m)	(m)	m/d	(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**

within the range found at the Bog of the Ring well field.

The Applicant's interpretation suggests that the transmissivity of the bedrock at Nevitt was up to 10 times lower than that found at the Bog of the Ring. As demonstrated in Table 2 below the extension of the transmissivity measured by the Applicant over the limited screen lengths used at Nevitt to the longer rock sections used at the Bog of the Ring allows for a more balanced comparison of the transmissivity data sets collected at Nevitt and the Bog of the Ring.

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

Table 2. Re-calculation of transmissivity values at Nevitt.

The shallow and partially completed wells completed by the Applicant have a combined yield of 1,550m^3/day.

Deepening the bedrock wells at PW 1 and PW 2 to the same depth as those completed at the Bog of the Ring well field and extending the well screen in the gravel well ASA2 over the full thickness of the gravel aquifer would probably double the output from these well sites.

By adding a further well into the gravel aquifer at the SHR3 site in the south west of the landfill footprint where 11m of gravel was recorded would likely provide a further 1,000m^3/day.

The output from four production wells at PW1, PW2, ASA3 and SHR3 at the Nevitt site would equal that available from the four production well sites in the Bog of the Ring well field.

The combined yield from the Nevitt and Bog of the Ring well fields could be readily increased by the installation of additional boreholes along the deep, fault controlled trough that connects the two areas. For example at the site of TW9 were the trial well recorded a yield of in excess of 1,000m^3/day.

Conclusion: **A revised EIS should be published limiting the tranmissivity values determined at Nevitt to the shallow bedrock at the test sites.**

Section 3.6 Conceptual Model.

The Conceptual Model does not reflect the geological picture determined by the boreholes or cross section B-B' and presented in the accompanying Figures 1, 2 and 3.

In particular the Conceptual Model does not include for ;

- the continuous gravel horizon shown on Section B-B',
- the layer of saturated gravel or weathered rock reported in the majority of resistivity cross sections accompanying the EIS
- the significant variations in the bedrock surface shown on Section B-B'

The Conceptual Model describes the overburden as a ***non-aquifer*** which is not consistent with the saturated gravel horizon shown on Section B-B'.

The Conceptual describes the gravels present in the model as ***discontinuous***. This is not consistent with the picture presented in Section B-B' nor with the resistivity sections

Conclusion: A revised EIS should be published with a Conceptual Model that properly reflects the geological and hydrogeolocal conditions present at the Nevitt site.

Section 5.2 Risk assessment

The risk assessment presented in the EIS is founded on an incomplete and inaccurate conceptual model as detailed above.

Conclusion: A revised EIS should be published with a Risk Assessment based on a conceptual model that properly describes the geological and hydrogeological conditions present at the Nevitt site.

Thank you for your attention.

Yours Sincerely,

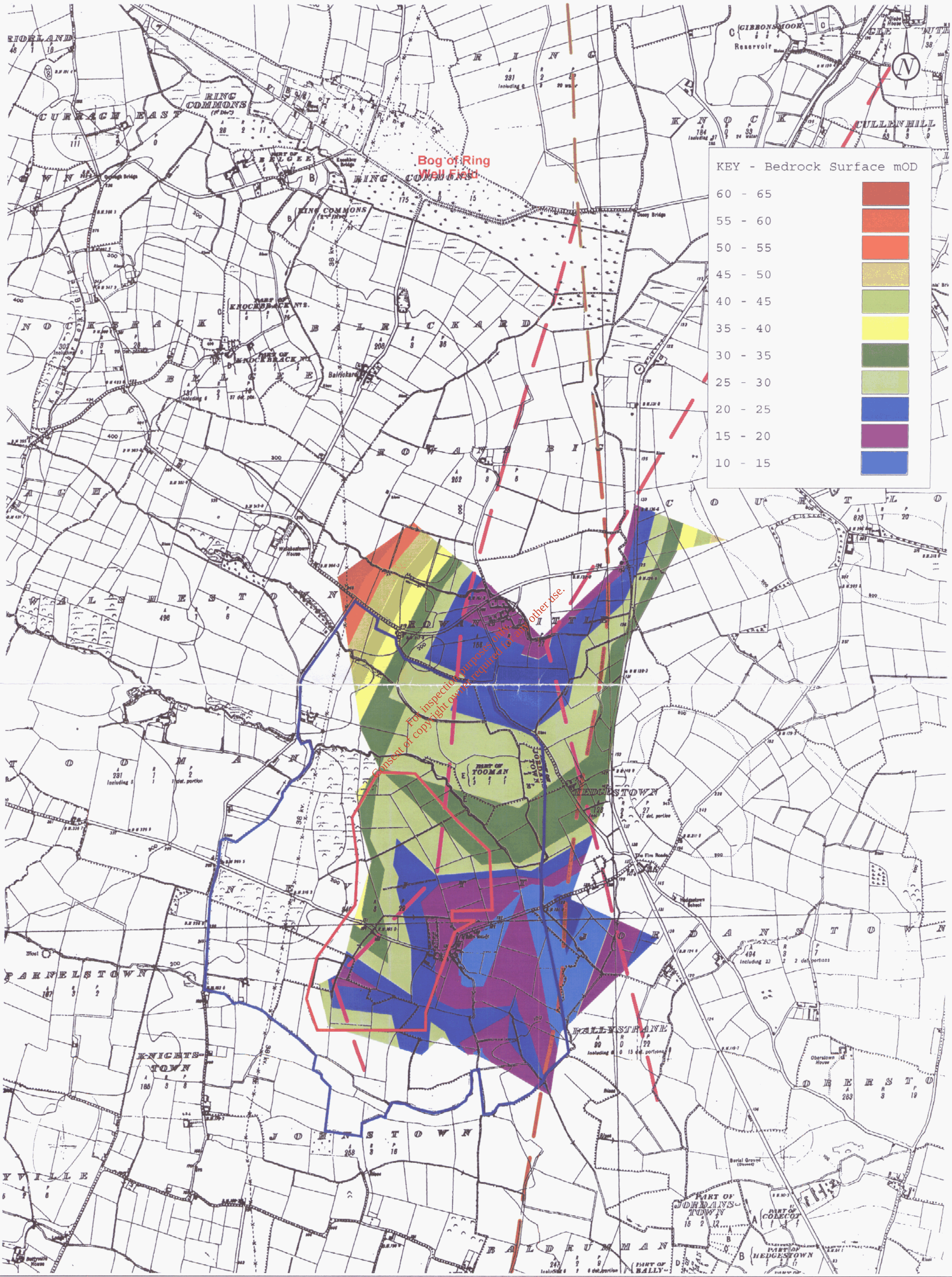
EurGeol Kevin Cullen P.Geo.

Accompanying Figures;

Figure 1 Bedrock Surface and Possible Fault zone

Figure 2 Possible Extent of Buried Sand & Gravel Deposit

Figure 3 Groundwater Contours – Bedrock – 17th January 2006



Note:

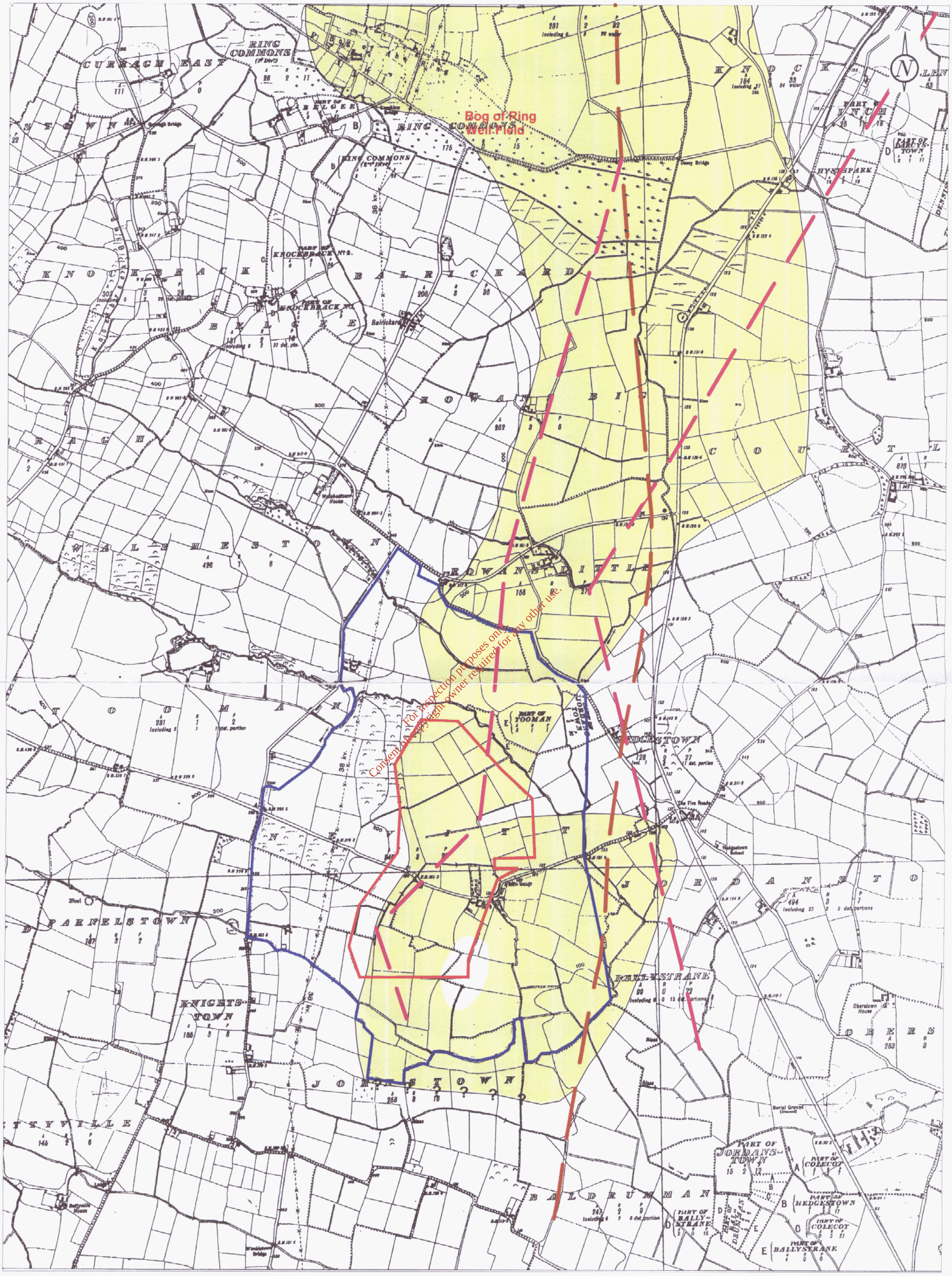
Drawing is for diagrammatic purposes only.
No measurements to be taken from the drawing.

Legend

- : Outline of Study Area B
- : Landfill Footprint
- : Line of GSI Fault
- : Possible Extent of Fault Zone

Site: Nevitt Landfill & Bog of the Ring Well Field	
Title: Approximate Bedrock Surface & Possible Fault Zone	
Drawn: --	Scale: Not to Scale
Job. No: --	Date: Sept 2006

Figure 1



Note:

Drawing is for diagrammatic purposes only.
No measurements to be taken from the drawing.

Legend

- : Outline of Study Area B
- : Landfill Footprint
- : GSI Fault
- : Proposed Fault Zone
- : Extent of Buried Sand & Gravel Deposit

Site: Nevitt Landfill & Bog of the Ring Well Field	
Title: Possible Extent of Buried Sand & Gravel Deposit	
Drawn: --	Scale: Not to Scale
Job. No: --	Date: Sept 2006

Figure 2

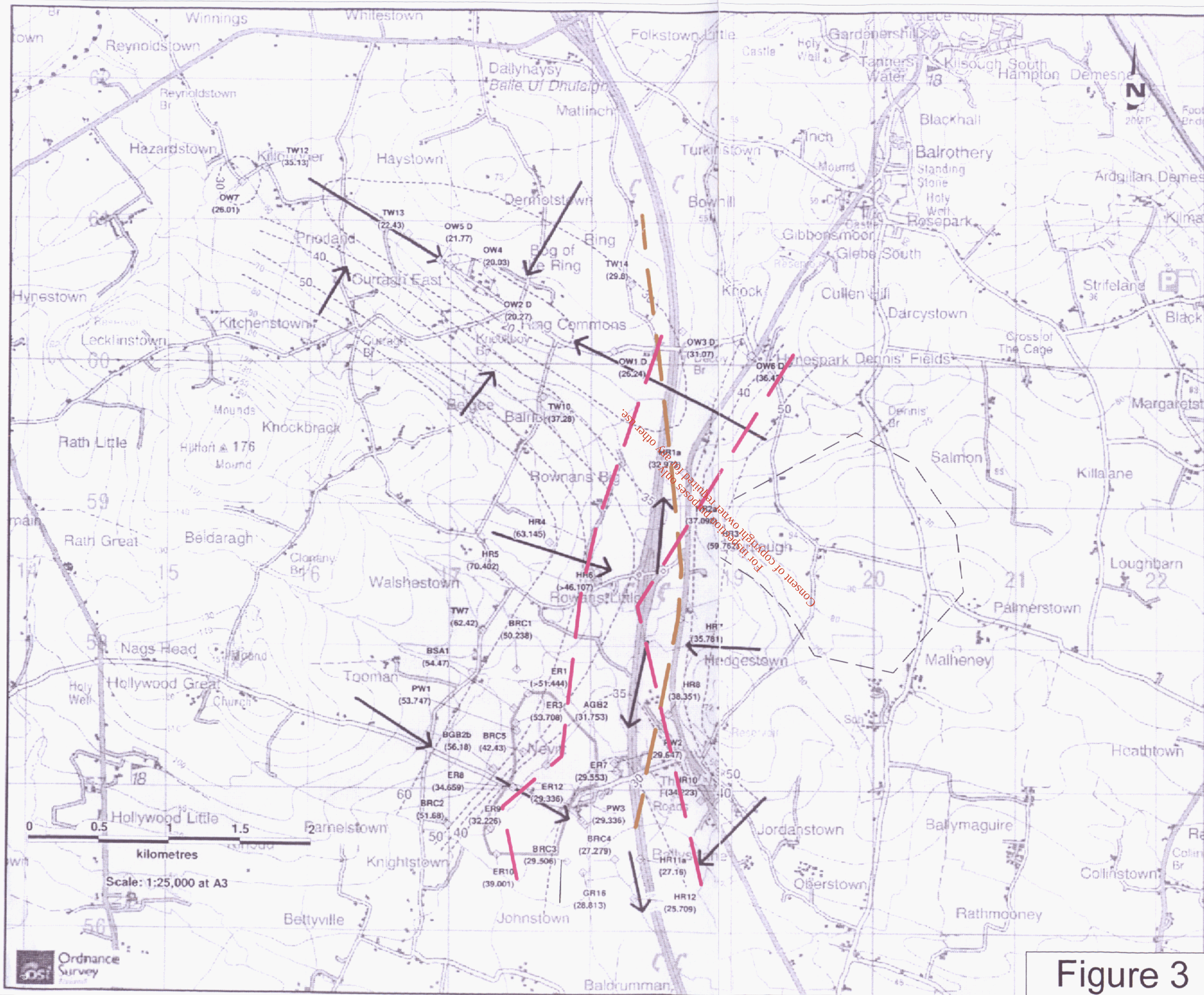


Figure 3

Legend

- BRC2 (51.72) — Borehole ID (Waterlevel mAOD)
- 30 — Groundwater Contour (mAOD)
- Groundwater Flow Direction
- Proposed Landfill Footprint
- Proposed Fault Zone
- Line of GSI Fault

Fingal County Council

Project: Fingal Landfill

Title: Groundwater Contours Bedrock 17th January 2006

APPENDIX A 5.8

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