Appendix A

mouchelparkman

Determination of Catchment Areas of the Abstractions in Blessington Site, 19th of May 2005.

Objectives

The model produced in December 2003 was used to estimate the likely effects of the landfill sites on the three currently active drinking water supply wells located to the south of Area 4. The specific objectives of this exercise are:

- Determine the catchment area of the abstractions
- Identify whether Areas 1, 4, 6 and the new landfill site are located within the estimated catchment area
- Estimate the pumped hydraulic gradient beneath each of the Areas 1, 4, 6 and the new landfill site

The details of these wells are given below:

Pumping Well	Location (m south of Area4)	Pumping Rate (m3/day)
Wicklow County Council Yard	1,500	624
Deerpark	1,250	456
Burgage	3,000	192

Approach to Modelling

A simple groundwater flow model was developed using Visual MODFLOW, version 3.1, by Waterloo Hydrogeologic. The model used a single layer, steady state model with no flow boundaries representing the catchment divide and flow lines on either side of the area of interest. A constant head boundary was used to represent the Pollophuca Reservoir.

The approach with the modelling was to fix or limit inputs for which we have reasonable site data and to produce a rough match between the observed and modelled groundwater heads by varying the hydraulic conductivity. When a reasonable match was produced this was considered an initial estimate of the hydraulic conductivity. Other factors which may affect the result were then considered qualitatively to provide a final estimate of the maximum hydraulic conductivity.

The principal considerations in this approach were:

- infiltration was assumed to equal 370mm/annum which is approximately equivalent to the effective rainfall and a reasonable upper estimate;
- the thickness of the alluvial deposits was established based on the limited available information and the overall interpretation that the alluvial deposits are

Parkman House Lime Kiln Close Stoke Gifford Bristol BS34 8SQ
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Mouchel Parkman Services Ltd Registered in England no. 1686040 at West Hall Parvis Road West Byfleet Surrey KT14 6EZ

thin towards the catchment divide and thicken towards the Pollophuca Reservoir;
- the hydraulic head in the reservoir is about 185m MHD (relative to Malin Head datum);
- the measured hydraulic gradient using data provided by Komex is approximately 0.025 at the upper end of the system around Areas 1 and 4 and further south between Area 6 and the reservoir it is about 0.007, with a relatively sudden change in gradient occurring upgradient of Area 6;
- the model was set up so that the observed hydraulic gradients were approximately matched by the model.

The model was then used to simulate pumping from the abstraction well.

Model Inputs

The model domain chosen was 3 x 3 km, with Area 6 located in the approximate centre at 1100-1250;1500. Spatial discretisation with 50 x 50m cells was used for the baseline model. For simulation of the pumping the grid was refined around the well location to 12m x 12m cells. The model consists of only one layer. The thickness of the layer represents the thickness of the gravel aquifer. Borehole information on depth to the bedrock was used to estimate thickness along the flow line through Area 6. This cross-section was then used throughout the domain. The table below shows elevations of the base and the top of the aquifer used in MODFLOW.

The assumption was made that the same hydraulic gradients derived from the water monitoring data provided by Komex in 2003 would be found to the north west of Pollophuca Reservoir. The pumping well was located approximately 150m down hydraulic gradient from Area 6, i.e. at a similar distance from the Reservoir (with exception of Burgage groundwater abstraction well, which is actually located at least 1,500m to the south west of the Reservoir).

The Pollophuca Reservoir is simulated using constant heads of 185m all along the southern boundary (left boundary in the model). The three remaining model domain boundaries were left as no flow boundaries, since they represent the catchment divide (north) and flow lines (east and west).

The River Burgess was not simulated as it is perched along much of its length and its influence on groundwater flow is likely to be mainly local to the source area.

A recharge of 370mm/year was used as the only water source to the model. This figure represents an estimate of the effective rainfall (GSI Groundwater Protection Report).

Results

Initial Model Scenario

Initially the flow was simulated for the current situation, i.e. without the production wells. The objective of this stage was to establish the most likely hydrogeological conditions, specifically to determine the hydraulic conductivity distribution which provides the best match to the observed heads.

The measured gradient ratio of approximately 3.6 was only achieved by dividing the model domain into two conductivity zones (Figure 5). Conductivities best matching measured gradients were $k_1 = 7x10^{-5}$m/s and $k_2 = 2.4x10^{-5}$m/s. The gradient between the envisaged well location and Area 6 was found to be 0.007.

Model Scenario with Production Wells

The wells were simulated individually at the location 1000;1500. The simulation well is screened through the entire thickness of the layer. Since Wicklow County Council Yard and Deerpark wells are located only about 375m apart, the sum of their pumping rates was also used in an additional scenario to simulate the combined effects. Backward particle tracking was used to estimate the catchment areas of the wells. The results of these scenarios are summarised below:

Pumping Well simulated	Drawdown within the well (m)	Max width of the catchment area (m).
Wicklow County Council Yard (WCC)	1.6	330
Deerpark	1.2	250
Burgage	0.5	130
WCC + Deerpark	2.7	580

Even though no data on the watertable in this area was provided, pumping at Burgage at the above rate is unlikely to have any effect on the four landfill sites due to the low abstraction rate, the distance from the landfill sites and the hydrogeologically relative location to the landfill sites.

The modelled catchment areas were superimposed onto a site plan at the actual locations of Wicklow County Council Yard well and Deerpark well. Flow directions around these wells were deduced from previous data from the landfill sites and with reference to the Reservoir. Equipotential lines were assumed to curve around the Reservoir with the hydraulic gradients similar to the ones encountered around the

previously monitored area. None of the landfill sites is located within the catchment areas of these wells, or of the combined scenario well.

In the modelling scenarios the influence of the pumping on the hydraulic gradient only extends to approximately 500m. The nearest area, i.e. Area 6, is located about 750m north east of the Deerpark well in a straight line perpendicular to the groundwater flow direction. The pumped hydraulic gradient down gradient of the 4 areas is not affected by the abstraction from the actual location of the wells.

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Mouchel Parkman Services Ltd Registered in England no. 1686040 at West Hall Parvis Road West Byfleet Surrey KT14 6EZ

Comhairle Chontae Chill Mhantáin

Wicklow County Council

Aras An Chontae
Cill Mhantáin
Telefón : (0404) 20100
Fax No : (0404) 67792
Intl VPN : 181 2100
E-Mail: envserv@wicklowcoco.ie
Web: www.wicklow.ie

Your Ref:

Our Ref: Mr Derek Luby
John Barnett & Associates
7 Dundrum Business Park
Windy Arbour
Dublin 14

03 MAY 2005

28th April 2005

Your Ref: JBA2901-10/L13/dl

Re: Roadstone Dublin Ltd.: Remediation of Unauthorised Landfill Sites
Waste Licence Application Ref. No. 213-1

Dear Derek

Further to your letter dated 19th April 2005 to the Council with regard to details of active water abstraction from wells at Blessington village, I provide the following details.

Well id	East	North	Elevation	Length of hole	Water level b.g.l	Pumping Rate
CoCo depot	297437	214219	Not available	20m	13m	26m³ / hour
Deerpark	297610	214520	Not available	20m	c 12m	10m³ / hour
Burgage	296946	213163	Not available	c 10m	<5m	8m³ / hour

There are four wells in the Co. Council depot yard with only one being used at a time. Two of the wells are 10-inch diameter and two are 6-inch. The Deerpark and Burgage wells are both 10-inch diameter wells. I have no details on the borehole construction or the zones of contribution for each well. The collar elevation for each hole is not available and the water level in the Deerpark and Burgage holes need to be dipped.

The new water pipeline from Ballymore to replace the current borehole well usage will be in place in approximately 18 months.

For and on behalf of Wicklow County Council

Michael Boland
Waste Management Section

ISO 9001 REGISTERED FIRM
ISO 14001 REGISTERED FIRM
Certificate No. GB6236 & GB10116

Ground Floor,
32 Manor Street,
Dublin 7

Telephone: 01-824 5000
Facsimile: 01-869 0964
E-mail: arobinson@ireland.komex.com

Date: 3rd September 2003
Our File: 50760-1

BY POST

Attention: Mr Philip Duffy
Environmental Services Section
Wicklow County Council
County Buildings
Wicklow
Co. Wicklow

Dear Philip,

Re: Well Audit and Water Features Survey, Blessington, Co. Wicklow

Komex were instructed by O'Laoire Russell Associates (OLRA) to perform a well survey and water features survey in and around the RDL site, and in the Blessington area approximately down-gradient from the RDL site. As requested by OLRA on 15th August 2003, the factual data recovered from this work are presented in this letter report.

WORK PERFORMED

The site and locale were visited by Komex engineers (Órla Dwyer and Claire Clifford) between 22nd - 25th April 2003. Wicklow County Council (WCC) operated, and private water supply wells were visited and surveyed by differential GPS to allow the groundwater surface and groundwater flow direction in the general Blessington area to be determined (the GPS survey base station was sited in two different locations to complete the survey). As much as possible, the water levels in the wells were measured under static conditions (*i.e.* no pumping was taking place). Several wells were revisited as pumping was taking place during the first visit.

Only those wells whose locations were known by Mr Noel Doody of WCC were visited in Blessington town centre. Several houses / businesses in areas known not to have mains water supply were visited as part of this study. However, a full house-to-house survey was not attempted, and many householders were either not present at the time of survey, or were not prepared to allow access to their properties.

In addition, surface water features in the same area were surveyed, and general assessments made of flow rates and appearance.

RESULTS

The well survey data plus any pertinent notes are given in Table 1. The survey data for the majority of the surface water features are given as Table 2, and the water features survey sheets are presented in the Plates section.

CLOSURE

We trust that this Factual letter report is to your satisfaction. If you would like to discuss any issues further, please do not hesitate to contact the undersigned in our Dublin office (01-824 5000).

Yours sincerely,
KOMEX

Dr Andrew Robinson
Senior Project Manager

Robert Bracken
Director

F:\Projects\50760 (Roadstone)\50760-1 Well audit & conceptual model\Report for 27th August 03\Factual letter report Sept 03 JACR.doc

Table 1
Local Well Survey

Well Survey Locations	Name & Address	Date	Well Usage	Well Depth	Well Diameter	Groundwater Level	Well head/casing Elevation	Groundwater Level	Well Location		Additional Notes
				m	mm	m btoc	m AOD	m AOD	Easting	Northing	
PW1	Wicklow County Council Yard, Blessington	22/04/2003	Not in use	~18	230	2.86	194.800	191.94	297461.9	214185.0	Top of casing below ground level in manhole with cover
PW2	Deerpark, Blessington	22/04/2003	Not in use	~30	250	3.86	197.199	193.34	297604.5	214527.7	Top of casing below ground level in raised manhole with cover
PW3	Deerpark, Blessington	22/04/2003	Not in use	~30	250	4.92	197.299	192.38	297601.9	214530.6	Top of casing below ground level in raised manhole with cover
Oakwood	Oakwood, Blessington	22/04/2003	Not in use (well drilled by K.T. Cullen)			9.54	201.820	192.28	298048.650	214983.25	No pump in well, not used for water supply
Downshire	Downshire House Hotel, Blessington	22/04/2003	Constant use	~33	250	17.8	206.003	188.20	298278.394	214306.154	Well in constant use. TOC below ground level. Well in manhole.
Lakeshore	Lakeshore Holiday Village	22/04/2003	Constant use	Not known	250		199.180	-	298157.068	213297.386	Pump at 14.8 mbgl. Pump on and water at pump level. Well in pumphouse, casing flush with ground level and water on floor.
Statoil	Statoil Garage, Blessington	23/04/2003	Constant use for car wash	~23	200	10.07	209.941	199.87	298367.623	214618.70	Perched water cascading into well at 7.1 mbgl. SWL is higher than regional levels
Mart	Blessington Cattle Market	25/04/2003	Occasional use	>30	200	17.61	212.704	195.09	298855.816	215340.42	Water used for washing down etc. after market days. Water level at 22.86 mbtoc when pumping. Well open to atmosphere, top of casing at ground level, no sanitary protection.
Burgage	Burgage, Blessington	25/04/2003	Not in use	-	800	1.50	197.448	195.95	297473.842	212709.94	Spring in gravel bed previously used as a domestic supply.
Billings	Private residence (Oldpaddocks)	22/04/2003	Single domestic use	Not known	250	-	-	-	-	-	Well pumping at time of survey. Could not get GPS fix.
Currans	Private residence	23/04/2003	Single domestic use	~44	200	7.7	222.741	215.04	296375.888	216140.2	Casing above ground level. Pump and well in steel unit.

m btoc: metres below top of casing
mAOD: metres above Ordnance Datum

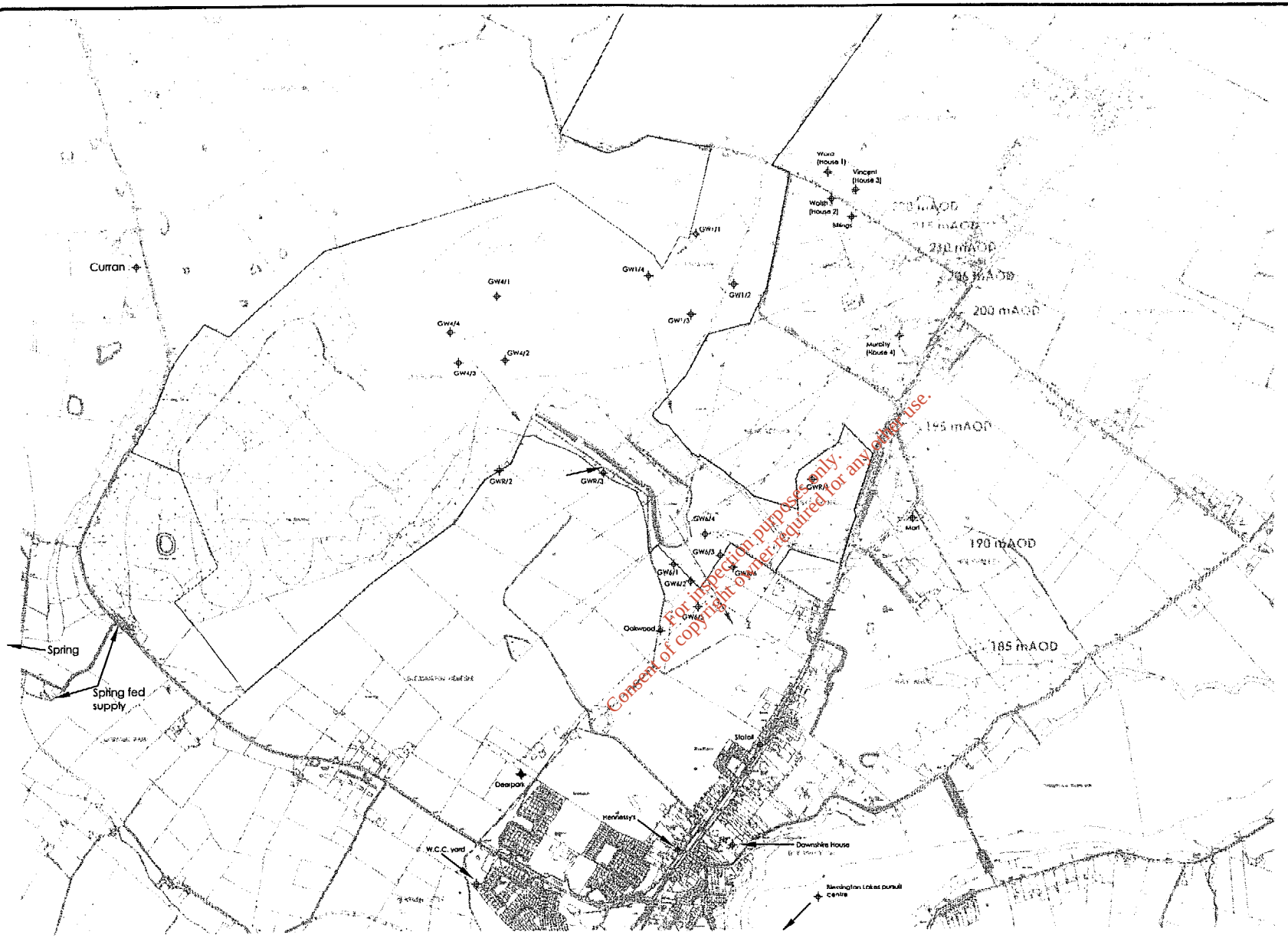
Table 2
Local Water Features Survey

Water Feature Locations	Water Feature Location		
	m AOD	Easting	Northing
SW1	201.912	298053.24	215052.7
SW2	203.072	298040.0	215154.4
SW3	204.503	298016.3	215227.7
SW4	199.022	298027.1	214869.4
SW5	198.579	297888.7	214734.5
SW6	196.165	297651.4	214514.9
SW9	190.709	297490.5	213927.5
SW10	189.882	297393.7	213795.0
SW11	229.571	298231.6	216178.9
SW13	211.108	298003.5	215623.3
SW15	215.682	297427.7	216028.2
SW15a (1)	214.741	297662.6	215888.8
SW16	208.275	297607.6	215610.5
SW17	206.638	297643.787	215652.59
SW18	211.877	298208.46	215295.373
SW19	205.341	298008.627	215400.883
SW20	182.402	296906.374	212757.11

mAOD: metres above Ordnance Datum

See water features survey sheets for details

(1) Outflow stream from 'groundwater lake'



Inferred groundwater contours in main sand/gravel groundwater unit. Elevation shown as metres above Ordnance datum.

Approximate groundwater flow direction

Roadstone site boundary

Investigation areas

Monitoring/pumping well

Job No. 50760-1
ROADSTONE, BLESSINGTON

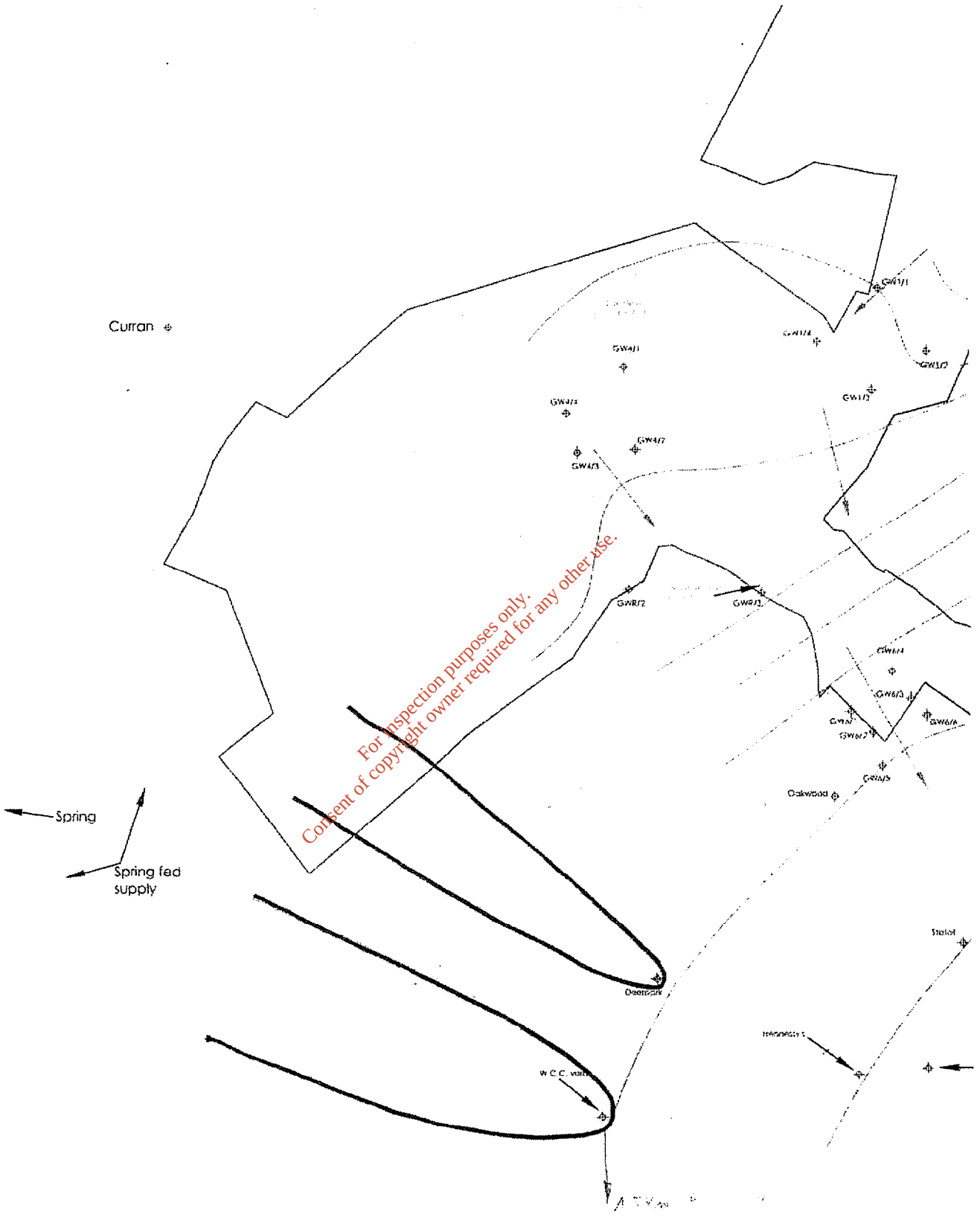
WICKLOW COUNTY COUNCIL

INFERRED GROUNDWATER CONTOURS AND FLOW DIRECTION (11th NOV 03)

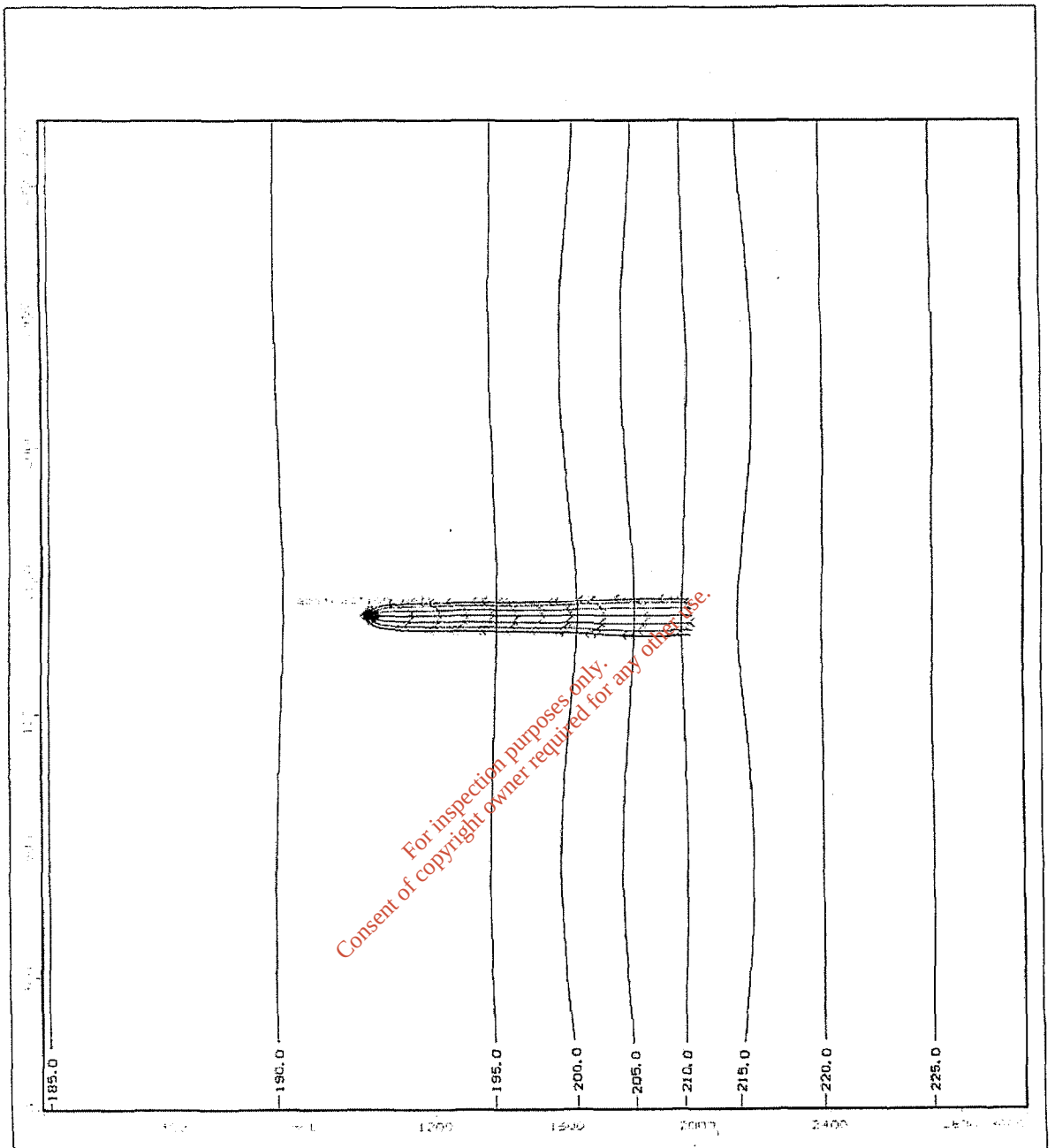
KOMEX
ENVIRONMENT AND WATER RESOURCES
Tel: 01 824 5000 Fax:01 869 0964
Email: info@ireland.komex.com

DRAWN BY	ORIGINAL	CHECKED	PASSED	DATE	SCALE	ISSUING OFFICE	DRAWING NUMBER	REV
JACR	A3			NOV 2003	SHOWN	DUBLIN	FIGURE 1	

F:\Projects\50760 Roadstone\50760-1\Report for 15th May 03\FIGURE 1.dwg

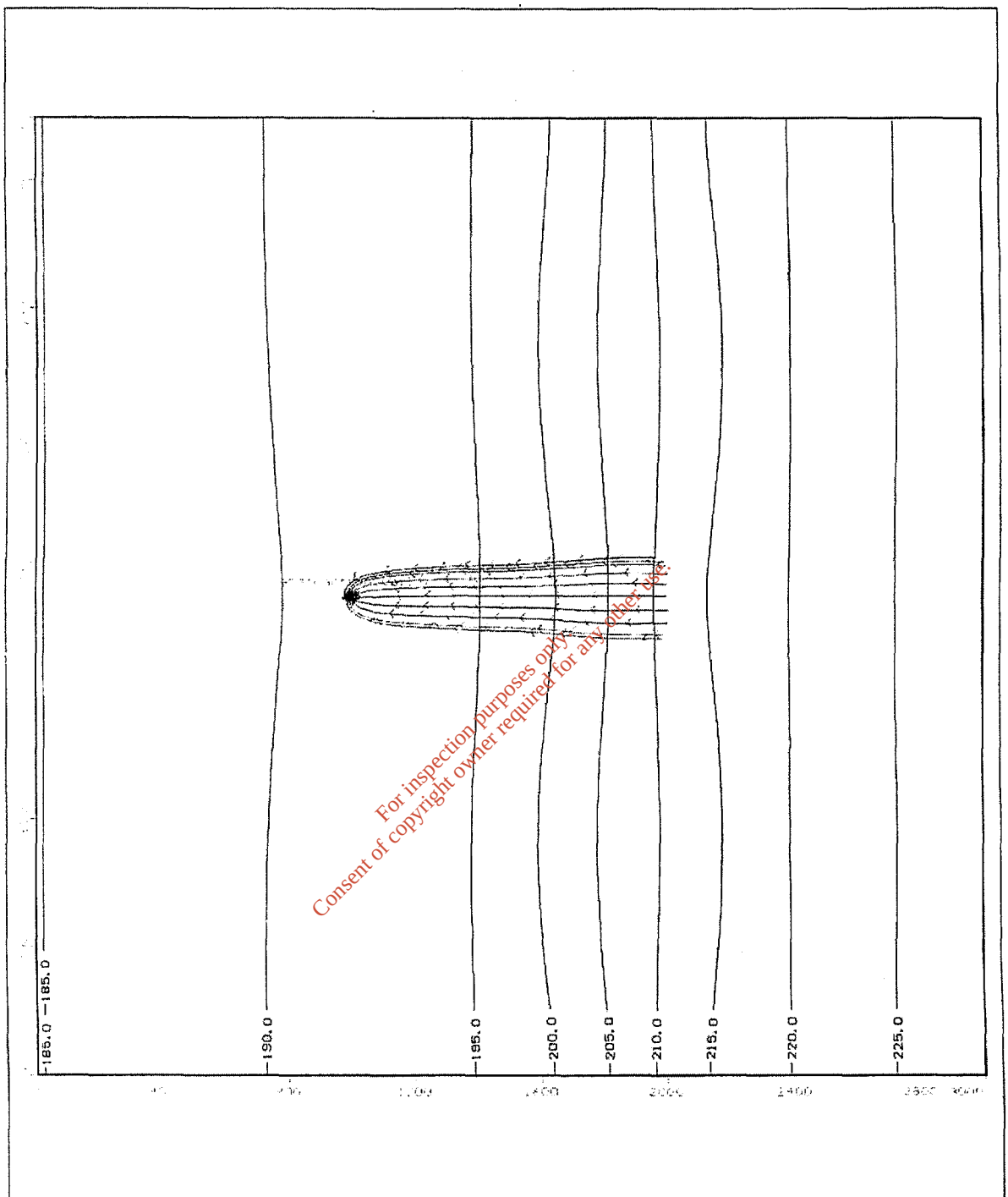


F:\Projects\50760 Roadstone\50760-10\report for 15th May 03\FIGURE 1.dwg

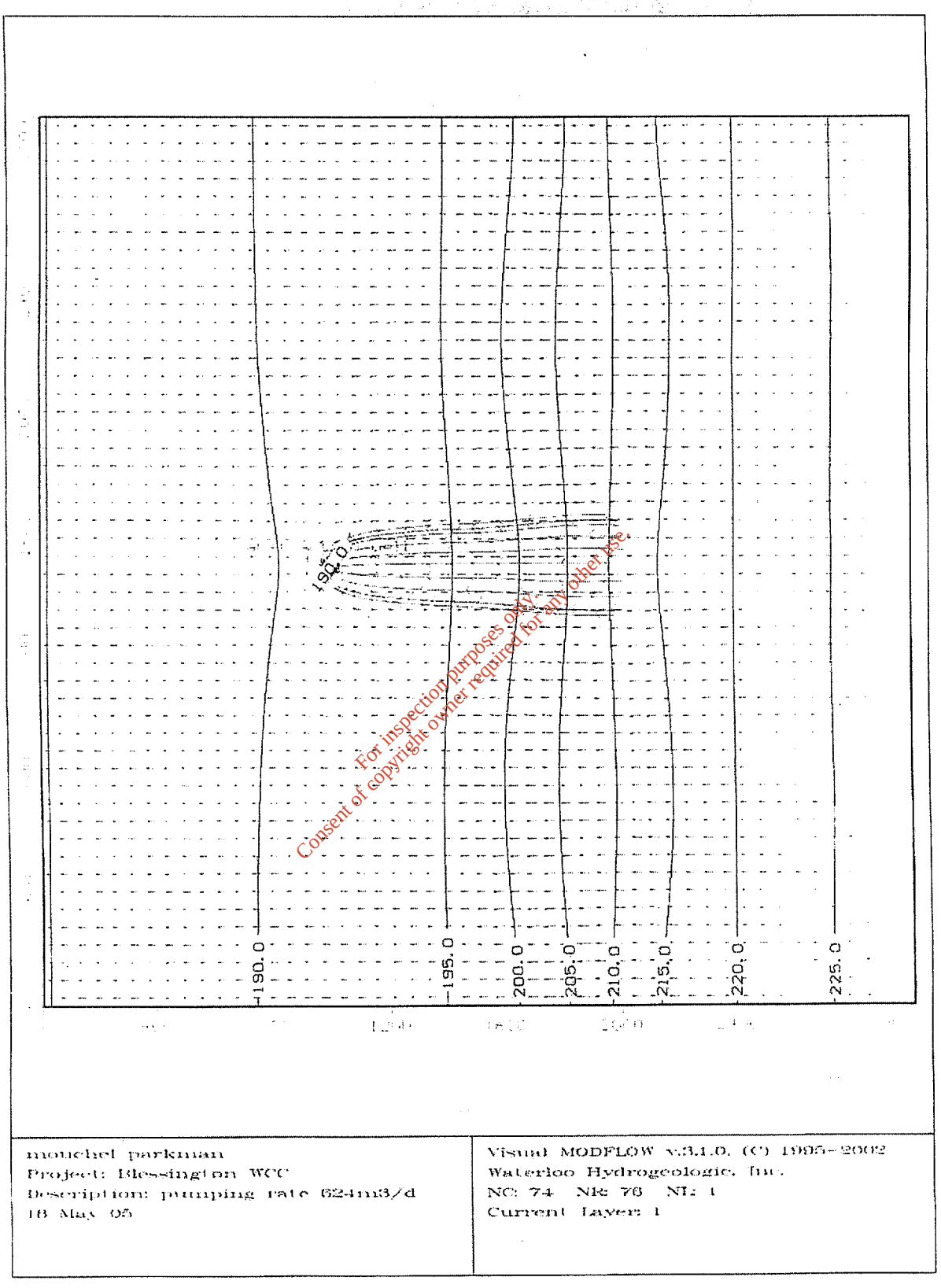


mouchel parkman
Project: Blessington Burgage
Description: pumping rate 193m3/d
18 May 05

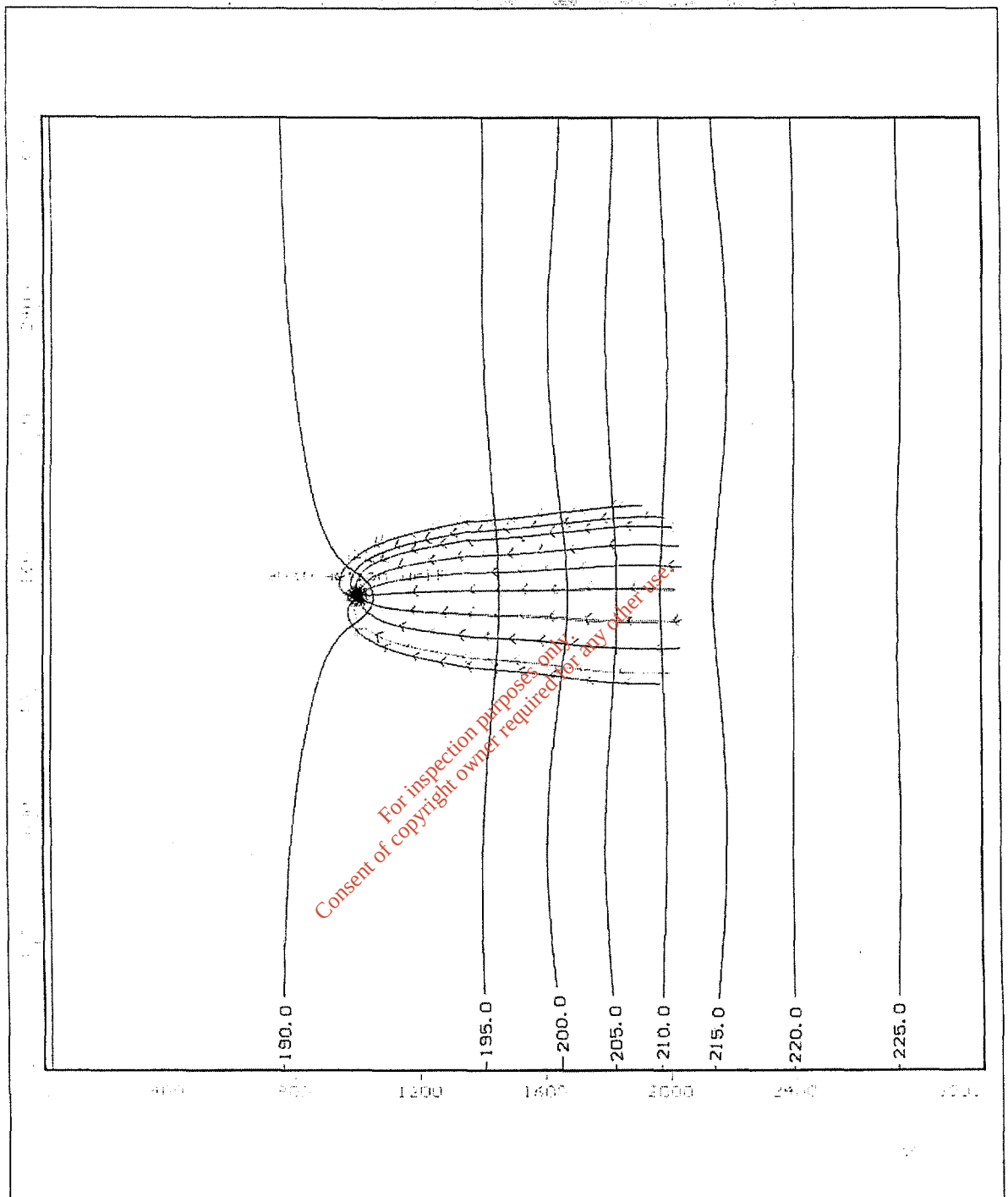
Visual MODFLOW v.3.1.0. (C) 1995-2002
Waterloo Hydrogeologic, Inc.
NC: 74 NR: 76 NL: 1
Current Layer: 1



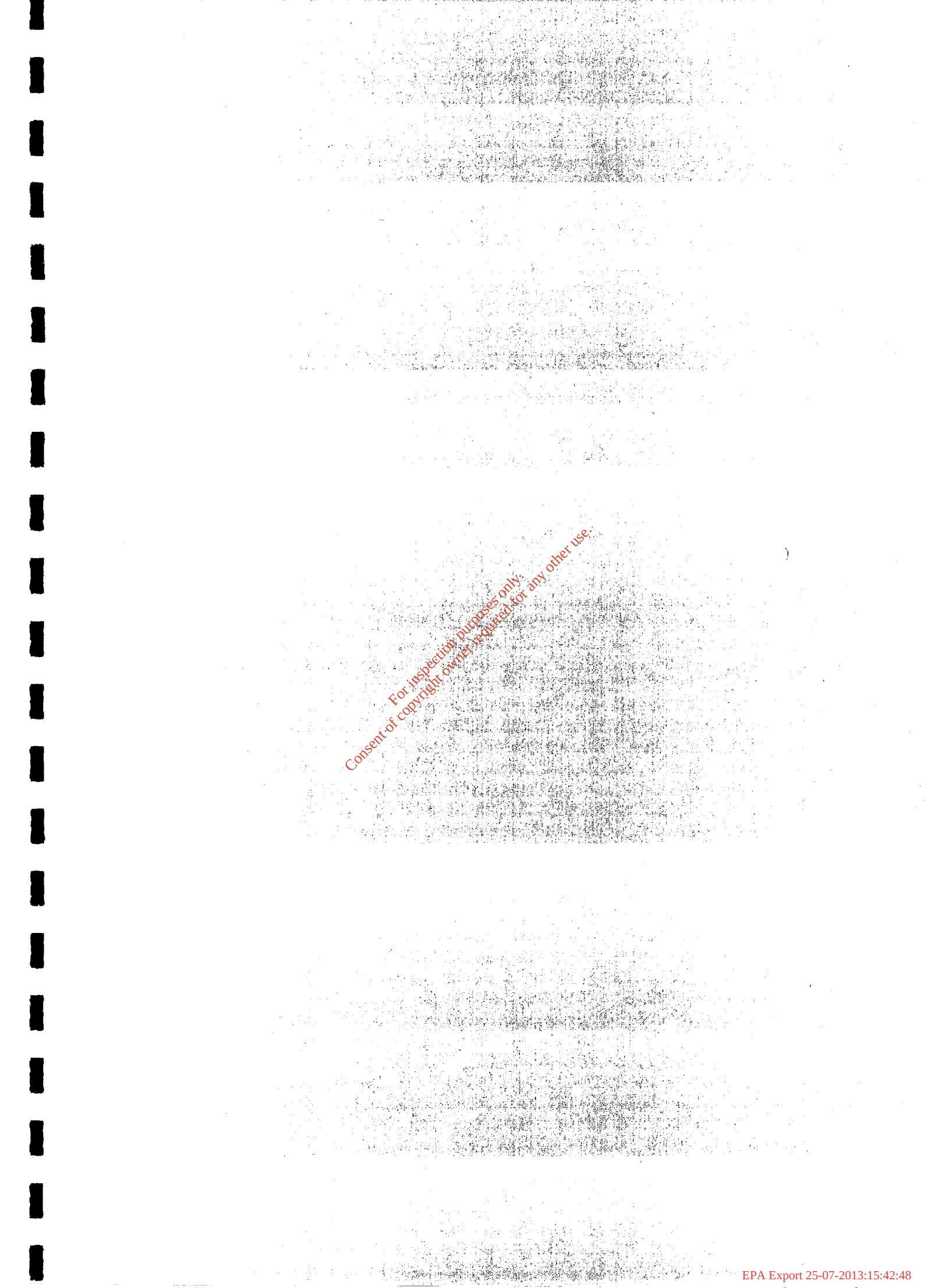
mouchel parkman Project: Blessington Deerpark Description: pumping rate 156m3/d 19 May 05	Visual MODFLOW v.3.1.0. (C) 1995–2002 Waterloo Hydrogeologic, Inc. NC: 74 NR: 76 NL: 1 Current Layer: 1



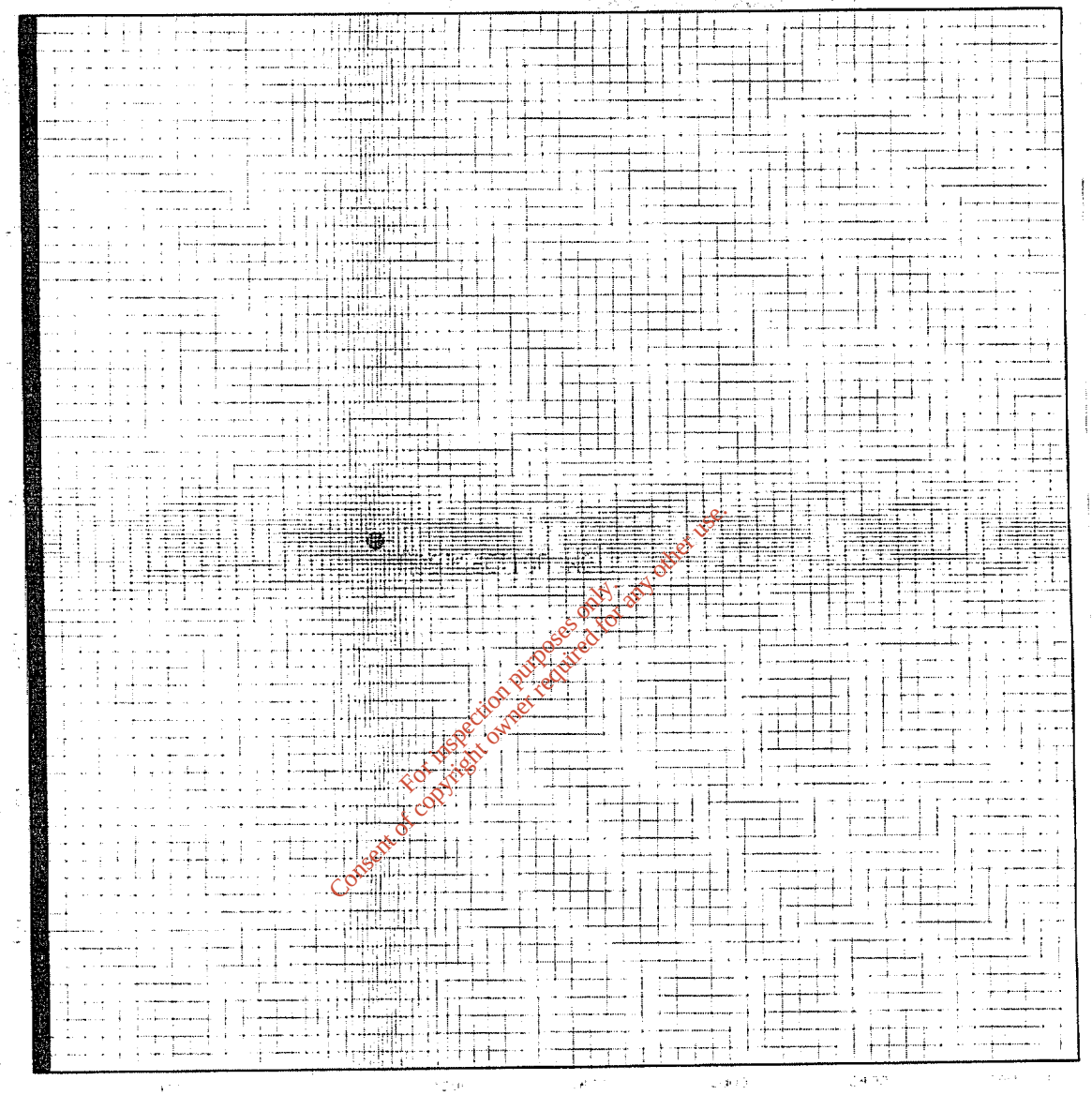
mouchel parkman Project: Blessington WCC Description: pumping rate 624m3/d 18 May 05	Visual MODFLOW v.3.1.0. (C) 1985-2002 Waterloo Hydrogeologic, Inc. NC: 74 NR: 76 NL: 1 Current Layer: 1



michel parkman Project: Blessington WTC+Deerpark Description: pumping rate 1080m3/d 19 May 05	Visual MODFLOW v.3.1.0. (C) 1995-2002 Waterloo Hydrogeologic, Inc. NC: 74 NR: 76 NL: 1 Current Layer: 1



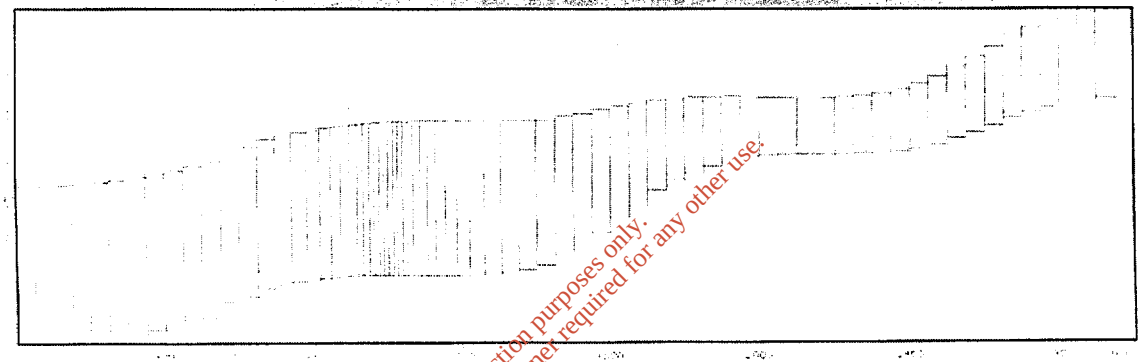
Appendix B



Parkmann Env. – UK
Project: Blessington
Description: model grid
15 Dec 03

Visual MODFLOW v.2.60, (C) 1995–1997
Waterloo Hydrogeologic Software
NC: 74 NR: 76 NL: 1
Current Layer: 1

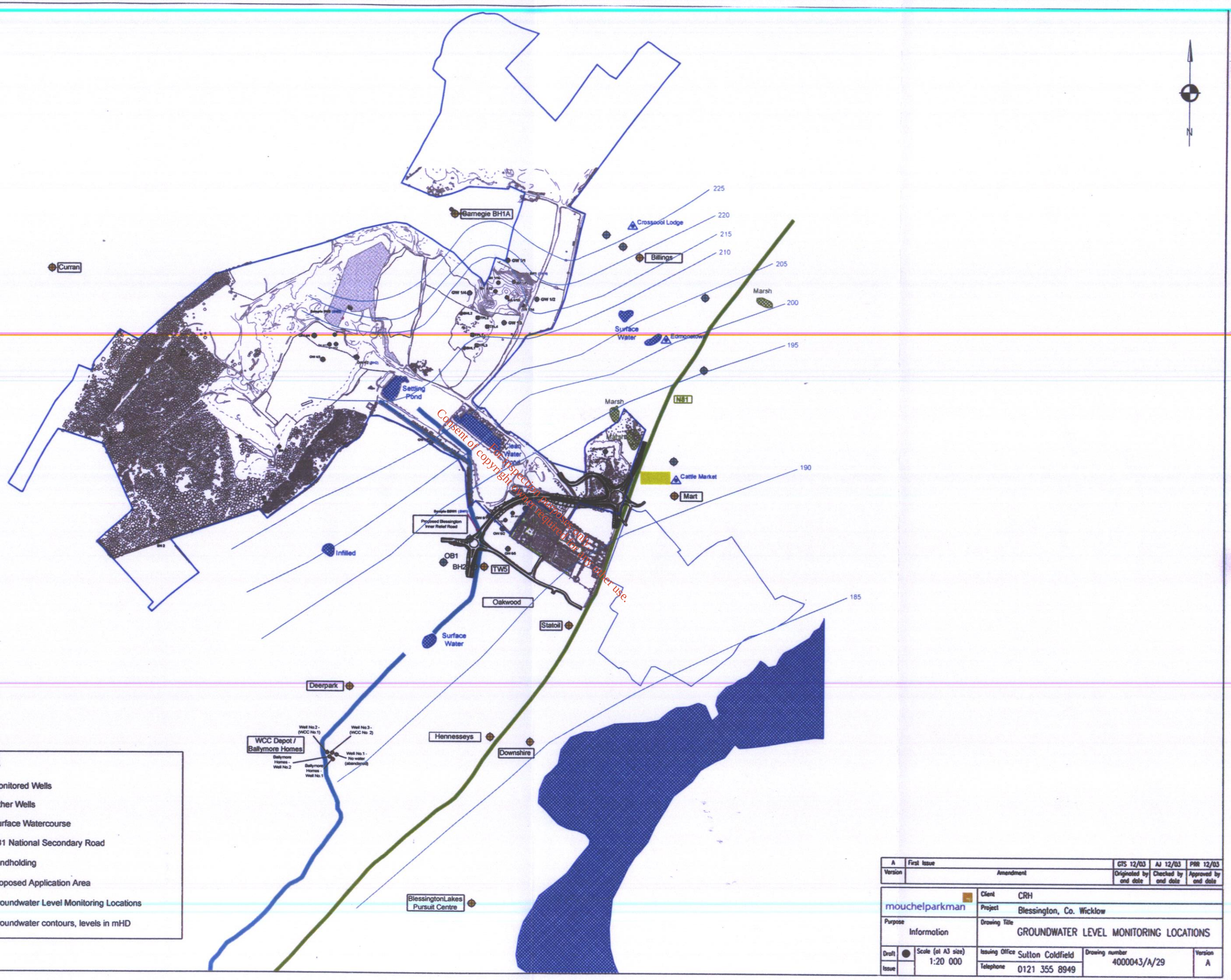
FIG 1A



Parkman Env. – UK
Project: Blessington
Description: model grid
15 Dec 03

Visual MODFLOW v.2.60. (C) 1995-1997
Waterloo Hydrogeologic Software
NC: 74 NR: 76 NL: 1
Current Row: 10

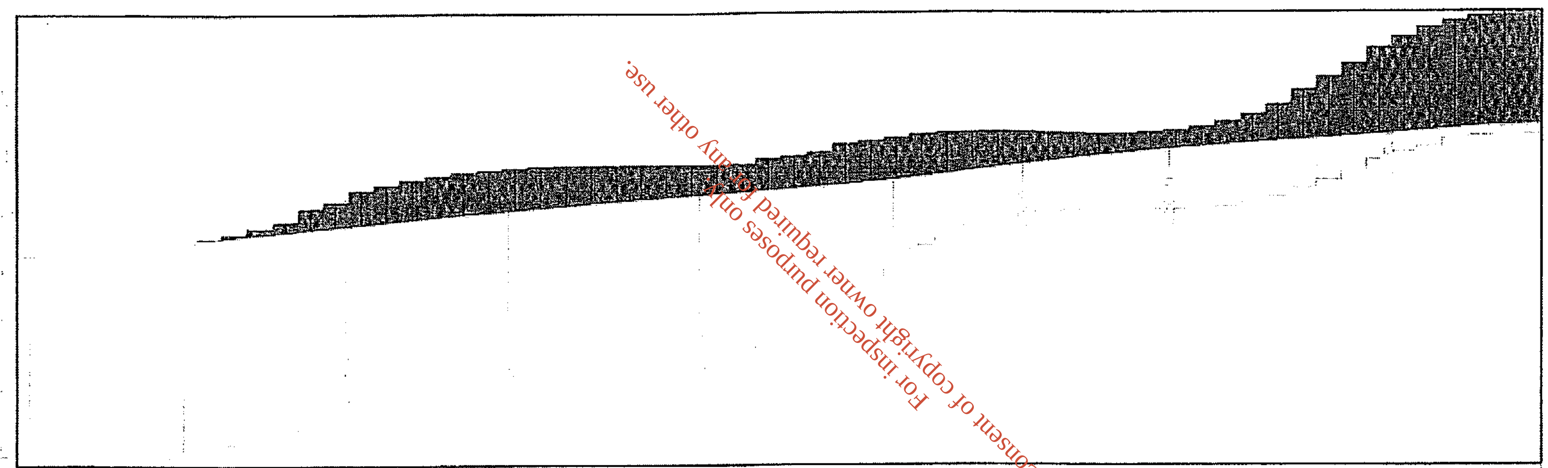
FIG 1B



Version	Amendment	Originated by and date	Checked by and date	Approved by and date
A	First Issue	GTS 12/03	AJ 12/03	PRR 12/03

mouchelparkman

Client	CRH
Project	Blessington, Co. Wicklow
Purpose	Information
Drawing Title	GROUNDWATER LEVEL MONITORING LOCATIONS
Draft / Issue	
Scale (at A3 size)	1:20 000
Issuing Office	Sutton Coldfield
Telephone	0121 355 8949
Drawing number	4000043/A/29
Version	A

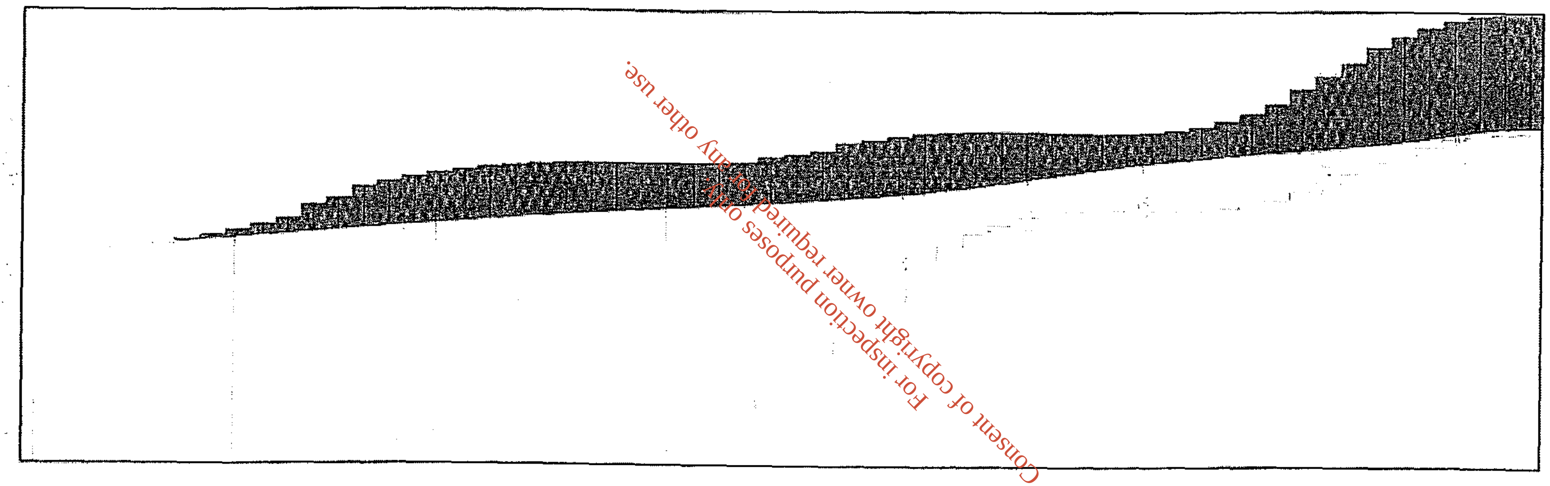


Project: Blessington
Description: uniform k=3e-5
9 Dec 03

Visual MODFLOW v.2.60, (C) 1995-1997
Waterloo Hydrogeologic Software
NC: 60 NR: 60 NL: 1
Current Row: 31

FIG 3

FIG 4



Project: Blessington
Description: k=3e-5, 20m thicker
9 Dec 03

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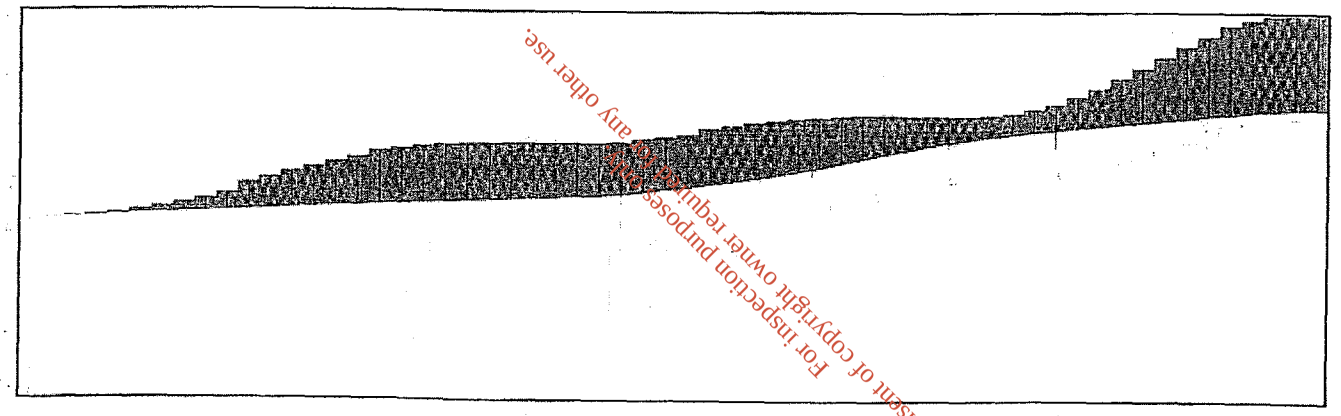
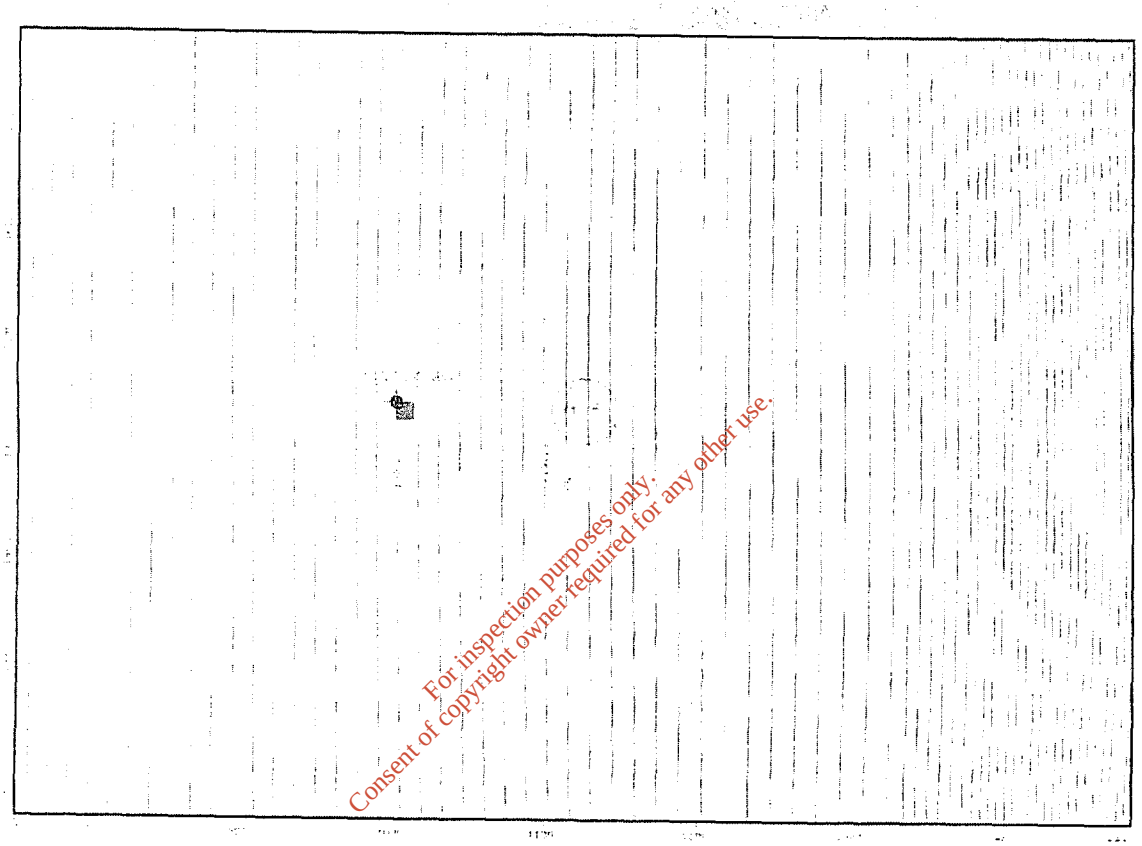
Waterloo Hydrogeologic Software
NC: 60 NR: 60 NL: 1
Current Row: 31



Parkman Env. - UK
Project: Blessington
Description: k1=7e-5, k2=2.4e-5
9 Dec 03

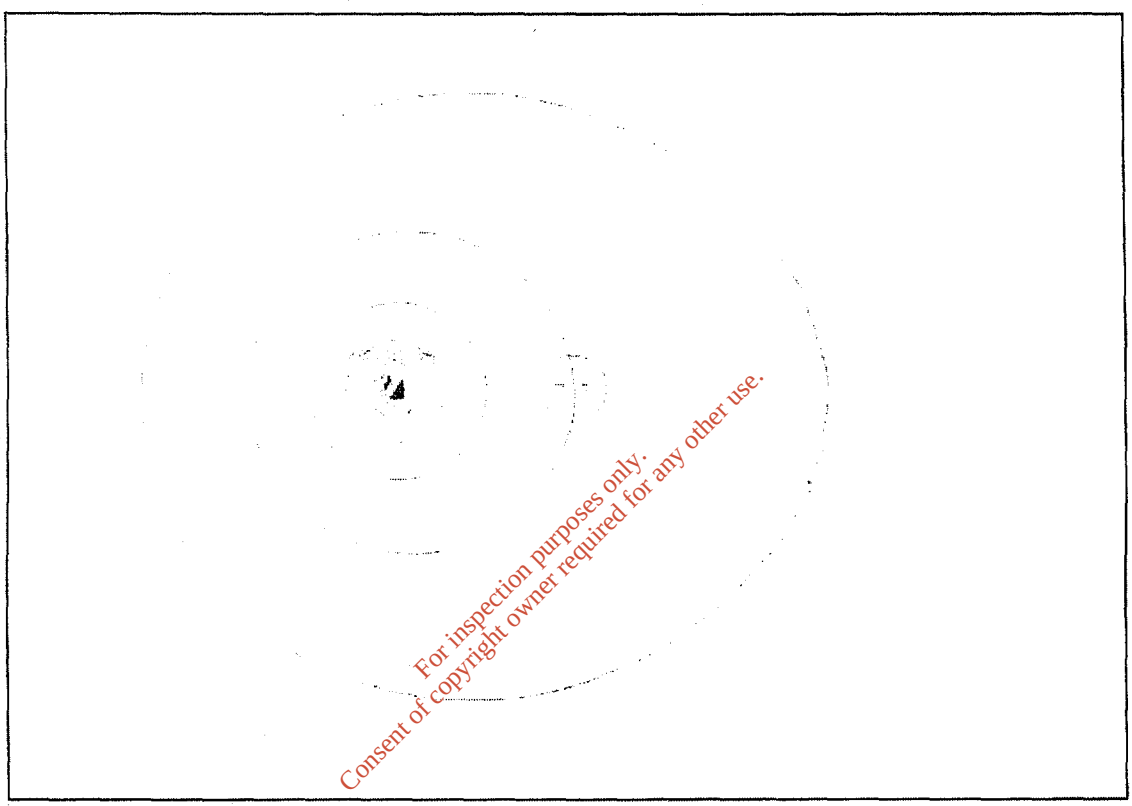
Visual MODFLOW v3.60, (C) 1995-1997
Waterloo Hydrogeologic Software
NC: 60 NR: 60 NL: 1
Current Row: 32



Parkman Env. - UK
Project: Blessington
Description: gradient-not active well
10 Dec 03

Visual MODFLOW v.2.60, (C) 1995-1997
Waterloo Hydrogeologic Software
NC: 74 NR: 76 NL: 1
Current Layer: 1

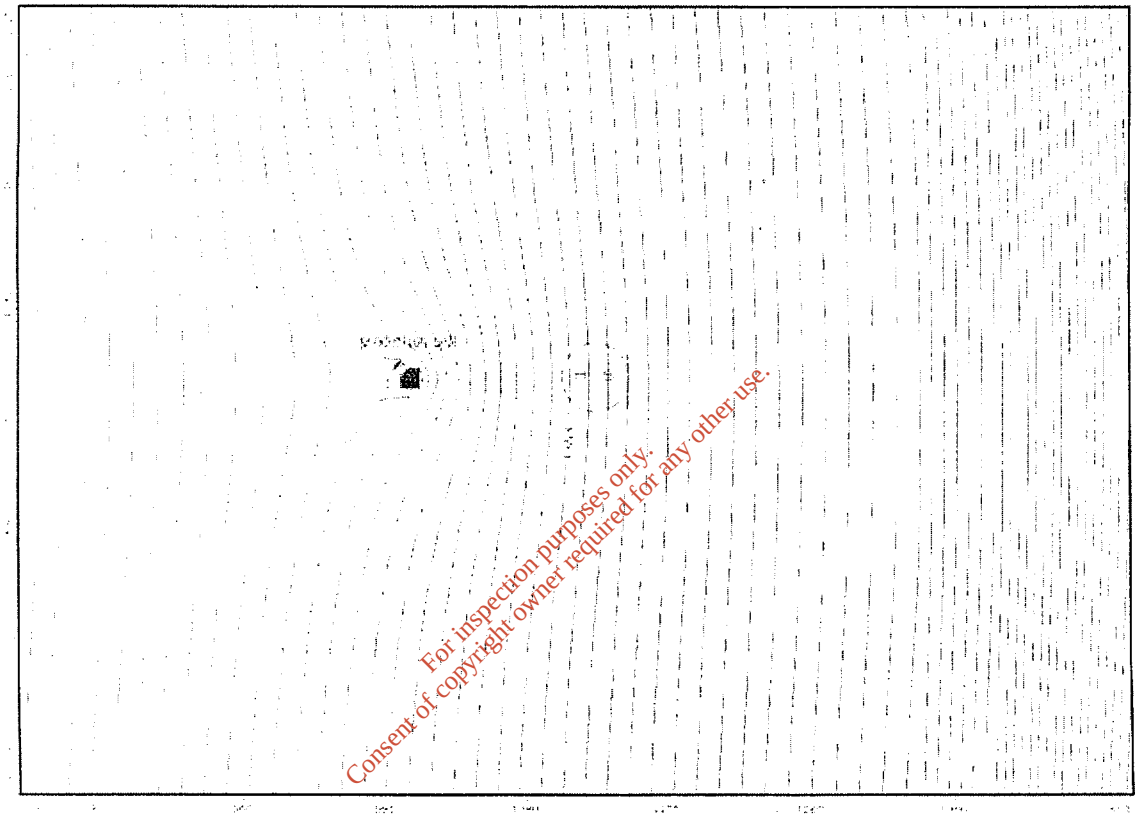
FIG 6



Parkman Env. - UK
Project: Blessington
Description: drawdown
10 Dec 03

Visual MODFLOW v.2.60, (C) 1995-1997
Waterloo Hydrogeologic Software
NC: 74 NR: 76 NL: 1
Current Layer: 1

FIG 7



Parkman Env. – UK
Project: Blessington
Description: Slope b/w well and Area 6
10 Dec 03

Visual MODFLOW v.2.60, (C) 1995–1997
Waterloo Hydrogeologic Software
NC: 74 NR: 76 NL: 1
Current Layer: 1

FIG 8

Memorandum

To: Mark Prendergast

CC: Anna Jeffcoat, Piers Sadler, Chris Chappell

From: Katrin Silvers (Graduate Hydrogeolist)

Date: 30/05/2005

Re: 4000043

Objectives

A meeting was held between consultants representing Roadstone Dublin Limited and Wicklow County Council on 18 November 2003 in Dublin to discuss issues associated with a Section 55 Notice related to unauthorised waste disposal at the Roadstone quarry near Blessington, County Wicklow. The meeting was attended by:

Piers Sadler	Mouchel Parkman (MP)
Derek Luby	John Barnett Associates (JBA)
Andy Robinson	Komex
Donal O'Laoire	O'Laoire Associates

This note addresses specific issues associated with the quantitative groundwater risk assessment undertaken for the site with the following objectives:

- to determine the maximum likely hydraulic conductivity in the area;
- assessing the effects of pumping at 300 m^3/day from a well 100m down hydraulic gradient of Area 6 on the hydraulic gradient between Area 6 and the well.

The results of the model have then been used as a basis for sensitivity analysis for the risk assessment.

Approach to Modelling

A simple groundwater flow model was developed using Visual MODFLOW, version 2.6, by Waterloo Hydrogeologic to assess the relationship between the key factors which govern groundwater flow. The model used a single layer, steady state model with no flow boundaries representing the catchment divide and flow lines on either side of the area of interest. A constant head boundary was used to represent the Pollophuca Reservoir. The system was modelled in steady state.

The approach with the modelling was to fix or limit inputs for which we have reasonable site data and to produce a rough match between the observed and modelled groundwater heads by varying the hydraulic conductivity. When a reasonable match was produced this was considered an initial estimate of the hydraulic conductivity. Other factors which may affect the result were then considered qualitatively to provide a final estimate of the maximum hydraulic conductivity.

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- infiltration was assumed to equal 370mm/annum which is approximately equivalent to the effective rainfall and a reasonable upper estimate;
- the thickness of the alluvial deposits was established based on the limited available information and the overall interpretation that the alluvial deposits are thin towards the catchment divide and thicken towards the Pollophuca Reservoir;
- the hydraulic head in the reservoir is about 185m MHD (relative to Malin Head datum);
- the measured hydraulic gradient using data provided by Komex is approximately 0.025 at the upper end of the system around Areas 1 and 4 and further south between Area 6 and the reservoir it is about 0.007, with a relatively sudden change in gradient occurring upgradient of Area 6 (see Figure 2);
- the model was set up so that the observed hydraulic gradients were approximately matched by the model.

The main challenge for the model was to simulate the very significant flattening of the hydraulic gradient down the groundwater flow path. Since the groundwater level in the southern part of the area is significantly below the ground level and there are no springs in the southern part of the area, the amount of water flowing through the system must increase down the flow path due to accumulating recharge. Therefore the flattening of the hydraulic gradient must be attributable to an increase in aquifer transmissivity in the south relative to the north. This is likely to be in part due to thickening of the aquifer, but may also be a result of increasing hydraulic conductivity to the south.

The model was then used to simulate pumping from an abstraction well.

Model Inputs

The model domain chosen was 3 x 3 km, with Area 6 located in the approximate centre at 1100-1250;1500. Spatial discretisation with 50 x 50m cells was used for the baseline model. For simulation of the pumping the grid was refined around the well location to 12m x 12m cells. The model consists of only one layer. The thickness of the layer represents the thickness of the gravel aquifer. Borehole information on depth to the bedrock was used to estimate thickness along the flow line through Area 6. This cross-section was then used throughout the domain. The table below shows elevations of the base and the top of the aquifer used in MODFLOW.

Location		Bottom Elevation [mOD]	Top Elevation [mOD]	Layer thickness
x	y			
0	0	115	185	70
0	1500	115	185	70
0	3000	115	185	70
1175	0	145	215	70
1175	1500	145	215	70

1175	3000	145	215	70
2150	0	200	225	25
2150	1500	200	225	25
2150	3000	200	225	25
3000	0	225	265	40
3000	1500	225	265	40
3000	3000	225	265	40

The model grid is summarised in Figures 1a and 1b.

The Pollophuca Reservoir is simulated using constant heads of 185m all along the southern boundary (left boundary in the model). The three remaining model domain boundaries were left as no flow boundaries, since they represent the catchment divide (north) and flow lines (east and west).

The River Burgess was not simulated as it is perched along much of its length and its influence on groundwater flow is likely to be mainly local to the source area.

A recharge of 370mm/year was used as the only water source to the model. This figure represents an estimate of the effective rainfall (GSI 2001).

Results

Initial Model Scenario

Initially the flow was simulated for the current situation, i.e. without the production well. The objective of this stage was to establish the most likely hydrogeological conditions, specifically to determine the hydraulic conductivity distribution which provides the best match to the observed heads.

A uniform conductivity of $3x10^{-5}$m/s roughly matches the observed trends in hydraulic gradients shown in Figure 2. The resulting water table is illustrated in Figure 3.

Changes in thickness of the gravel layer in the lower part of the model produced outputs better matching the measured groundwater levels. As can be seen from Figure 4, the ratio of gradients increases as the gradient in the lower area flattens and the gradient in the upper region steepens.

However, the measured gradient ratio of approximately 3.6 was only achieved by dividing the model domain into two conductivity zones (Figure 5). Conductivities best matching measured gradients were $k_1 = 7x10^{-5}$m/s and $k_2 = 2.4x10^{-5}$m/s. The gradient between the envisaged well location and Area 6 was found to be 0.007 (Figure.6).

Model Scenario with Production Well

The well was simulated at the location 1000;1500, with a production rate of $300m^3/d$, it is screened through the entire thickness of the layer. The resulting drawdown equals 1.1m within the well, and about 0.5m at Area 6 (Figure 7). The gradient increases by 0.003 to about 0.01 (Figure 8)

Attached Figures:

Figure 1	Model Stet-up
Figure 2	Observed Hydraulic Gradients
Figure 3	Model with uniform K=3e-5m/s
Figure 4	Model with uniform K=3e-5m/s and increased thickness of aquifer below the southern half of the domain by 20m
Figure 5	K_1=7e-5m/s; K_2=2.4e-5m/s
Figure 6	Hydraulic Gradient between envisaged production well and Area 6, well inactive
Figure 7	Drawdown caused by water production (300m^3/d)
Figure 8	Hydraulic Gradient between envisaged production well and Area 6, well active producing 300m^3/d

Reference:

Geological Survey of Ireland, 2001. Wicklow County Council Groundwater Protection Scheme