

**APPENDIX 8
GEOLOGICAL AND
HYDROGEOLOGICAL ASSESSMENT**

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**EIS for Proposed Development Site
At Killycarran, Emyvale, Co. Monaghan**

October 2001

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Prepared by:
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**EIS for Proposed Development
At Killycarran, Emyvale, Co. Monaghan.**

October 2001

1 GEOLOGY AND HYDROGEOLOGY

1.1 Introduction

K.T Cullen and Co were requested by South Western Environmental Services to complete the Geology and Hydrogeology sections of the EIS for a proposed Biomass CHP plant at Killycarran, Emyvale Co Monaghan.

This report summarises the geological and hydrogeological environment of a proposed development site at Killycarran, Emyvale, Co. Monaghan. The site is located approximately 4km to the west of Emyvale in the townland of Killycarran, (Figure 1). It is written in tandem with a report by this office on the drilling and testing of a trial water well (TW 1) at the site, which will be utilised to provide plant water requirements. The proposed site area is about 7 acres in size and it's location outlined in Figure 3.

1.2 The Receiving Environment

In considering the existing environment and any impacts of the proposed development on geology and groundwater quality, bedrock geology, overburden geology, depth to water, and groundwater vulnerability have been examined. The receiving environment has been examined under three headings; (1.2.1) Bedrock Geology, (1.2.2) Overburden Geology and (1.2.3) Hydrogeology.

1.2.1 Bedrock Geology

The area around Emyvale is underlain by Carboniferous aged rocks, comprising various limestones, sandstones, siltstones and mudstones. The geology of the area is shown in figure 2. It can be seen that the site is underlain by the Maydown Limestone Formation (MA). In general, the Maydown Formation consists of various lithologies ranging from muddy and silty limestones to laminated calcareous siltstones and calcareous shales. Drilling carried out on the site indicated the presence of grey-black limestone bedrock.

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1.2.2 Overburden Geology

Drilling on the site has shown that the overburden deposits are quite thick, in the order of 24 to 30 metres, and are composed predominantly of low permeability clays. 26 metres of clays are seen to overlie 4.5 metres of gravels on top of the bedrock, at the trial well location (TW 1). 24.08 metres of clay are seen to overlie the bedrock at the monitoring well location. The geological logs of both wells are included in Appendix A.

1.2.3 Hydrogeology

Groundwater is an important resource in Monaghan, supplying approximately 16% of drinking water in the county. Groundwater is discussed under three headings; groundwater flow, groundwater use, aquifer classification and aquifer vulnerability.

1.2.3.1 Groundwater Flow

The locations of the newly drilled trial well (TW 1) and observation well (MW 1) on the site are shown in Figure 3. These are used in conjunction with an unused well at the neighbouring poultry farm, located 40 metres from the site, to obtain groundwater flow direction and gradient on the site (figure 4). Water levels on site show that the groundwater on site is flowing in a south-easterly direction at a gradient of 0.016. The site is situated on the northern slope of a drumlin feature which has an elevation of greater than 122 metres. This is an elongated feature which runs in a north-south direction. Regionally, the groundwater is likely to be flowing in a radial fashion from apex of this structure with a chief component of flow towards the Mountain Water River.

1.2.3.2 Groundwater Use

Groundwater is used locally for domestic supply at McCarrons property (the site owners); all other houses are supplied by a group scheme which obtains its supply from Lough More, located some 5.4 km to the north-west of Derrygola. It is proposed to abstract groundwater on the site for use in the proposed development. A trial well was drilled and pump tested as described by the report by our office entitled "Drilling and Testing of a Trial Well at Emyvale, Co Monaghan". This well was shown to be capable of yielding at least 650 m³/day. Driller's estimates placed the potential yield at 1091 m³/d

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Table 1: GSI Vulnerability Mapping Guidelines.

The site would be classified as having a low vulnerability rating according to the guidelines as there are >10m of low permeability clays overlying the site (Table 1). Any contaminants that may enter the subsurface will be adsorbed onto these clays, thereby affording the underlying groundwater protection from pollution. The groundwater in the area is confined under significant thickness of clays, and as such, the recharge area may be quite a distance from the site.

1.3 Characteristics of the Proposal

The proposed development involves the construction of a biomass CHP plant at a site at Killycarran, Emyvale, County Monaghan. Abstraction of groundwater will be undertaken for utility and plant process purposes.

14 Potential Impacts of the Development: Water Impacts

In a development such as this, the main potential impacts are as follows:

- Abstraction from and discharges to groundwater
- Removal of overburden cover and bedrock
- Reduction of recharge areas
- Leaking sewers and accidental oil spills
- Impact on the hydrological regime of Natural Heritage Areas

1.4.1 Abstractions and Discharges

It is intended to abstract groundwater on the site for use as potable and process water in the proposed development. The trial well has been shown to be capable of yielding in the order of 650 m³/day. Water levels were recorded during the course of the pump test in the unused well in the farmyard, some 170 metres to the south of the trial well. The maximum drawdown recorded in TW1 during the pump test was 8.8 metres. There is one domestic well in use close to the site, owned by the site owner.

A wastewater treatment system will be installed at the site which will discharge treated effluent to the ground at the northern boundary of the site. From here the groundwater will discharge into the drain. There are no groundwater abstractions within the immediate vicinity of the site.

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1.4.2 Removal of Overburden Cover and Bedrock

It is not proposed that any significant volume of overburden or bedrock will be removed from the site.

The site is approximately 0.033km² in area in total. The total amount of hardstanding, which consists of asphalt paving and concrete paving is 0.00732 km²; this will add protection to the underlying aquifer. This is approximately 22% of the site area.

1.4.3 Accidental spills

It is possible that accidental oil spills may occur from tanks or vehicles.

1.4.4 Natural Heritage Areas and Special Areas of Conservation

There are no Natural Heritage Areas or Special Areas of Conservation within 5 km of the site.

1.5 Remedial or Reductive Measures

1.5.1 Abstractions and Discharges

Groundwater abstraction on the site will impact upon the domestic well at McCarrons property as the pumping test showed an impact of 8 metres. It would be advisable to monitor the water levels in the observation well and the unused well at the farm on an ongoing basis, to build up a database. The sustainable yield of the trial well was shown to be 650 m³/day and the test was carried out during the time of lowest water table levels. It is unlikely that normal pumping at the required rate will significantly impact local groundwater levels. All other residences in the area are supplied by a group scheme with a surface water source. Consequently, any groundwater abstraction will have no real impact in the area.

The effluent will be treated by passing through a Bioclear Treatment System which will provide a high level of treatment. The resultant effluent will be further attenuated as it passes through the subsoil deposits and into the drain. The drilling of an observation well near the area of discharge shows the

presence of 24.08 metres of tight clay. This will prevent any of the discharges from reaching the groundwater.

1.5.2 Removal of Overburden Cover and Bedrock

As there is no significant removal of overburden material from the site and no quarrying of bedrock there are no remedial measures necessary.

1.5.3 Accidental Spills

Standard surface water drains will be installed on the site. To mitigate for any accidental spillages of oil or car leaks, an oil interceptor will be placed at the outlet of the surface water drains. This interceptor would allow any oil to be separated out from the water, thus ensuring that the discharged water is free from hydrocarbons. In the unlikely event of a leakage to groundwater, the low vulnerability of the overburden will act as an impermeable barrier to flow.

Oil tanks on the site should be bunded with 110 % capacity of the oil tank in order to reduce the risk of spills occurring.

During the construction phase, exposed soil can be dampened to avoid erosion of soil and generation of dust.

1.5.4 Natural Heritage Areas and Special Areas of Conservation

As there are no conservation areas in the vicinity of the site no mitigation measures are necessary.

1.6 Predicted Residual Impacts of the Development

The proposed development is not expected to have any negative impact on groundwater quality. Baseline water quality samples were taken at the time of drilling of the supply well (6th September 2001). These can be used to compare any future changes in water quality.

Groundwater abstraction on the site will result in the lowering of groundwater levels around the well. This is not likely to have any significant impact as there is only one domestic well in use close-by, which is owned by the developers.

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Amy Brennan B.Sc. M.Sc.

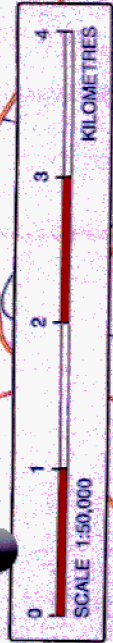
Victoria Conlon B.Sc. M.Sc.

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FIGURES

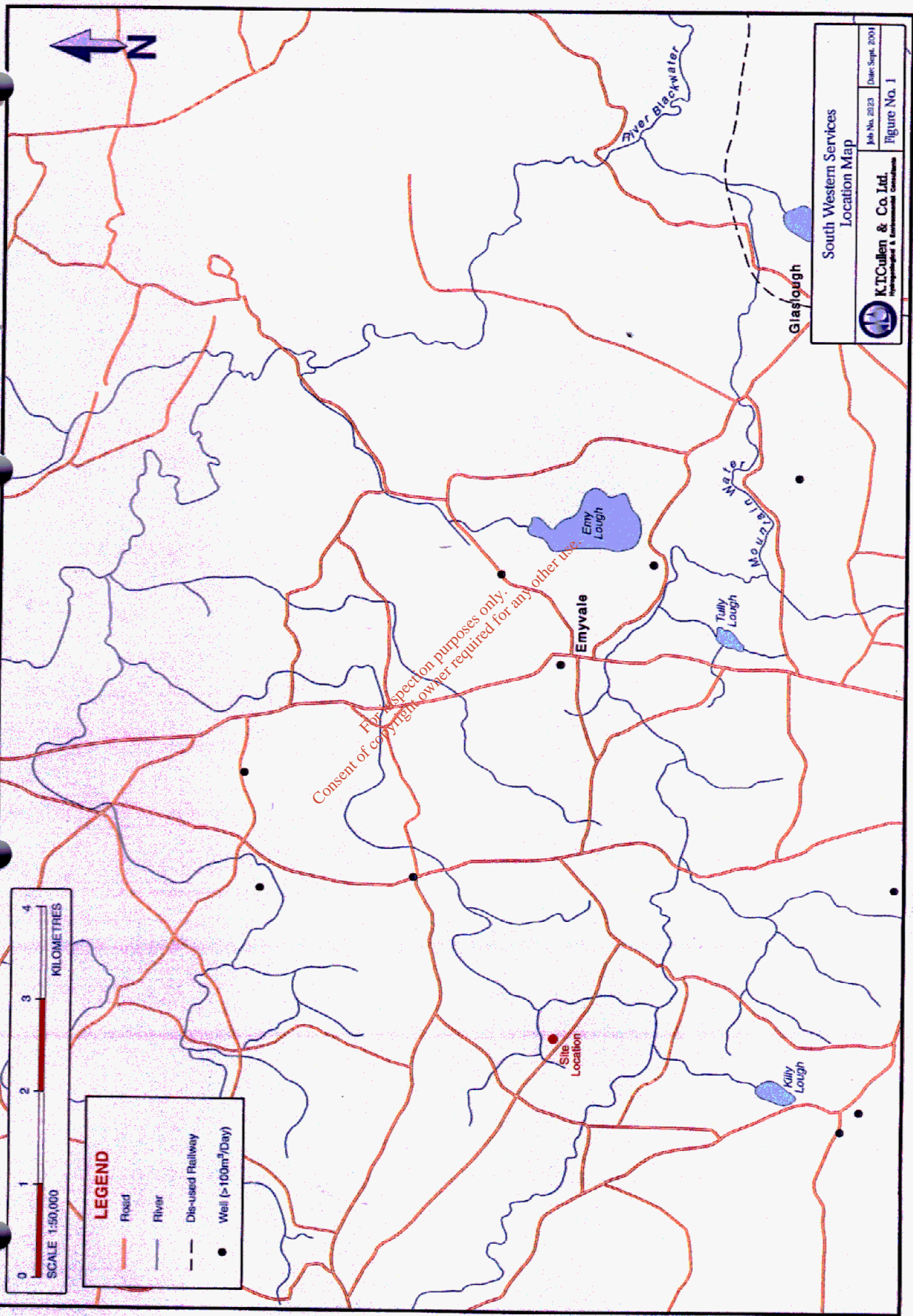
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LEGEND

- Road
- River
- Dis-used Railway
- Well (>100m³/Day)

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South Western Services
Location Map

Job No. 2023 Date: Sept. 2001
Figure No. 1

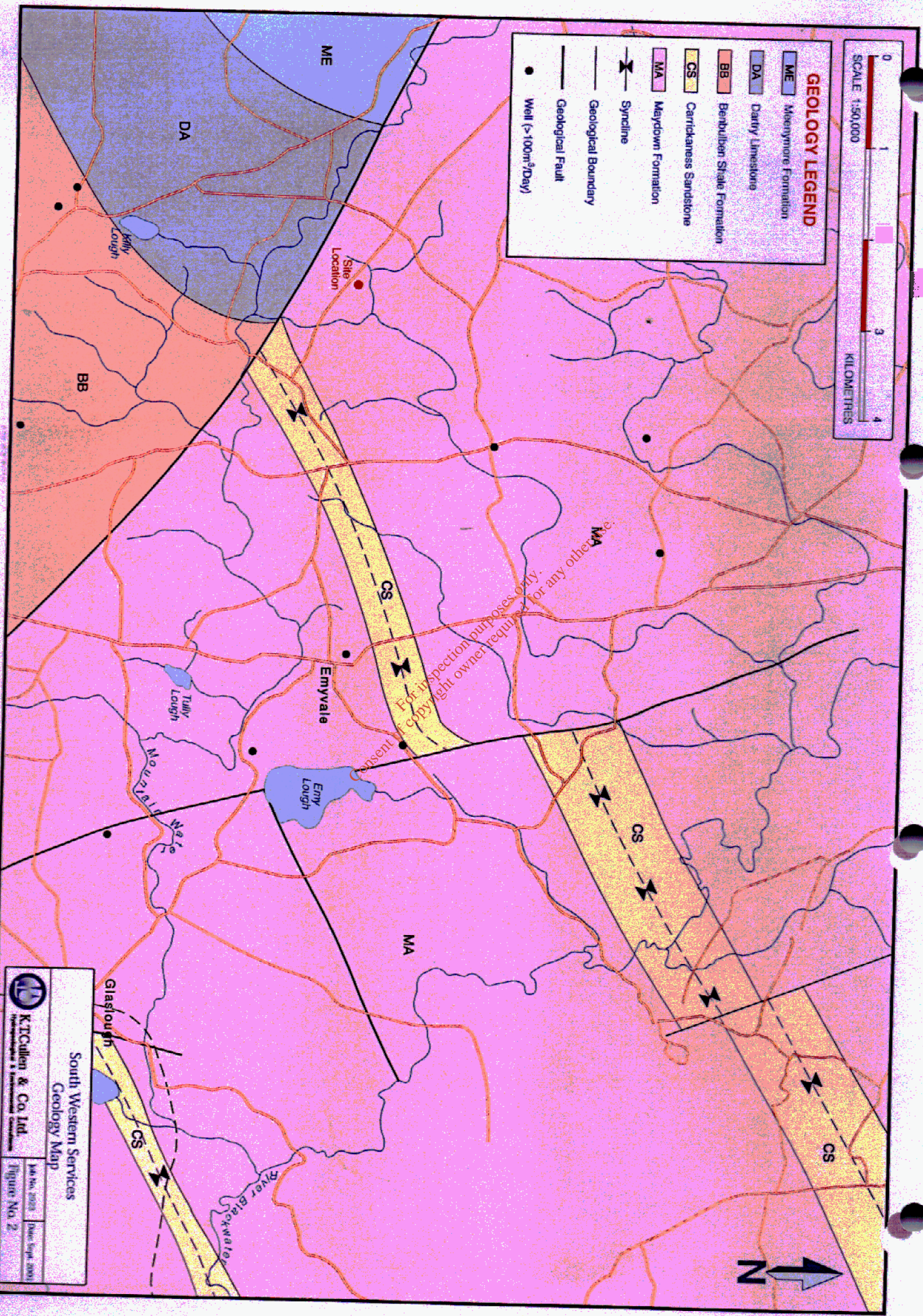
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Hydrographical & Environmental Consultants



GEOLOGY LEGEND

- ME Meenymore Formation
- DA Darryl Limestone
- BB Benbulbin Slate Formation
- CS Carrickness Sandstone
- MA Maydown Formation

- Syncline
- Geological Boundary
- Geological Fault
- Well (>100m³/Day)









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South Western Services
Geology Map

Lab No. 2028	Date Sept. 2001
Figure No. 2	

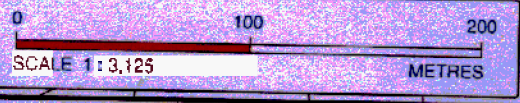
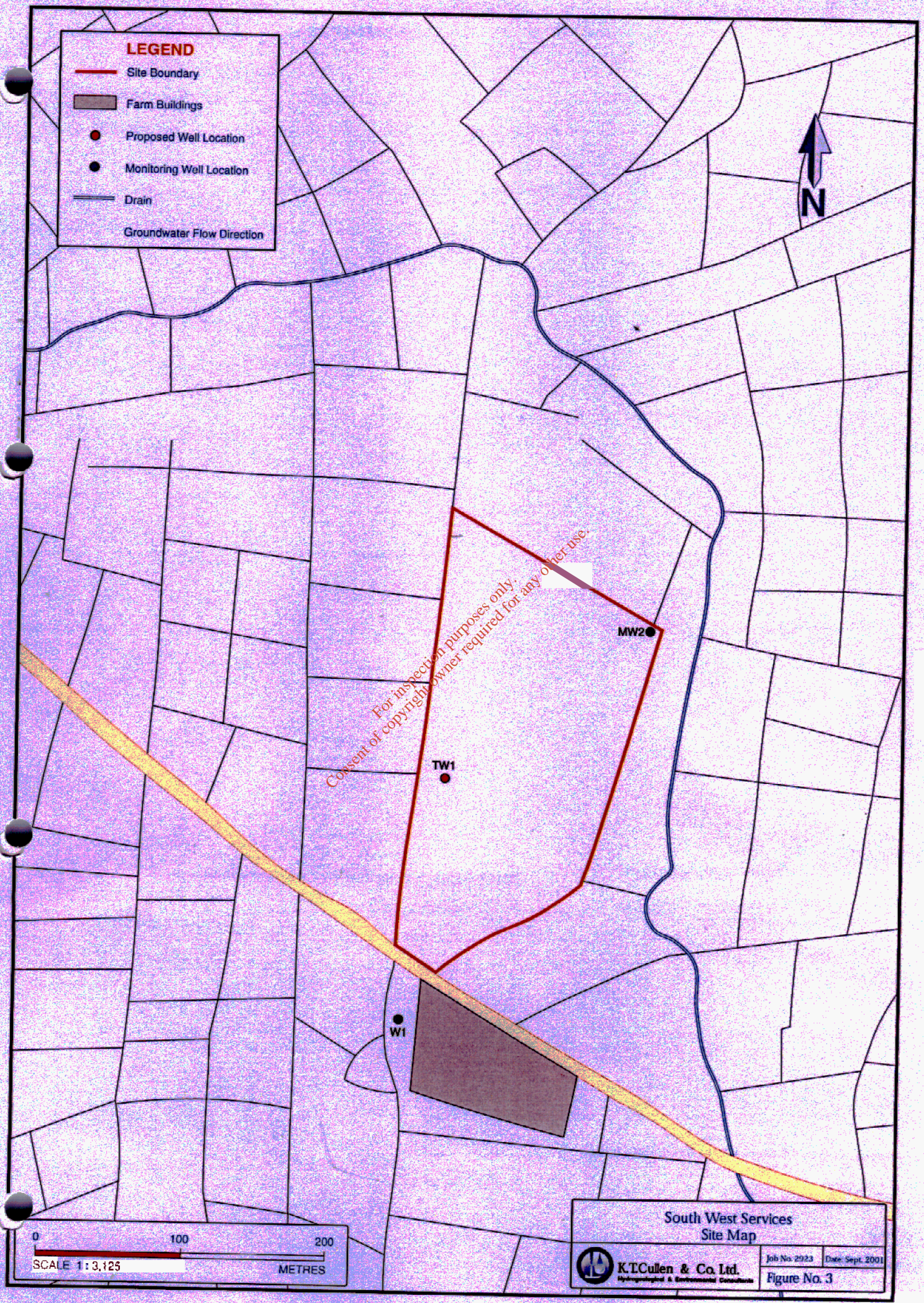
K.T.Cullen & Co. Ltd.
Hydrogeology & Environmental Geologists

LEGEND

-  Site Boundary
-  Farm Buildings
-  Proposed Well Location
-  Monitoring Well Location
-  Drain
-  Groundwater Flow Direction

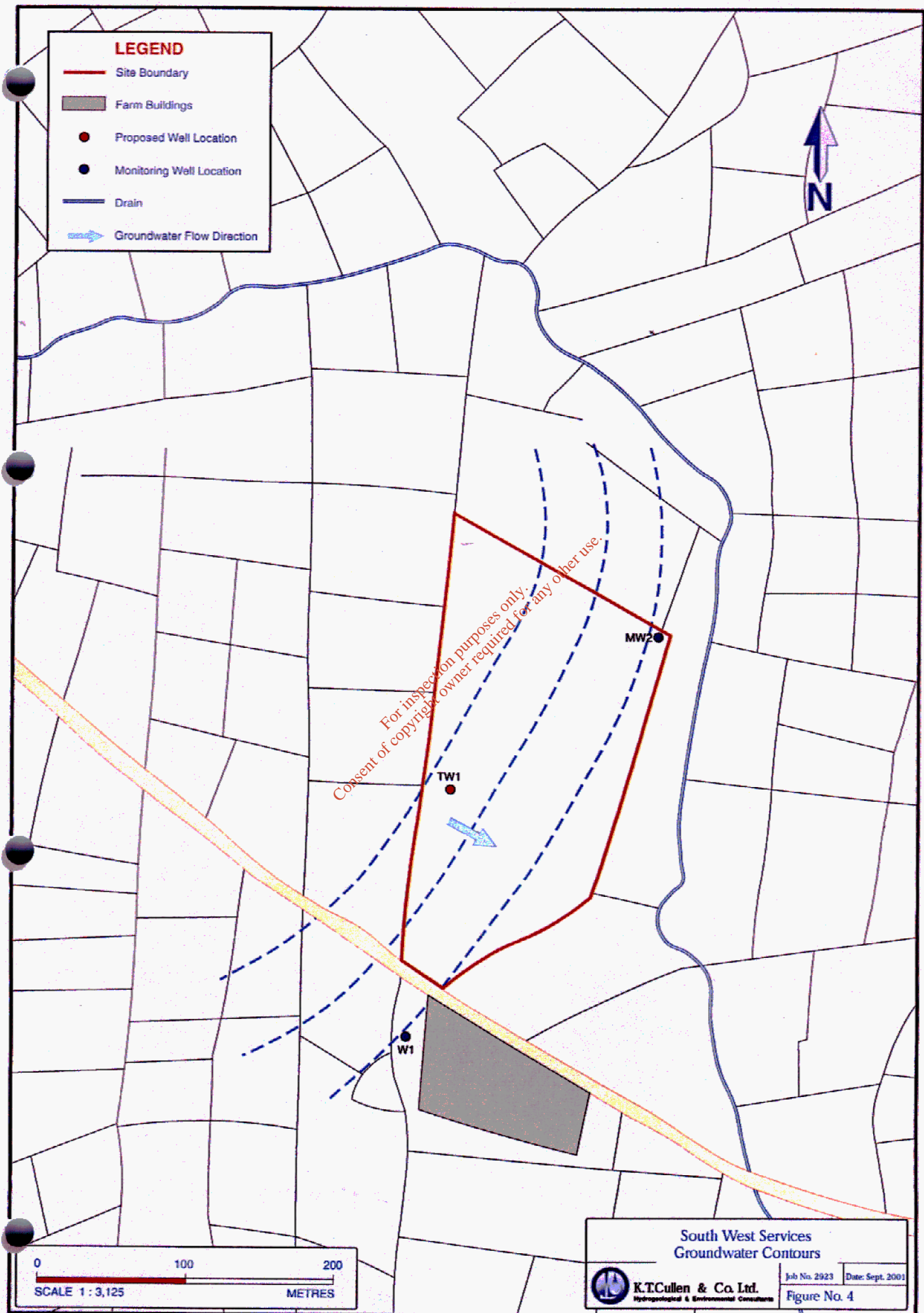


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**South West Services
Site Map**

	K.T.Cullen & Co. Ltd.		Job No 2923	Date Sept. 2001
	Hydrological & Environmental Consultants		Figure No. 3	



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TABLES

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Parameters	Unit	TW 1 9/7/01	Potable Water M.A.C.
pH	units	8.2	6 - 9
Conductivity	µS/cm	1410	1500
Hardness	CaCO ₃ mg/l	232	
Alkalinity	CaCO ₃ mg/l	350	
Calcium	Ca mg/l	27	200
Magnesium	Mg mg/l	40	50
Sodium	Na mg/l	280	150
Potassium	K mg/l	4	12
Sulphate	SO ₄ mg/l	280	250
Chloride	Cl mg/l	133	250
Nitrate	NO ₃ mg/l	<5	50
Nitrite	NO ₂ mg/l	4.01	0.1
Ammonia	NH ₄ mg/l	1.5	0.3
Non-Purg Org. Carb.	C mg/l	0.7	
Aluminium	Al mg/l	<0.05	0.2
Iron	Fe mg/l	0.04	0.2
Manganese	Mn mg/l	<0.01	0.05
Copper	Cu mg/l	<0.01	0.5
Plate Count (22°C)	T.C.C./ml	> 300	No significant increase above background level
Plate Count (37°C)	T.C.C./ml	>300	
Coliforms	count/100ml	Nil	
Eaecal Streptococci	count/100ml	Nil	
Faecal Str	count/100ml	Nil	
LEGEND			
M.A.C. = Maximum Admissible Concentration under E.C. Directive (No. 80/778/E.C.)			
< = Less Than			

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Table 1: Chemical and Bacteriological Analysis from TW 1 Killycarran, Co. Monaghan.

Parameter
Petrol Range Hydrocarbons
Diesel Range Hydrocarbons
Mineral Oil
Benzene
Toluene
Ethyl Benzene
Total Xylene

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APPENDIX A

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Table 2	Hydrocarbon Analyses	(as in preceding report)

Appendices

Appendix A	Geological Logs	(as in preceding report)
Appendix B	Pump Test Data	

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Drilling and Testing of a Trial Well At Killycarran, Emyvale, Co. Monaghan

October 2001

1 Introduction

Based on the findings of a desk study carried out by our office (K.T. Cullen and Co. Ltd.) in April 2001, it was decided to drill and pump test a trial well at a site at Killycarran, County Monaghan, see Figure 1. An observation well was also drilled, which was monitored during the pump test.

The required yield is approximately 90 m³/d. This water will be used as a potable supply as well as process water.

2 Well Drilling.

Dunnes Water Services of Dundalk, Co. Louth, were retained to carry out the drilling of the trial well and the observation well. The trial well was drilled on 3rd September 2001, to a total depth of 111.25 metres. Overburden was encountered to a depth of 30.5 metres and consisted of 26 metres of clay underlain by 4.5 metres of gravel. Grey-black limestone was encountered to the end of the hole with the main groundwater inflow occurring between 105 and 110 metres. The driller's initial estimates indicated a well yield in the order of 1090 m³/day.

An observation well was also drilled on the site to a depth of 36.6 metres. This consisted of 24.1 metres of clay overlying black limestone bedrock. The first water entry was at 30.5 metres and a final yield in the order of 218 m³/day was estimated. Well logs are included in Appendix A and well locations can be seen on Figure 1.

3. Trial Well Testing

Seamus Kelly and Sons of Enniscorthy, County Wexford, were retained to carry out the pump testing of the trial well. The pump test was conducted over a period of 72 hours and the data is tabulated and graphed in Appendix B. A 6" submersible pump was installed into the well. As the well is a 6" well the pump could only be placed as far as the level of the steel casing i.e. 30 metres. The oversized pump was used in order to estimate more accurately the maximum capacity of the well even though the pumping rate was limited by the available drawdown. A smaller pump (4") could have been installed but this would only have had the capacity to pump approximately 436 m³/d.

The static water level, before the test began was at 15.55 metres below ground level. Pumping began at a rate of 490 m³/day with a resultant drawdown of 3.63 metres after 40 minutes. The pumping rate was then increased to 763 m³/day at which point the drawdown began to increase a little more rapidly. The pumping rate then dropped off during the course of the test as a result of increasing drawdown. A final drawdown of 9.95 metres was recorded at a pumping rate of 698 m³/day. The water level was still dropping at the end of the test and recovery was slow, which implies that the sustainable yield of the well is somewhat less than 698 m³/day, in the order of 650 m³/day.

During the pump test the two wells on Mc Carron property were monitored. One of these (OW1) is not pumping and so any changes in water level are directly associated with pumping. It decreased from 15.5 metres below ground level to 21.3 metres- a drawdown of 5.8 metres. The pumping well behind the Mc Carron house had a drawdown of 8.8 metres. This is obviously experiencing the effects of domestic pumping as well as from the pump test. The pumping rate throughout the test is much higher than that which would normally be used and pumping may not be constant. Both wells began to recover as soon as pumping ended.

4. Hydrochemistry

Groundwater samples were taken from the trial well at the end of the 72-hour pump test and were forwarded to the following laboratories for standard chemical, bacteriological and hydrocarbon analyses.

Enterprise Ireland, Glasnevin-Chemical

AI Control Geochem-Organics

Dr D.E Hood, Dundrum-Bacteriological

The results of the chemical and bacteriological analyses are shown in Table 1. The results of the hydrocarbon (organic) analyses are shown in Table 2.

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The chemical quality of the groundwater is indicative of the bedrock geology of the area. The high sulphate, sodium and chloride concentrations are associated with the presence of gypsum layers in the Meenymore Formation, which outcrops to the west of the site. Gypsum is an evaporite deposit which was formed by evaporation in shallow seas during the Carboniferous. This also accounts for the relatively high conductivity (1400 μ S/cm) for a groundwater. The water is moderately hard with a pH typical of an alkaline parent rock. Total ammonia is also higher than its MAC of 0.3 mg/l. This would normally be indicative of sewage pollution but the fact that nitrite and nitrate levels are very low would appear to indicate that the ammonia is naturally occurring. In the presence of oxygen, the available ammonia would normally be converted to nitrate and nitrite but obviously conditions in the aquifer are particularly anaerobic and therefore reduction rather than oxidisation is occurring. Without the presence of associated indicators of sewage contamination, such as potassium, nitrite and coliforms the high ammonia levels are not harmful to health.

High sulphate levels can affect concrete structures.

The bacteriological quality is excellent with no faecal or total coliforms present. This is due to the fact that the vulnerability of the site is very low on account of the thick overburden deposits.

There is also no evidence of organic pollution as all the values are below the detection limit.

5. Conclusions and Recommendations

The trial well drilled on the site has been shown to be capable of yielding in the order of 650 m³/day. This is 1.7 times the required yield. The pump test and driller's estimates indicate that the well is capable of producing significantly larger volumes of water. If larger volumes were required, an 8" production well should be drilled next to the 6" well. This would allow the installation of a 6" pump which would be capable of supplying larger yields.

The groundwater quality reflects the geological terrain; the levels of ammonia, sodium and sulphate exceed the potable water MAC's and as such, it would be advisable that the water undergoes treatment prior to human consumption. Aeration will reduce the levels of ammonia by converting it to nitrate and deionisation or reverse osmosis processes can be used to reduce sodium and sulphate levels. Chlorination should also be undertaken as a matter of course for potable water supply. Deionisation and reverse osmosis processes are, however, expensive and it may be more financially viable to obtain potable water for the plant from the local group scheme, if possible.

Respectfully Submitted

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Appendix B Pump Test Data

Actual Time	TIME (MINS)	FIELD DATA (METRES)	WATER LEVEL BELOW G.L. (m.)	DRAWDOWN (METRES)	YIELD (M3/DAY)
04-09 16:00:00	0	16.05	15.55	0	
04-09 16:00:30	0.5	16.98	16.48	0.83	490
04-09 16:01:00	1	17.72	17.22	1.67	
04-09 16:01:30	1.5	17.83	17.33	1.78	490
04-09 16:02:00	2	17.95	17.45	1.9	
04-09 16:02:30	2.5	18.02	17.52	1.97	490
04-09 16:03:00	3	18.1	17.6	2.05	
04-09 16:03:30	3.5	18.16	17.88	2.11	490
04-09 16:04:00	4	18.22	17.72	2.17	
04-09 16:04:30	4.5	18.28	17.78	2.23	
04-09 16:05:00	5	18.32	17.82	2.27	490
04-09 16:06:00	6	18.4	17.9	2.35	
04-09 16:07:00	7	18.46	17.95	2.4	
04-09 16:08:00	8	18.55	18.05	2.5	
04-09 16:09:00	9	18.81	18.11	2.58	
04-09 16:10:00	10	18.66	18.16	2.61	490
04-09 16:12:00	12	18.78	18.28	2.73	
04-09 16:14:00	14	18.88	18.38	2.83	
04-09 16:16:00	18	18.98	18.48	2.93	490
04-09 16:18:00	18	19	18.5	2.95	
04-09 16:20:00	20	19.1	18.6	3.05	
04-09 16:22:00	22	19.16	18.66	3.11	490
04-09 16:24:00	24	19.24	18.74	3.19	490
04-09 16:26:00	26	19.3	18.8	3.25	490
04-09 16:28:00	28	19.36	18.88	3.31	490
04-09 16:30:00	30	19.43	18.93	3.38	490
04-09 16:35:00	35	19.56	19.06	3.51	490
04-09 16:40:00	40	19.68	19.18	3.63	490
04-09 16:45:00	46	19.79	19.29	3.74	763
04-09 16:50:00	50	19.91	19.41	3.88	763
04-09 16:55:00	55	20.02	19.52	3.97	763
04-09 17:00:00	60	20.12	19.62	4.07	763
04-09 17:15:00	75	20.41	19.91	4.36	763
04-09 17:30:00	90	20.61	20.11	4.56	763
04-09 17:45:00	105	20.8	20.3	4.75	763
04-09 18:00:00	120	21.02	20.52	4.97	763
04-09 18:30:00	150	21.27	20.77	5.22	752
04-09 19:00:00	180	21.45	20.95	5.4	752
04-09 19:30:00	210	21.88	21.18	5.63	752
04-09 20:00:00	240	21.9	21.4	5.85	752
04-09 21:00:00	300	22.12	21.62	6.07	752
04-09 22:00:00	360	22.45	21.96	6.4	752
04-09 23:00:00	420	22.62	22.12	6.57	751
05-09 00:00:00	480	22.78	22.28	0.73	751
05-09 01:00:00	540	22.95	22.45	6.9	751
05-09 02:00:00	600	23.1	22.0	7.05	751
05-09 04:00:00	720	23.39	22.89	7.34	735

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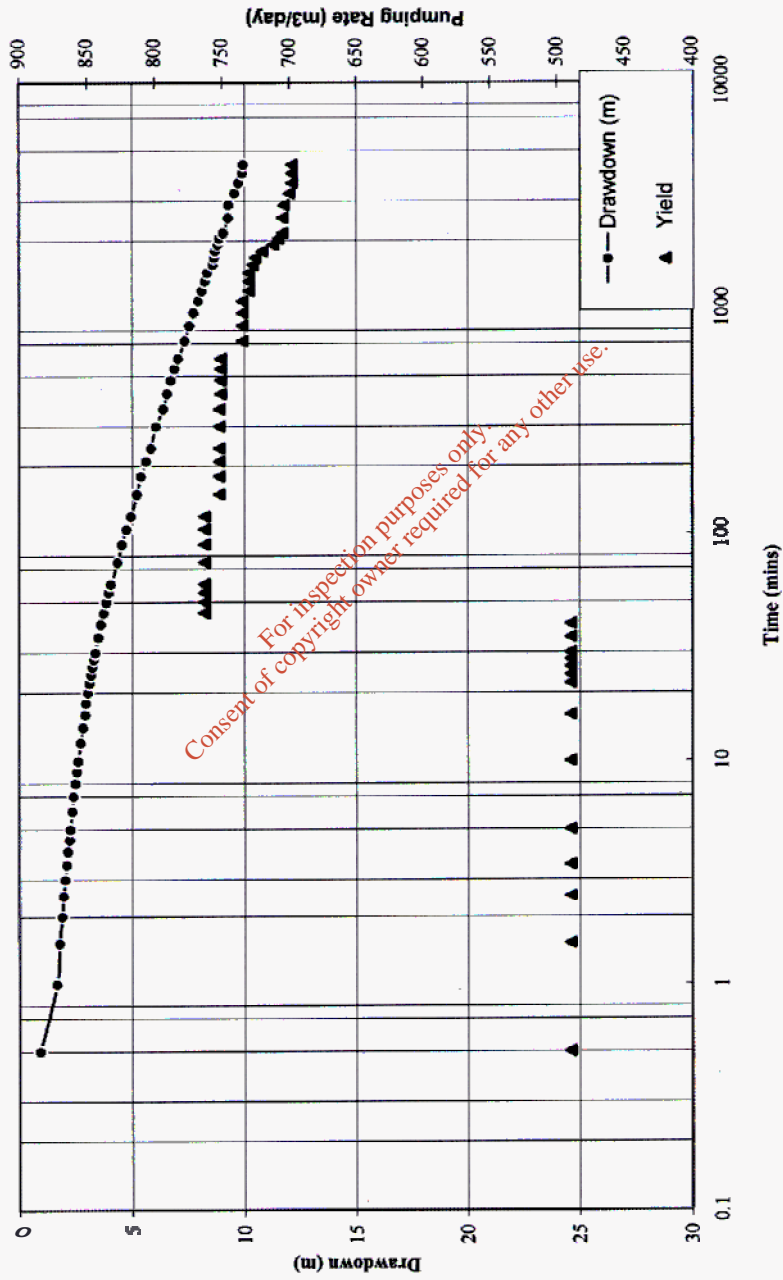
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05-09 06:00:00	840	23.6	23.1	7.55	735
05-09 08:00:00	960	23.79	23.29	7.74	735
05-09 10:00:00	1080	24	23.5	7.96	735
05-09 12:00:00	1200	24.17	23.67	8-12	730
05-09 14:00:00	1320	24.3	23.8	8.25	730
05-09 16:00:00	1440	24.4	23.9	8.35	730
05-09 18:00:00	1560	24.65	24.15	8.6	727
05-09 20:00:00	1680	24.7	24.2	8.65	725
05-09 22:00:00	1800	24.76	24.26	8.71	720
06-09 00:00:00	1920	24.88	24.36	8.81	712
06-09 02:00:00	2040	24.94	24.44	8.89	708
06-09 04:00:00	2160	25.11	24.61	9.06	705
06-09 10:00:00	2520	25.32	24.82	9.27	705
06-09 16:00:00	2880	25.35	24.85	9.3	704
06-09 22:00:00	3240	25.61	25.11	9.58	700
07-09 04:00:00	3600	25.79	25.29	9.74	698
07-09 10:00:00	3960	25.97	25.47	9.92	698
07-09 16:00:00	4320	26	25.5	9.95	698

Time Drawdown Data for 72 Hour Pump Test at Killycarran, September 2001.

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REFERENCE



Time Drawdown Graph for 72hr Pump Test on TW1, Killycarran, Emyvale, September 2001

Elapsed Time (mins)	IELD DATA METRES)	Water Level Below g.l. (m)	Drawdown (m)
0	26	25.5	9.45
0.5	25.6	25.1	9.05
1	25.4	24.9	8.85
1.5	25.08	24.58	8.63
2	24.6	24	7.95
2.5	24.25	23.75	7.7
3	24.2	23.7	7.65
3.5	24.13	23.63	7.58
4	24.07	23.57	7.52
4.5	24.02	23.52	7.47
5	23.97	23.47	7.42
6	23.93	23.43	7.38
7	23.8	23.4	7.35
8	23.8	23.3	7.25
9	23.72	23.22	7.17
10	23.69	23.19	7.14
12	23.6	23.1	7.05
14	23.5	23	6.95
16	23.4	22.8	6.85
18	23.31	22.81	6.76
20		22.73	6.68
22	23.16	22.66	6.61
24	23.09	22.59	6.54
26	23.02	22.52	6.47
28	22.95	22.45	6.4
30	22.88	22.38	6.33
35	22.76	22.26	0.21
40	22.64	22.14	6.09
45	22.52	22.02	5.97
50	22.42	21.92	5.87
55	22.3	21.8	5.75
60	22.22	21.72	5.67

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Time Drawdown Recovery data for 72 hour Pump Test, Killycarran, September 2001

Well Log

Well No. TW1

Grid Reference

Project No. 2923

Client South Western Services

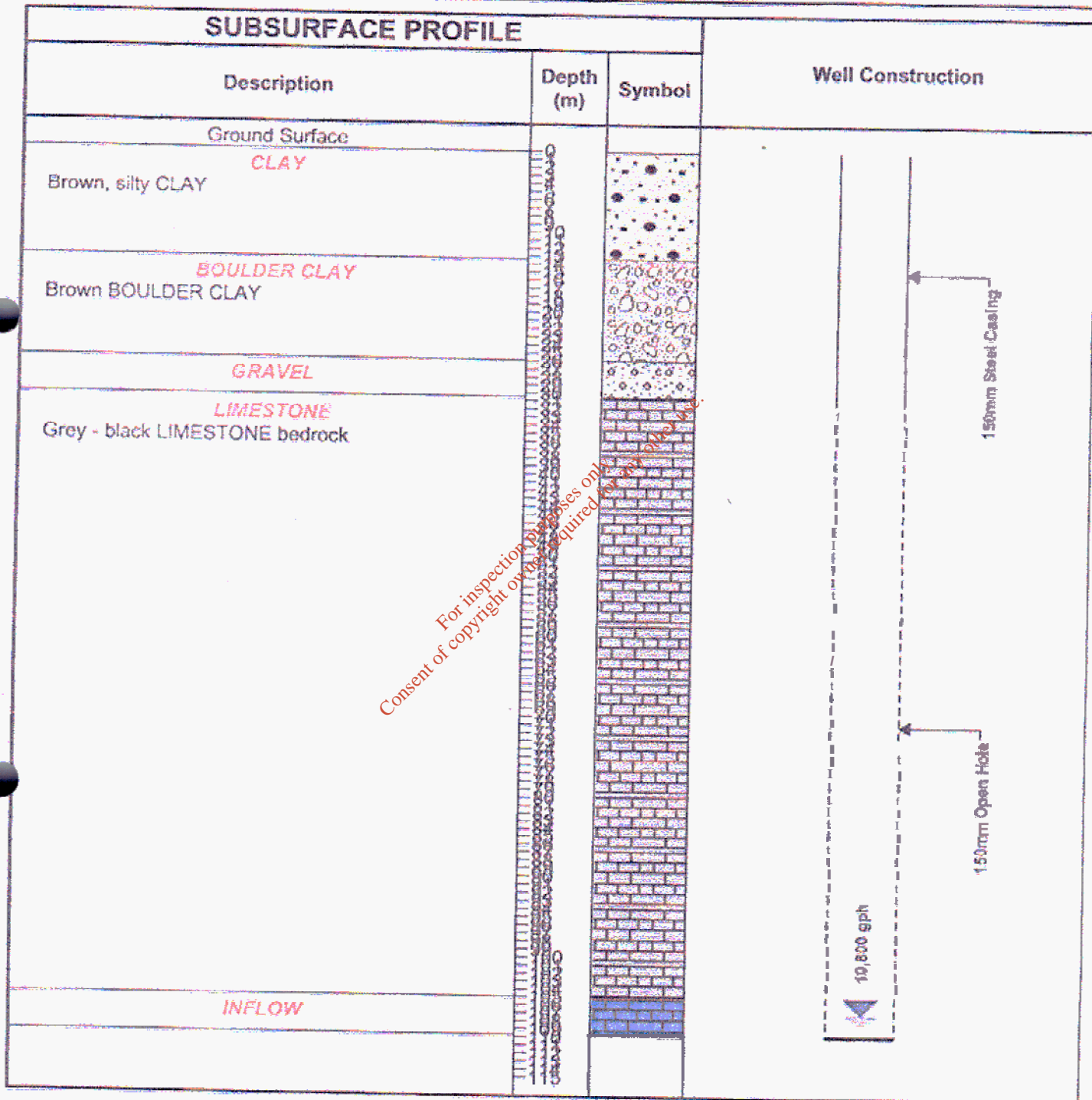
Drill Date 3/9/01

Well Type Trial

Location Emyvale, Co. Monaghan

Geologist Owen Millar

SUBSURFACE PROFILE



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K.T. Cullen & Co. Ltd.

Drill Method Air Rotary
Casing Length (m) 30.48
Driller Dunnes

Hole Size (mm) 150
Ground Level (mOD)
Static Water Level (bgl)

Well Log

Well No. MW1

Grid Reference

Project No. 2923

Client South Western Services

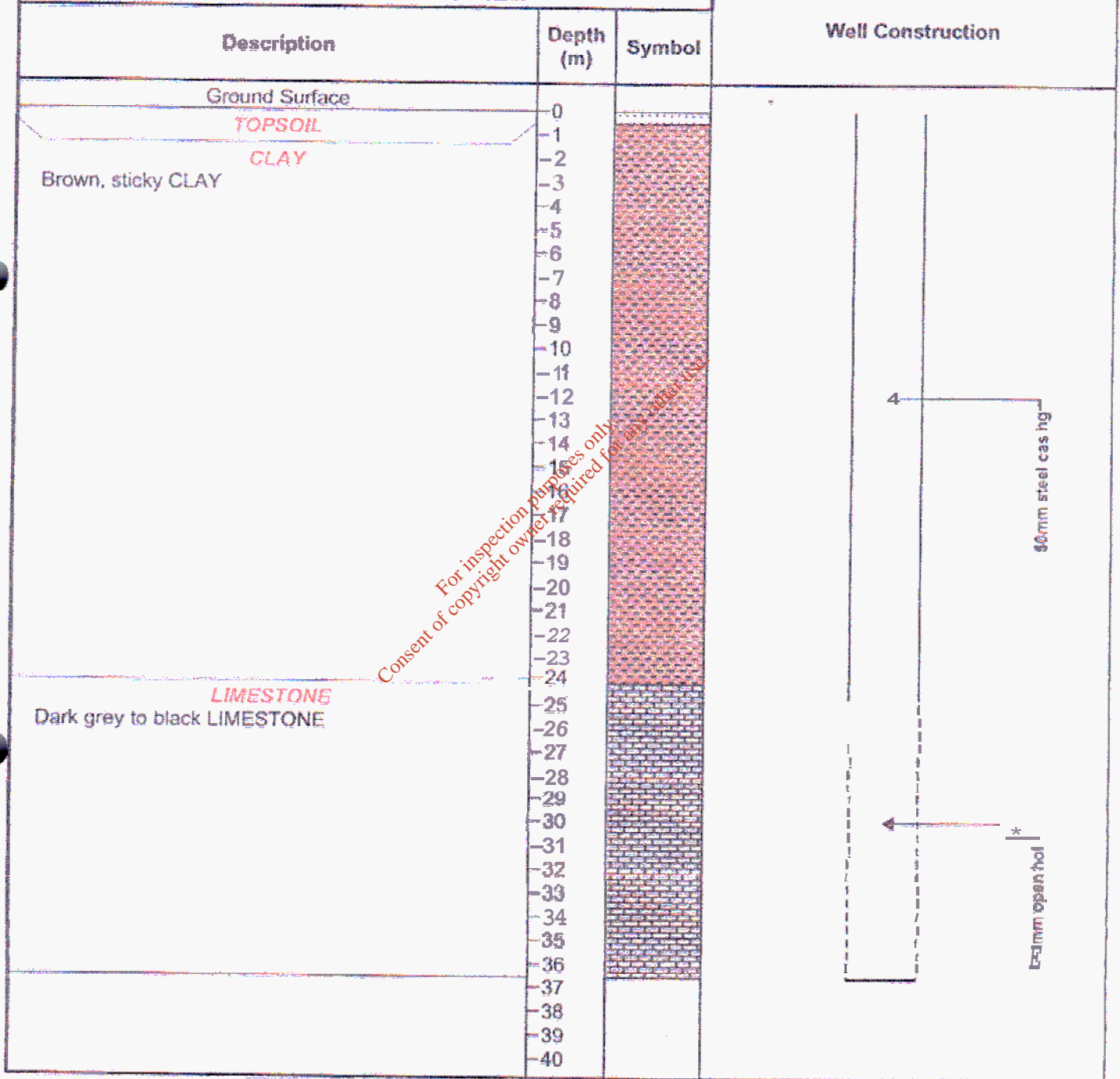
Drill Date 4/9/01

Well Type Monitoring Well

Location Emyvale, Co. Monaghan

Geologist Owen Millar

SUBSURFACE PROFILE



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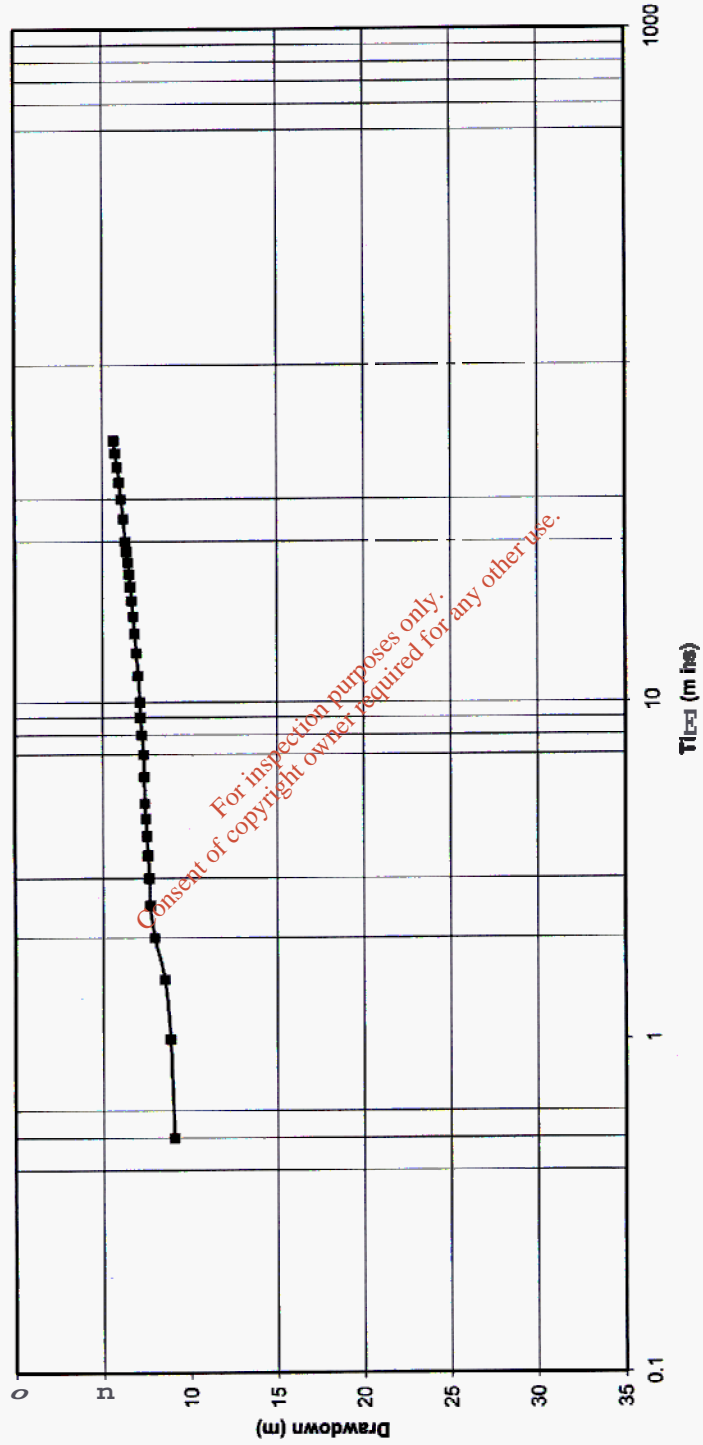


K.T.Cullen & Co. Ltd.

Drill Method Air Rotary
Casing Length (m) 24.4m
Driller Dunnes Drilling Services

Hole Size (mm) 150mm
Ground Level (mOD)
Static Water Level (bgl)

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Time Drawdown Recovery Graph for 72 Hour Pump Test on TW1, Killycarran, Emyvale, October 2001.

Actual Time	Time (mins)	Field Data (m)		Drawdown	
		House	Farm	House	(m) Farm
04-09 16:00:00	0	15.5	19	0	0
04-09 21:00:00	300	16.3	21	0.8	2
05-09 07:00:00	900	18	25	2.6	6
05-09 13:00:00	1260	19.02	26.01	3.52	7.01
05-09 16:00:00	1440	18.05	26.01	3.45	7.01
05-09 21:00:00	1740	18.75	26.03	3.25	7.03
06-09 09:00:00	2460	20.04	26.4	4.54	7.4
06-09 13:00:00	2700	20.02	26.84	4.52	7.84
06-09 17:00:00	2940	20	26.77	4.5	7.77
06-09 21:00:00	3180	20	26.72	4.5	7.72
07-09 05:00:00	3660	20.7	27.3	5.2	8.3
07-09 09:00:00	3900	21.3	27.8	5.8	8.8
07-09 16:30:00	4350	19.65	26.94	4.15	7.94

Observation Well data for 72 Hour Pump Test on TW1 at Killycarran, Emyvale, September 2001.

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Ground water Quality Results

Table 8.1: Inorganics and Bacteriological Results

McCarrons Well: Sampled 13.06.01; Well Depth: 60.96m Estimated Well Yield: 136m³/dSite Well TW1: Sampled 7.09.01; Well Depth:111.25m; Estimated Well Yield>650m³/d

Sampling Procedure : based on BSI 6068

Parameters	Units	McCarron Well	TW 1 Site Well	SI 81 1988	Dutch MAC	
					S	I
Calcium	mg/l Ca	38.96	27	200		
Iron	mg/l Fe	<0.05	0.04	0.2		
Zinc	mg/l Zn	<0.05		†	0.053	0.8
Chloride	mg/l Cl	20	133	250		
Nitrite	mg/l NO ₂ -	0.60	<0.01	0.1		
Nitrate	mg/l NO ₃ -	0.5	<5	50		
Sulphate (soluble)	mg/l SO ₄ -	96	280	250		
Ammoniacal Nitrogen as NH ₄ -N	mg/l NH ₄ -	1.5	1.5	0.3		
Mercury Low Dutch Target AA	µg/l Hg	<0.05		1		
Potassium	mg/l K	3.4	4	12		
Sodium	mg/l Na	78	280	150		
Cadmium by ICP-USN	mg/l Cd	<0.4		5	0.0004	0.006
Copper	mg/l Cu		<0.01	0.5		
Manganese	mg/l Mn		<0.01	0.05		
Magnesium	mg/l Mg		40	50		
Non purg Org Carbon	mg/l C		0.7			
Aluminium	mg/l Al		<0.05	0.2		
Electrical Conductivity	µS/cm	695	1410	1500		
pH Value In Water	pH units	8.57	8.2	6 - 9.		
Conductivity	µS/cm		1410	1500		
Bicarbonate	mg/l CaCO ₃	300	582			

Legend

MAC: Maximum Admissible Concentration as per EC/80/778

S Value: Dutch Guideline for Uncontaminated Water

I Value: Dutch Guideline for Intervention

< Below detection limit

Table 8.2 Bacteriological Water Quality

Parameter	Unit	Results	Potable MAC
Plate Count 22°C	T.C.C/ml	>300	No significant increase
Plate Count 37°C	T.C.C/ml	>300	above background level
Coliforms	count/100ml	Nil	Nil
E. Coli	count 100ml	Nil	Nil
Faecal Streptococci	count 100ml	Nil	Nil

REFERENCE

Table 8.3 : Groundwater Quality Analytical Results
Volatile Organic Compounds (EPA 624/6260)
Sample Date: 13.06.01

Compound	Units ug/l	Conc.	Dutch MAC S	Dutch MAC I
Dichlorodifluoromethane	ug/l	<1	-	-
Chloromethane	ug/l	<1	-	-
Vinyl chloride	ug/l	<1	-	0.7
Bromomethane	ug/l	<1	-	-
Chloroethane	ug/l	<1	-	-
Trichlorofluoromethane	ug/l	<1	-	-
trans-1,2-Dichloroethene	ug/l	<1	-	-
Dichloromethane	ug/l	<1	-	-
Carbon disulphide	ug/l	<1	-	-
1,1-Dichloroethene	ug/l	<1	-	-
1,1-Dichloroethane	ug/l	<1	-	-
tert-butyl methyl ether	ug/l	<1	-	-
cis-1,2-Dichloroethene	ug/l	<1	-	-
Bromochloromethane	ug/l	<1	-	-
Chloroform	ug/l	<1	-	-
2,2-Dichloropropane	ug/l	<1	-	-
1,2-Dichloroethane	ug/l	<1	0.01	400
1,1,1-Trichloroethane	ug/l	<1	-	-
1,1-Dichloropropene	ug/l	<1	0.20	30
Benzene	ug/l	<1	-	-
Carbon tetrachloride	ug/l	<1	-	-
Dibromomethane	ug/l	<1	-	-
1,2-Dichloropropane	ug/l	<1	-	-
Bromodichloromethane	ug/l	<1	-	-
Trichloroethene	ug/l	<1	-	-
cis-1,3-Dichloropropene	ug/l	<1	-	-
trans-1,3-Dichloropropene	ug/l	<1	-	-
Dichloropropene	ug/l	<1	-	-
1,1,2-Trichloroethane	ug/l	<1	0.20	1000
Toluene	ug/l	<1	-	-
1,3-Dichloropropane	ug/l	<1	-	-
Dibromochloromethane	ug/l	<1	-	-

Compound	Units ug/l	Conc.	Dutch MAC S	Dutch MAC I
1,2-Dibromoethane	ug/l	<1	-	-
Tetrachloroethene	ug/l	<1	-	-
1,1,1,2-Tetrachloroethane	ug/l	<1	0.01	40
Chlorobenzene	ug/l	<1	0.20	150
p/m-Xylene	ug/l	<1	-	-
Bromoform	ug/l	<1	-	300
Styrene	ug/l	<1	0.50	-
1,1,2,2-Tetrachloroethane	ug/l	<1	-	-
o-Xylene	ug/l	<1	-	-
1,2,3-Trichloropropane	ug/l	<1	-	-
Isopropylbenzene	ug/l	<1	-	-
Bromobenzene	ug/l	<1	-	-
2-Chlorotoluene	ug/l	<1	-	-
Propylbenzene	ug/l	<1	-	-
4-Chlorotoluene	ug/l	<1	-	-
1,2,4-Trimethylbenzene	ug/l	<1	-	-
4-Isopropyltoluene	ug/l	<1	-	-
1,3,5-Trimethylbenzene	ug/l	<1	-	-
1,2-Dichlorobenzene	ug/l	<1	0.01	50
1,4-Dichlorobenzene	ug/l	<1	0.01	50
sec-Butylbenzene	ug/l	<1	-	-
tert-Butylbenzene	ug/l	<1	-	-
1,3-Dichlorobenzene	ug/l	<1	0.01	50
n-Butylbenzene	ug/l	<1	-	-
1,2-Dibromo-3-chloropropane	ug/l	<1	-	-
1,2,4-Trichlorobenzene	ug/l	<1	-	-
Naphthalene	ug/l	<1	-	-
1,2,3-Trichlorobenzene	ug/l	<1	-	-
Hexachlorobutadiene	ug/l	<1	-	-

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Table 8.4: Groundwater Quality Results
 Polyaromatic Hydrocarbons
 Sampling Date 06.09.01

Parameter	Units	Results
Petrol Range Hydrocarbons	µg/l	<10
Diesel Range Hydrocarbons	µg/l	<11
Mineral Oil	µg/l	<12
Benzene	µg/l	<13
Toluene	µg/l	<14
Ethyl Benzene	µg/l	<15
Total Xylene	µg/l	<16

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Table 8.5: Groundwater Quality Results
 Polychlorinated Biphenyls
 Sampled 06.09.01

Parameter CAS Number	P.Q.L. Units	Units	Results † µg/l	Dutch values	
				S	I
12674-11-2	Aroclor 1016	µg/l			
11104-28-2	Aroclor 1221	µg/l			
11141-16-5	Aroclor 1232	µg/l			
53469-21-9	Aroclor 1242	µg/l			
12672-29-6	Aroclor 1248	µg/l			
11097-69-1	Aroclor 1254	µg/l			
11096-82-5	Aroclor 1260	µg/l			
	Total			0.01	0.01

Legend

µg/l: micrograms/litre

MAC: Maximum Admissible Concentration

S- Level: Dutch Guideline

I- Level: Dutch Guideline for Intervention

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