Appendix VI

RPS McHugh Hydrogeological Report 2003

COPY

HYDROGEOLOGICAL REPORT ON THE MR. BINMAN FACILITY AT LUDDENMORE, GRANGE, KILMALLOCK, CO. LIMERICK

WASTE LICENCE 61-2

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RPS McHugh Planning & Environment

REPORT NUMBER:	IR1037 Mr. Binman Hydrogeology Report
STATUS OF REPORT:	Final
DATE OF REPORT:	24th of February 2003
PREPARED BY:	Kevin Motherway

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1. INTRODUCTION

RPS McHugh Planning & Environment (RPS) were requested by Mr. Binman Ltd. (hereafter referred to as "the client") to carry out all works necessary to conduct a hydrogeological study to comply with Condition 11.7 of Waste Licence No. 61-2 as issued by the Environmental Protection Agency (hereafter referred to as "the Agency")

"11.7 Groundwater Monitoring Boreholes

A report by a qualified hydrogeologist detailing the groundwater flow direction and the proposed locations of the groundwater monitoring boreholes should be submitted to the Agency for agreement within six months of the date of the grant of the licence. The report shall include all relevant hydrogeological data."

In a meeting with the Agency Inspector on the 13th of October 2003, the location of 2 No. monitoring boreholes was agreed, it was also agreed that the boreholes be drilled to allow the report to be completed rather than a hydrogeology report with no borehole data merely proposing boreholes locations.

2. METHODOLOGY

2.1 INTRODUCTION

In order to assess the site's overall hydrogeological setting, a desk-based study of publicly available information to assess the regional geology, hydrogeology, groundwater vulnerability and aquifer type of the area, was conducted. 2 No. boreholes were also drilled to allow watertable measurements as well as water samples to be taken. Both boreholes drilled and the Group Water Scheme boreholes were survey to a temporary bench mark (TBM) to allow the relative levels of the watertable and gradients in the area to be determined.

The sources of information used were:

- Geology of Tipperary, (GSI) 1996
- Geological Survey of Ireland 6 inch to 1 mile 1850 field mapping sheets (unpublished).
- Ireland General Soil Map (Second Edition) 1:575,000, M.J. Gardiner An Foras Taluntais 1980.
- County Limerick Groundwater Protection Scheme (GSI, 1998)

Site location & Description

The transfer station and recycling centre at Luddenmore, is located approximately 11km outside of Limerick city just off the Kilmallock road (R512).

The waste transfer station is situated in a rural environment and is surrounded by agricultural land. The site is bounded to the south by the regional road that provides access to the site. This road joins with the Kilmallock - Limerick road (R512) at Sheahan's Cross approximately 1km to the west of the site as described above (See Drawing No. IR1137/2). The road joins with the

Ballylanders - Limerick road (R513) at Caherconlish approximately 4.5km to the east of the site. The road adjacent to the site bears traffic from the transfer station, local residents, farm machinery and vehicles that service the adjacent quarry operation.

The nearest occupied residence to the facility is situated approximately 50m from the main entrance of the facility on the southern side of the regional road that bounds the southern side of the site. There is a water supply reservoir located to the north west of the site, which is operated as the supply source for a group water supply scheme that services approximately 200 households and 100 farms in the locality. The reservoir is serviced by three groundwater wells in the vicinity of the site. Two of the wells are located approximately 0.4km to the east of the transfer station and the third well is located approximately 2km south of the site at Ballybricken.

The site incorporates a waste reception hut, weighbridge, indoor waste transfer area, indoor picking station, glass sorting area, glass storage area, wood storage area, waste quarantine area, skip storage area, truck parking area, truck wash area, refuelling area, wastewater treatment plant, truck repair garage, administration offices, and car parking area (See Drawing No. IR1137/1). The site occupies an area of approximately 4.4 acres (17,960 m^2) of which approximately 2,534 m^2 is occupied by buildings (the Waste Transfer Building, i.e. transfer area & picking station 1,119 m^2). The remaining 1,415 m^2 (of buildings) consists of the glass sorting building garages, offices, cattle sheds and canteen. Of the remaining 15,246 m^2 , approximately 13,651 m^2comprises of the glass storage area, wood storage area, skip storage area, waste quarantine area, truck wash area, refuelling area and access roads, that is covered by concrete hardstanding. The remaining 1595 m^2 is surfaced with hardcore material (truck parking area, wood/pallet storage area and the car parking area). Prior to development of the waste transfer station, the site was operated as a farm. All waste tipping and waste segregation is carried out under enclosed (roofed) conditions in the Waste Transfer Building. The entire site apart from a portion of the truck parking area and the wood storage area is concrete paved.

2.2 HISTORY

The site was operated as a farm prior to its development as a waste transfer station. Mr. Binman Ltd. is a family operated business, which is managed by Mr. Martin Sheahan. Mr. Binman Ltd., has operated the site as a waste transfer station since 1993. After the Waste Management Act was established in 1996, Mr. Binman Ltd., obtained and has since been operating under a waste licence granted by the EPA in November 1999. The waste licence permits Mr. Binman Ltd. to carry out activities as per Classes 12 and 13 of the Third Schedule and Classes 2, 3, 4, 10 and 13 of the Fourth Schedule of the Waste Management Act, 1996.

2.3 TOPOGRAPHY

The topography in the area of the site is gentle rolling hills with occasional abrupt changes in slope, primarily due to differential weathering of the volcanic rocks compared with the limestones, which weather more easily (See Drawing No. IR1137/2). The site itself is located on the southern slopes of a hill, which is ca 170mOD at its highest point, with the upper parts of the site at a level of ca.140mOD and the lower boundary of the site at a level of ca.100 mOD. To the southeast of the site there is a flat valley floor at an elevation of 90-100 mOD approximately 500m wide, before the topography again rises to an elevation of 204 m in the south.

3 REGIONAL ENVIRONMENT

3.1 REGIONAL SOIL & SUBSOIL GEOLOGY

The soil in the area has been documented as being principal soil type 35, "Minimal Grey Brown Podzolics, with associated Gleys and Brown Earths". The parent material for this soil is thought to be Limestone Glacial Till. The origin of the unconsolidated materials in this area is associated with the movement and deposition from the Irish Ice Sheet and glacial melt outwash deposits during the last Ice Age, which is part of the Quaternary Period, the most recent period in the geological timeframe. The ice sheets ripped and ground down the underlying bedrock, breaking it and grinding it into rock fragments and fine clays as it advanced depositing the material during its retreat underlain by glacial till, which was deposited as an unsorted mix of material ranging from boulders to fine clay as the ice retreated. The subsoils in the area are generally Limestone Till of varying thickness and composition.

3.2 REGIONAL BEDROCK GEOLOGY

The site is located on the northwest edge of the area known geologically as "the Limerick Volcanics", a complex of shallow intrusive and extrusive rocks, consisting of basalts, lithic tuffs and syenites, which were erupted just after the deposition of the Waulsortian Limestone and comptemeraneous to the deposition of the Herbertstown Formation (see Figure 3.1). The principal formations of the volcanic complex are the Knockroe Formation (250 to 550 m thick) comprising lavas, tuffs and agglomerates and the Knockseefin Formation (0 to 500 m thickness) comprising lavas and tuffs, which decrease in thickness as one moves from the centre of the volcanic complex. The Herbertstown Limestone is inter-fingered with both volcanic formations lying stratigraphically between the two and are comprised of clean, pale-blue, thickly bedded, well sorted, medium to coarse, oolitic and skeletal grainstones. The Waulsortian Limestone which is older underlies the entire complex and comprises poorly bedded, fine grained, fossiliferous limestone with frequent calcite filled cavities. The Waulsortian Limestone is generally at least 300 m thick.

All these rocks were later deformed as a result of folding and faulting which resulted in the formation of gentle folds as well as fissures and cracks in the bedrock which are primarily responsible for the secondary permeability of the aquifers in the area which generally have very little primary porosity or pore spaces. In the case of the limestones, particularly the Waulsortian Limestone some of the fractures have been enlarged due to solution (karstification).

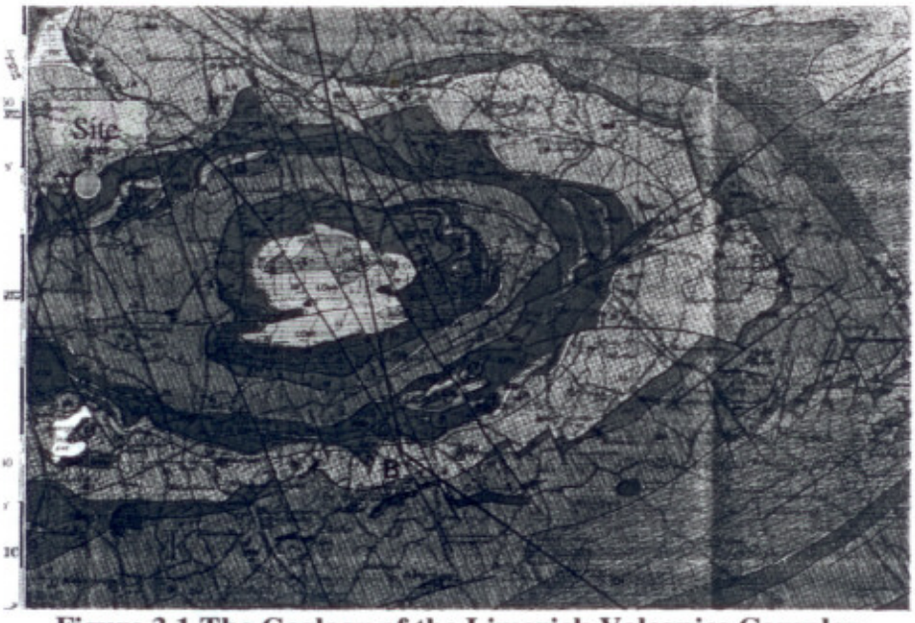


Figure 3.1 The Geology of the Limerick Volcanics Complex

3.3 REGIONAL HYDROGEOLOGY

Aquifer Categories

The volcanic rocks of the Limerick Volcanics are classed as Locally Important Aquifer, which is generally moderately productive (Lm) (See Appendix I). Substantial flows can occur in the Regionally Important Herbertstown Limestones Aquifer (Rf) in the Limerick Volcanics complex and also the Waulsortian Limestones Regionally Important karstic Aquifer (Rk) which underlie and outcrop outside the boundaries of the Limerick Volcanics Complex. Groundwater flow in the area is dominated by the Shannon River Basin, with all local groundwater and surface water flow systems eventually flowing to the north towards the Shannon estuary and eventual discharge to the Sea.

Recharge in area

Within the Limerick Volcanics complex recharge is generally diffuse in pattern over the volcanics, however there may be point recharge in the Herbertstown Limestone, which is a Regionally important fractured aquifer (Rf). It is believed that the potential recharge in the area is in the order of 600 mm per annum (Collins *et al* 1986).

Regional Vulnerability

Vulnerability across the area is dependant on the thickness and permeability of the overburden. The GSI Groundwater Protection Scheme for the area indicates that the vulnerability for the area is extreme with several outcrops of rock noted in the site area (see Appendix 1). The subsoil cover in the area is variable but is generally quite thin, especially on slopes, with thicker deposits present in flat-floored valleys.

Water abstractions

There are a number of known water abstractions in the area surrounding the site including two boreholes belonging to the Ballybricken Group Water Supply Scheme (GWSS). As part of this study the 2 No. boreholes were surveyed and the Caretaker questioned at length about the state of the boreholes and GWSS (See Appendix II).

The two bores both have "Good" well yields of between 163 m^3/day and 273 m^3/day, with specific capacities of between 27 m^3/day/m and 43 m^3/day/m. Estimates of Transmissivity for the bores are in the order of 33 m^2/day to 53 m^2/day. Estimation of permeability from Transmissivity for fracture and fissured aquifers is notoriously difficult, however using an approximate calculation taking the aquifer saturated thickness as the depth of the bore, the permeability for the aquifer is in the order of 2 m/day (2.3×10^{-5} m/s). (see well data sheets and calculations in Appendix II). The Zones of Contribution (ZOC) for these boreholes are in the order of 2.2 Ha to 5.2 Ha, with the majority of this flow most probably coming from the North as indicated by the surface drainage pattern (see Drawing No. IR1137/2). The groundwater flow direction in the area is influenced by topography with the water table probably represented as a subdued version of the topography. The possible flowpaths in the area are therefore also influenced by the topography and the groundwater catchment divides that result.

4. ENVIRONMENT OF SITE AREA

4.1 DRILLING OPERATIONS

The volcanic rocks underlying the site are classified as an Lm aquifer and the results of the drilling confirm the variable nature of the aquifer with very low well yields encountered during drilling operations on the site, in contrast to the presence of 2 No. GWSS "Good" yielding boreholes ca. 300 m to the south of the site. GW1 was located near the crest of the hill overlooking the site and encountered no water strikes during drilling with a final hole depth of 50m. Fortunately there was enough water in small pores and fissures in the borehole to fill the well to a depth of 22 m bgl overnight and this allowed a groundwater sample to be taken. (see Appendix IV for Borehole logs and Drawing No. IR1137/1 for GW and GWSS borehole locations). A water strike was noted in GW2 a few metres below the subsoil rock interface, however this yield was poor, although sufficient for sampling purposes.

4.2 SITE SUBSOIL GEOLOGY

Subsoil cover on the site is variable but generally quite thin with a number of outcrops noted on the site, most notably to the rear of the current office complex, where excavations into volcanic tuffs and basalt have revealed very thin soil cover. The monitoring borehole (GW1) drilled on the upper slopes of the site as part of this investigation, showed a thin subsoil cover of only 2m depth. However on the lower slopes of the site the subsoil thickness tends to increase with a thickness of 24 m being encountered in monitoring borehole GW2. The subsoil encountered during drilling were generally limestone tills with a 4 m thick clay deposit being encountered beneath the till in GW2. The origin of this clay may be glacial or a breakdown product of volcanic rocks, which commonly decay to form clays. The depth to bedrock at the GWSS is uncertain, but is thought to be quite deep.

4.3 SITE GEOLOGY

The published GSI geology map for the area indicates that the site is underlain by the Knockroe Volcanic Formation (KR) and (KRv) Knockroe Volcanic Formation Vitric-Lithic Tuff Member (see Figure No. 4.1). However newly revealed outcrops on the site reveal that there are also areas of the site underlain by vesicular and amygdaloidal basalts, which were also encountered during drilling of the monitoring boreholes. The tuffs encountered on-site are generally friable; however the basalts can be quite resistant and difficult to excavate.

In terms of porosity, the tuffs are generally welded material with a large portion of fine ash which would have a low porosity. The basalts while often vesicular (containing air bubble) are often amydaloidal (vesicles infilled by mineralisation) and the connectivity between these vesicles quite limited. Basalts also typically weather to clay so any weathered basalt will also have a limited permeability.

The local GWSS boreholes appear to be sited in the same Knockroe Formation (Vitric Tuff Member) as the site, however no detailed log of the boreholes or the lithologies encountered is available.

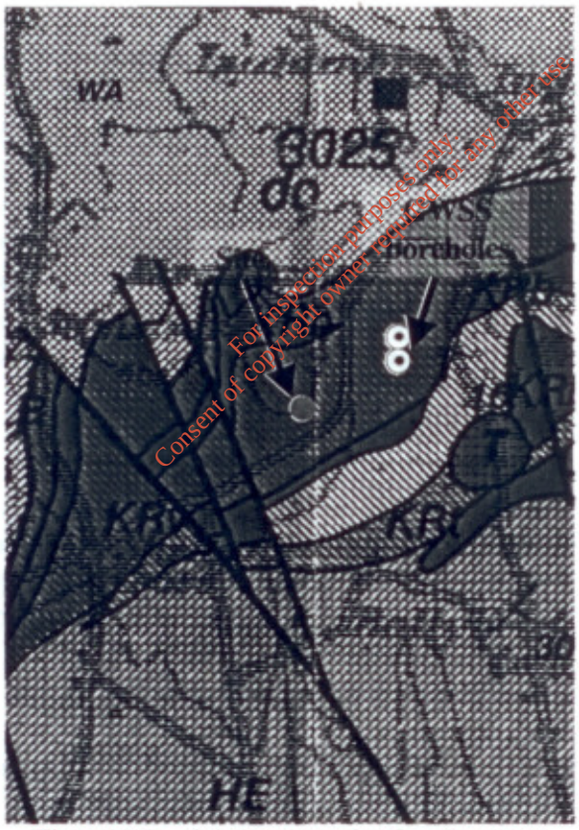


Figure No. 4.1 Geology in the site area

4.4 SITE HYDROGEOLOGY

Site Vulnerability Rating

Given the limited data available from the 2 No. boreholes drilled onsite the vulnerability rating of the site is uncertain. The depth to bedrock encountered in GW1 on the upper part of the site was less than 3 m and so confirms the Extreme rating assigned by the GSI. The depth to bedrock

encountered in GW2 on the lower part of the site was 24m composed of low permeability material and so would be classed as Low Vulnerability. Adopting a precautionary approach it is probably best to assume that the entire site has a vulnerability rating of Extreme. This results is an aquifer resource protection rating of Lm/E.

Static Water Levels

The static water levels (SWL's) observed at the site on a number of days, however pumping water levels (PWL's) at the GWSS boreholes could only be taken on one day with the prior arrangement of the caretaker due to the pumping schedule (see Table 4.1). The watertable was quite deep on the site as one would expect with the topography and was 19.12 m bgl (121.08 m aTBM) for GW1 and 16.23 m bgl (95.24 m aTBM). The static water levels at the GWSS boreholes were much higher at 4.07 m gbl (100.63 m aTBM) for GWSS1 and 2.52 m bgl (100.99 m a TBM) for GWSS2. The shallow nature of the groundwater in the flat valley floor where the GWSS boreholes are located indicate that the valley floor may be an area of groundwater discharge, while the sloping hills on which the site is located and where the water table is deep may represent a recharge zone for the aquifer.

Table 4.1 Observed groundwater levels

Date	Monitoring Point	Water Level (mbgl)	Water Level (m aTBM)
26/11/2003	GW1	19.12	121.08
26/11/2003	GW2	16.23	95.24
26/11/2003	GWSS1 (SWL)	4.07	100.63
26/11/2003	GWSS1 (PWL)	10.73	93.97
26/11/2003	GWSS2 (SWL)	2.52	100.99
26/11/2003	GWSS2 (PWL)	4.40	99.12

Hydrochemistry

Both GW1 and GW2 were tested for a suite of parameters as specified by the Agency as part of their monitoring commitments as set out in the Waste Licence. No appreciable difference was detected between the up-gradient and down-gradient samples, indicating that the activities at the site have not had an appreciable effect on the groundwater quality beneath the site (see Table 4.2).

Table 4.2 Results of Analysis

Borehole Name	Units	MAC	GW1	GW2
pH	pH Units	6-8	7.5	6.96
Electrical Conductivity	µS/cm	1,500	549	764
Total Organic Carbon	mg/l	-	3	<2
Ammoniacal Nitrogen	mg/l	0.5	<0.2	<0.2
Total Phosphorous	mg/l	-	3.53	3.08
Total Nitrogen	mg/l	0.1	7	6

- = No MAC

Piezometry & Flow Directions

The hydraulic gradients in the site area are limited to 4 No. data points; namely the groundwater monitoring boreholes GW1 and GW2 on-site and the Ballybricken GWSS abstraction boreholes GWSS1 and GWSS2 to the southeast of the site (see Drawing No. IR1137/1). The elevations of all 4 No. wellheads were surveyed to a temporary benchmark and are expressed in metres above temporary bench mark (m aTBM) to allow the relative levels and gradients of the watertable in the area to be determined. Gradients between all 4 No. points were calculated based on water table levels taken both during pumping and non pumping times at the Ballybricken GWSS (see Appendix II). As expected the watertable is in general a subdued version of the topography with a significant change in groundwater level between GW1 and GW2 of 25.84 m. The head difference and hydraulic gradient between GW2 and the 2 No. Ballybricken GWSS abstraction boreholes is much gentler with a hydraulic gradient from both GWSS boreholes towards GW1 with a head difference of ca. 5 m. Even under pumping conditions there is only a flow gradient towards GWSS1 due to a head difference of 1.27 m and GWSS2 maintains a head difference *towards* GW1 of ca. 3.8 m. In all, this indicates that in terms of calculated gradients there is no significant flow from the Mr. Binman Site toward the GWSS boreholes.

Analysis of the water levels using the 'three point graphical analytical method' allows the piezometric contours and the flow lines orthogonal to these to be determined (see Appendix III). By using the observed static and pumping water levels for the four possible scenarios (2 No. GWSS boreholes either static or pumping) the flow direction of the groundwater can be determined for each scenario (see Table 4.3). The results of this analysis clearly demonstrate that the flow direction of the groundwater beneath the site is in a south-easterly direction (130° to 145°) and that it is most improbable that groundwater could flow (at complete variance to the hydraulic gradient) towards the GWSS boreholes to the northeast of the site (51°to 62°) (see Table 4.3).

Table 4.3 Direction of Groundwater flow beneath site for varying conditions at the GWSS boreholes

GWSS Borehole (and state)	Groundwater flow direction beneath site (as compass bearing)
GWSS1 (SWL)	130°
GWSS1 (PWL)	115°
GWSS2 (SWL)	145°
GWSS2 (PWL)	142°

Table 4.3 Direction from centre of site to GWSS boreholes.

GWSS Borehole	Compass bearing from centre of site to GWSS borehole
GWSS1	51°
GWSS2	62°

Calculated Gradients and flows

The results of the analysis of the gradients indicate that under static conditions that the water table is ca. 5 m higher at both GWSS boreholes than at GW2 on-site. Under pumping conditions there

is a gradient of between 0.004 (0.4%) and 0.014 (1.4 %) to GWSS1 only. Naturally there are higher calculated gradients between GW1 on-site and the GWSS boreholes as they are at significantly different elevations. The gradients between GW2 on-site and the GWSS boreholes are more representative of the groundwater flow regime in the site area.

Groundwater flow rates were estimated using an estimated effective porosity of 5%, the calculated gradients and permeability estimated from the Logan Approximations (using static and pumping water levels) carried out on the GWSS boreholes. This indicates that flow rates in the aquifer are in the order of 1.4 m/day (1.6×10^{-5} m/s). Theoretical travel times (as flow direction analysis above has shown it not be possible) from GW1 and GW2 to the GWSS boreholes were calculated using a cautious slightly over-estimated gradient of 0.035 (median is 0.026) (see Appendix II).

In terms of travel times to the public water supply from the complex of buildings on the site an estimate of 250 days (between 205 and 330 days) would appear reasonable. It must again be stressed that these are calculated values from estimates and assumptions and that under static water condition there is actually a gradient *from* the GWSS boreholes towards GW1 and during pumping times the gradient is in the range 0.013 to 0.004 (0.4% to 1.3%).

Flowlines and ZOC analysis

While these figures are interpreted from real data, it is probably more useful to consider the flow direction as a function of the topography, which influences the shape of the watertable. While there is a calculated hydraulic gradient between GW2 and GWSS2 during pumping, that does not necessarily mean that flow will occur between the two points (e.g. there is hydraulic gradient between Corrán Tuathail and Dublin, however that is not the groundwater flow direction). In this case the site is located on a topographic divide that influences the possible flow-paths in the watertable. The head is higher at the GWSS indicating that the boreholes are located in a discharge zone for the area. While the lower watertables at GW2 indicates that the recharge is still occurring. However as can be seen from Drawing No. IR1137/2 the probable Zone of Contribution (ZOC) to the GWSS boreholes is several hundred metres to the north of the site and it is not possible to draw a logical flow-line from the site towards the GWSS boreholes.

Based on the topography the groundwater flowing beneath the site flows in a southeasterly direction down hydraulic gradient of the GWSS boreholes, which are directly to the east and northeast of the site. Taking a site width of 150m the calculated flow beneath the site across the aquifer is in the order of 262.5 m^3/day.

5. CONCLUSIONS & RECOMMENDATIONS

Static water levels at the site and GWSS boreholes indicate no hydraulic gradient between the two (excluding the water level at GW1 for the topographical reasons outlined). Pumping water levels indicate a very low gradient between one of the boreholes (GWSS1) and the site. Graphical analysis of the static and pumping water levels indicate that groundwater beneath the site flows to the southeast and cannot flow northeast towards the GWSS boreholes. Analysis of the flowlines and Zone of Contribution (ZOC) for the GWSS boreholes indicate that the site is to the south and outside the ZOC and that no sensible flowline can be drawn from the site to the GWSS boreholes.

The groundwater beneath the site most likely flows in south-easterly direction and even under pumping conditions it is very improbable that the groundwater flowing beneath the site (and hence any contaminant therein) can flow towards the Group Water Supply Scheme.

Initial monitoring of the groundwater indicates there is no appreciable difference between the up-gradient and down-gradient hydrochemistry or evidence of any contamination. It is recommended that monitoring in accordance with the condition of the waste licence be continued.

Appendix I
GSI Data

Suirbhéireacht Gheolaíochta Éireann
Tor an Bhacaigh
Bóthar Hadington
Baile Átha Cliath 4

Geological Survey of Ireland
Beggars Bush
Haddington Road
Dublin 4
Tel. +353 1 6782000
Direct +353 1 6782802
Fax. +353 1 6782549
http://www.gs i.ie
Email: jenny.rush@dcmnr.gov.ie

Kevin Motherway
R.P.S. McHugh,
Unit 3a University Technology Centre,
Curraheen Road,
Cork

17 October 2003

Re: Luddenmore, Co. Limerick

Dear Mr. Motherway,

Thank you for your enquiry on the 16/10/03 requesting a vulnerability rating, an aquifer classification and information on bedrock for your site in county Limerick.

Please note that when the National Aquifer Classification Map has been completed as part of the requirements of the Water Framework Directive, the classification given may be subject to revision. It is based on our current understanding of the hydrogeology of the area and on available hydrogeological data. The vulnerability rating and the provisional aquifer classification are given below.

Site	Rock unit	Vulnerability	Provisional Aquifer classification
Site at Luddenmore, Co. Limerick (As marked on the map)	KRv – Knockroe Vitric-lithic Tuff Member Vitric-lithic tuff & conglomerate	Extreme	Lm

Please see attached pages for descriptions of the aquifer classification and additional hydrogeological information.

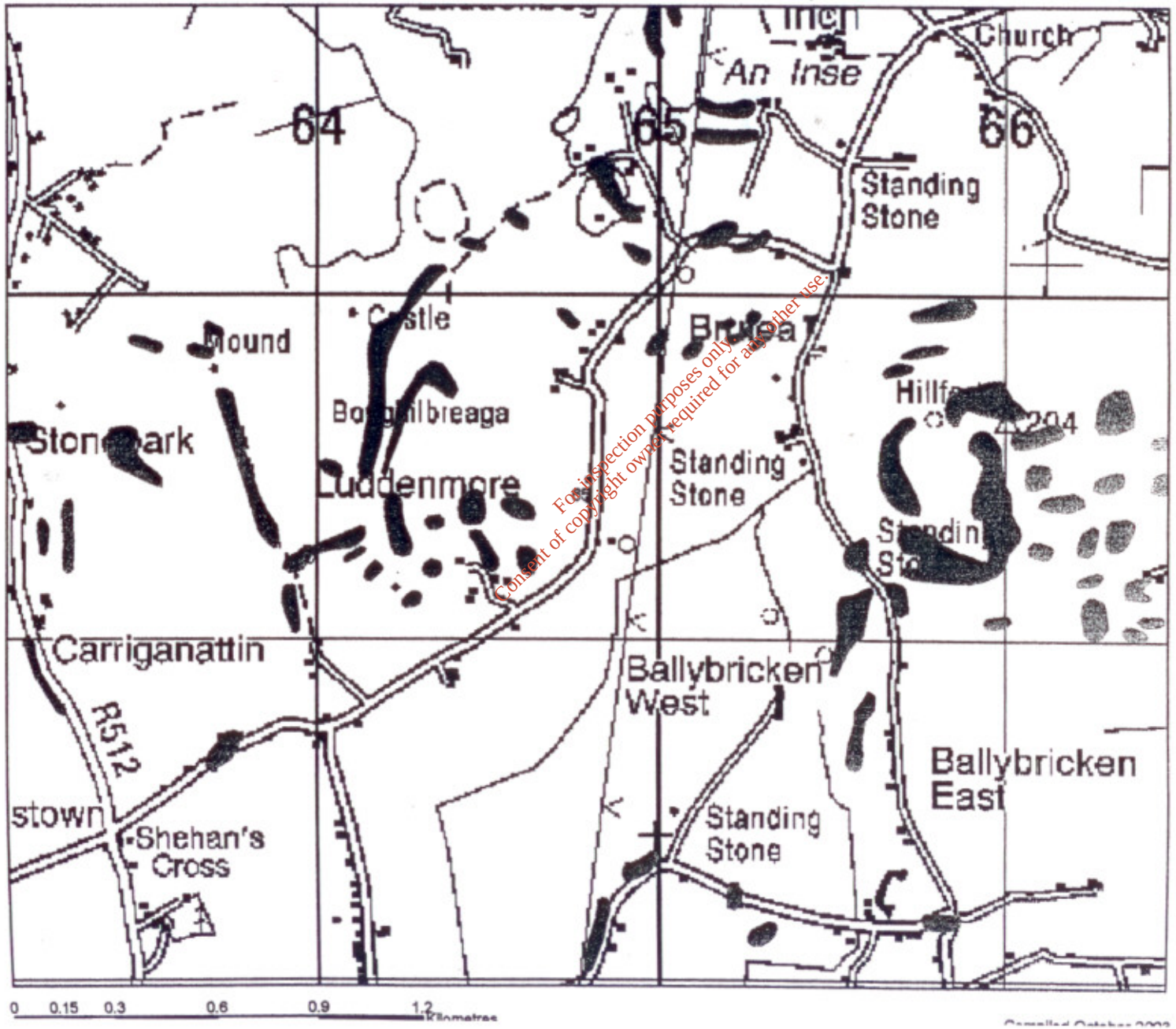
If you have any further questions please do not hesitate to call Jenny Rush at (01) 678 2782.

Yours sincerely,

Donal Daly

Donal Daly
Groundwater Section

Outcropping Bedrock near Luddenmore, Co. Limerick

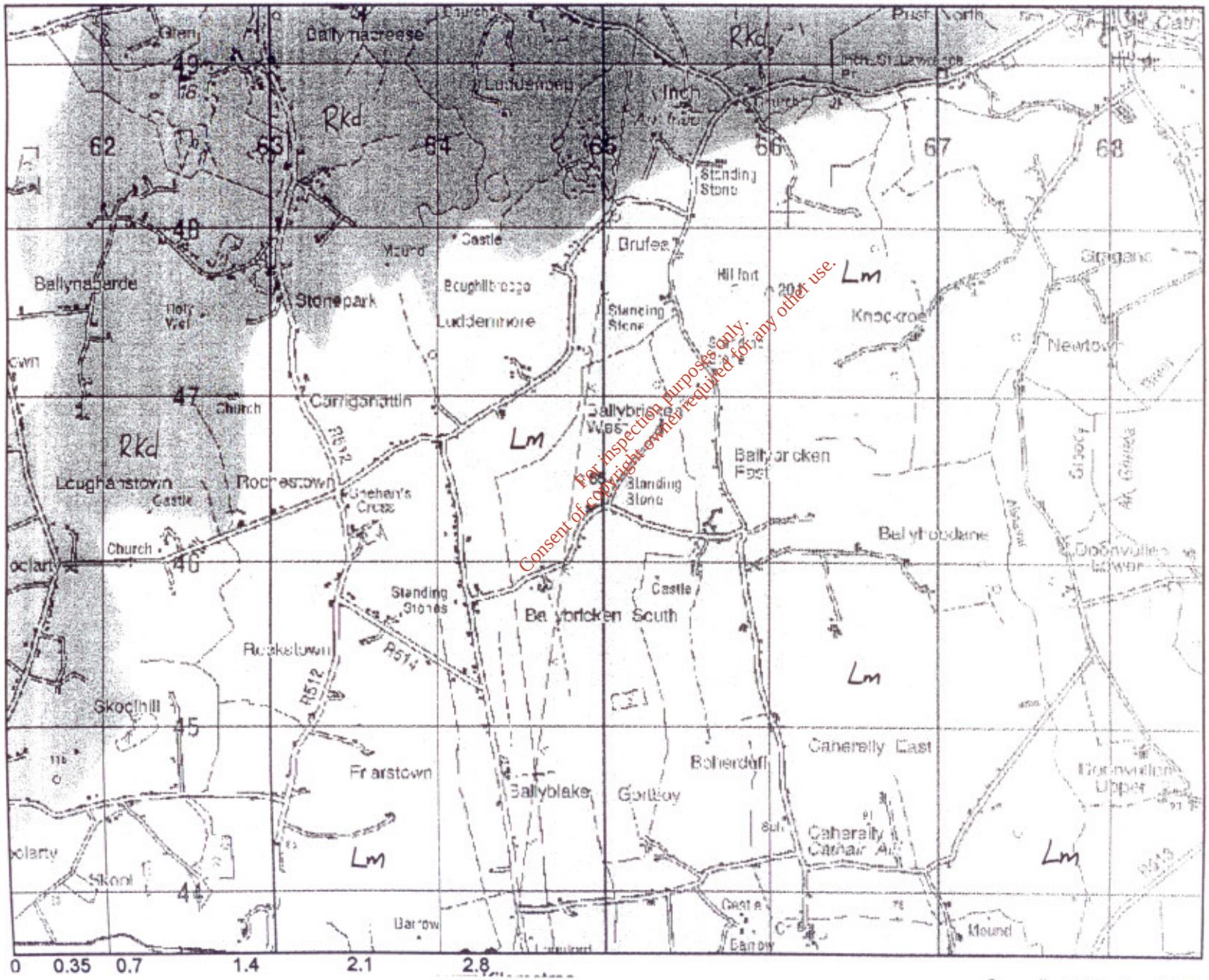


Legend

Outcrop_polygons

N
W
E
S

Draft Aquifer Map for Luddenmore, Co. Limerick



Legend

DraftAquifer

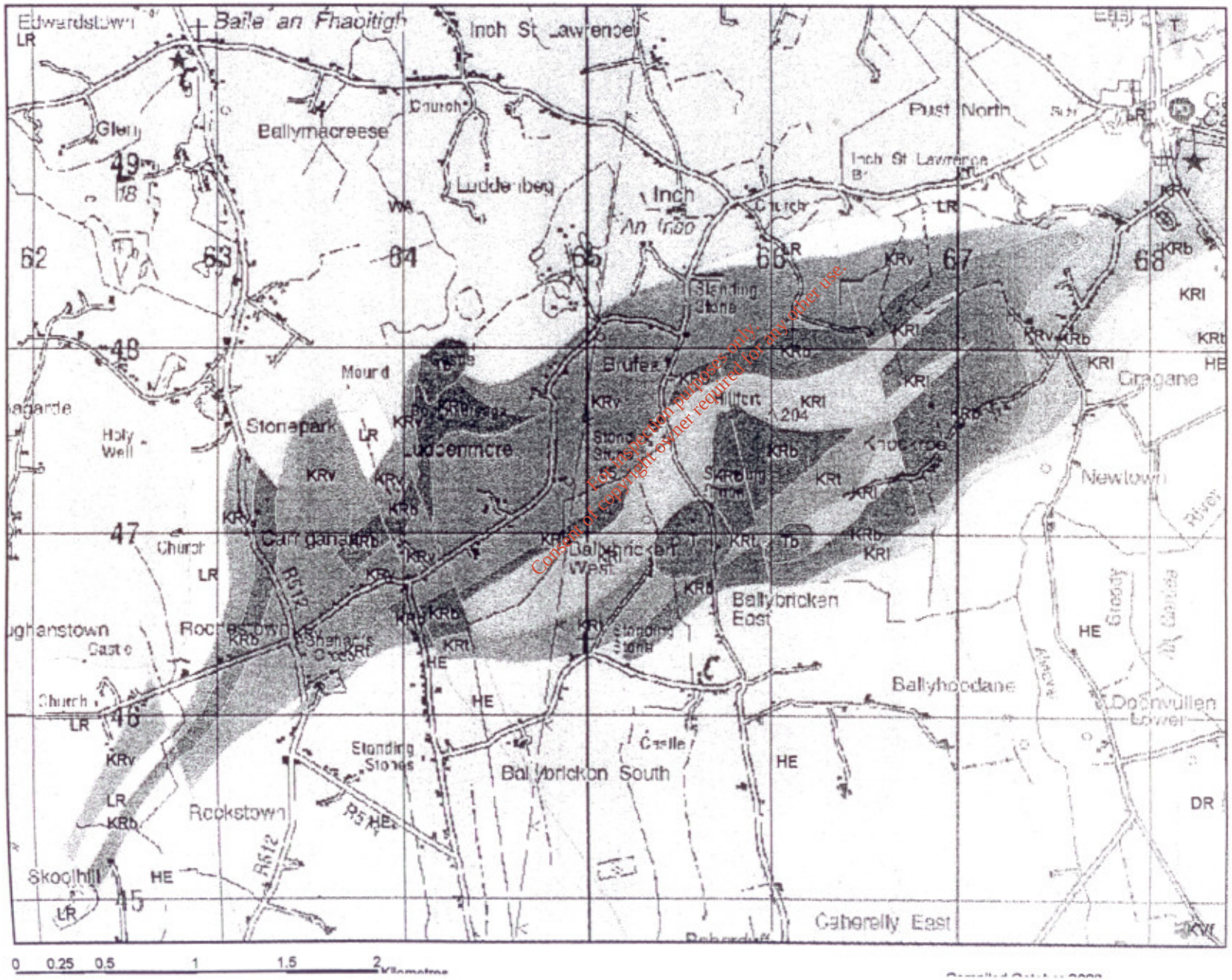
<all other values>

AquiferCat

- Rkd
- Rkc
- Rf
- Rk
- Ll
- Lm
- Pl
- Pu

N
W E
S

Bedrock Geology Map for Luddenmore, Co. Limerick



Appendix II
Water Levels and Hydrogeological Calculations

Appendix II
Water Levels and Hydrogeological Calculations

IR1137			
TOC m aOD	140.2		
TOC m agl	0.705		
Ground Level	139.495		
GW1			
Date	m belowTOC	Water Level	Water Level
	m	mbgl	mOD
10/11/2003 10:00	22.77	22.065	118.135
26/11/2003 10:00	19.825	19.12	121.08

IR1137			
TOC m aOD	111.462		
TOC m agl	0.705		
Ground Level	110.757		
GW2			
Date	m belowTOC	Water Level	Water Level
	m	mbgl	mOD
10/11/2003	19.95	19.245	92.217
26/11/2003	16.93	16.225	95.237

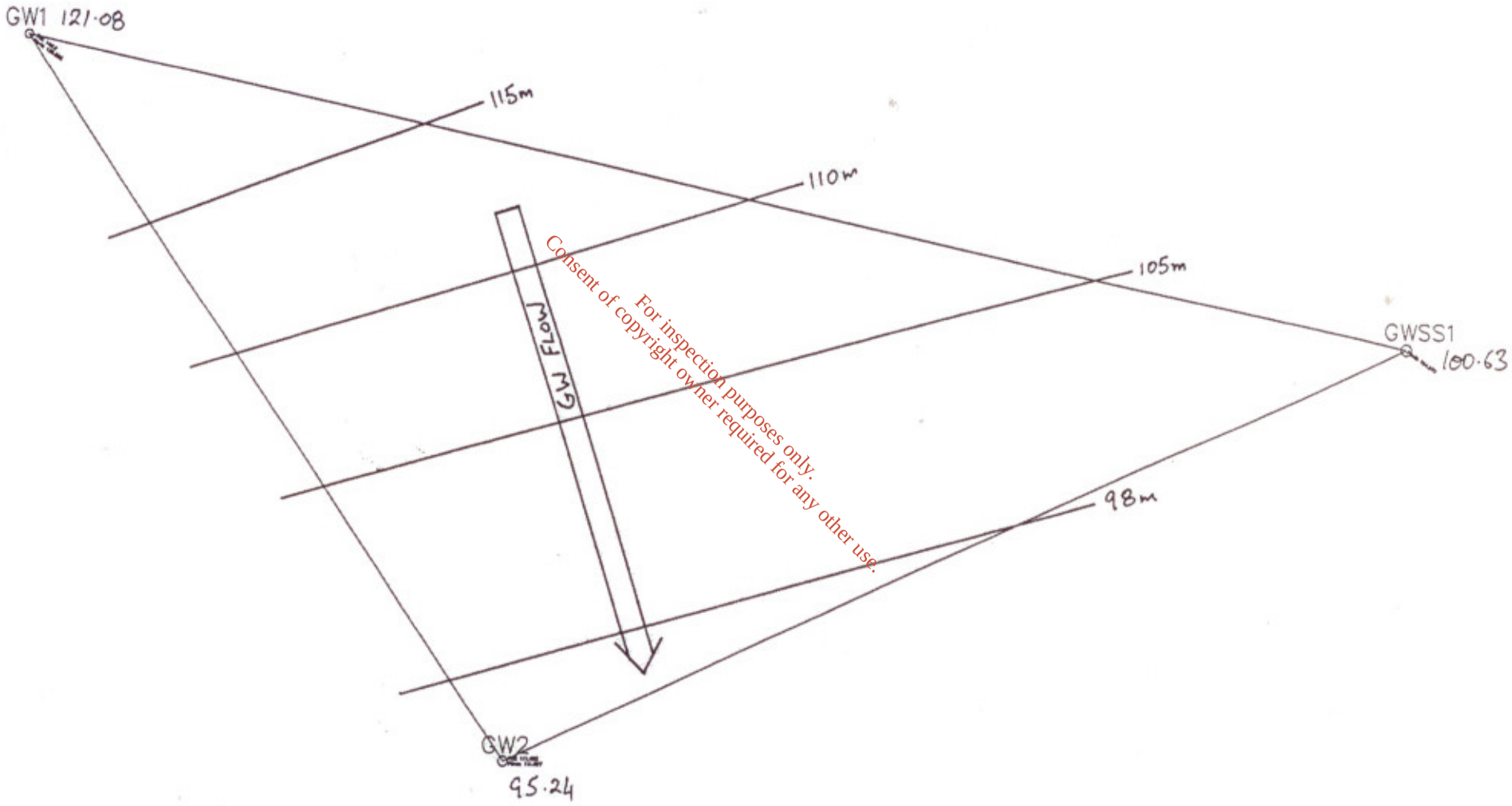
IR1137				
TOC m aOD	104.7			
TOC m agl	0.08			
Ground Level	104.62			
GWSS1				
Date	m belowTOC	Water Level	Water Level	
	m	mbgl	mOD	
26/11/2003 11:20	4.15	4.07	100.63	SWL
26/11/2003 12:45	10.81	10.73	93.97	PWL

IR1137				
TOC m·aOD	103.511			
TOC m agl	0.385			
Ground Level	103.126			
GWSS2				
Date	m belowTOC	Water Level	Water Level	
	m	mbgl	mOD	
26/11/2003 11:20	2.9	2.515	100.996	SWL
26/11/2003 12:45	4.78	4.395	99.116	PWL

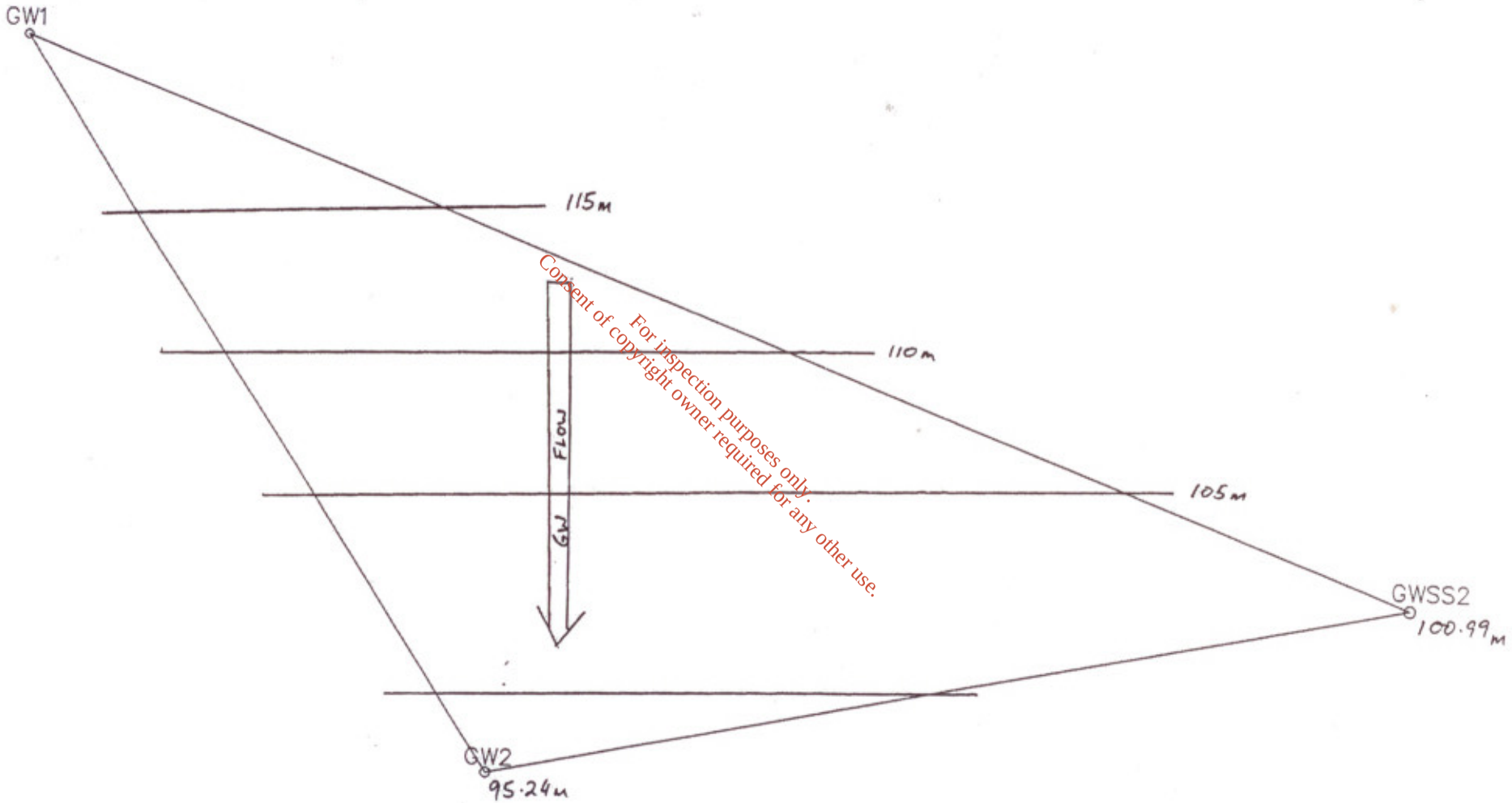
From	to	Distance	Head 1	Head 2	Δh	i			
Units		m	m	m	m	[ ]			
GW1	GW2	270.8	121.08	95.24	25.84	0.095420975	Static		
GW1	GWSS1	437	121.08	100.63	20.45	0.046796339	Static		
GW1	GWSS2	462	121.08	100.99	20.09	0.043484848	Static		
GW2	GWSS1	306.7	95.24	100.63	-5.39	0.017574177	Static		
GW2	GWSS2	287.6	95.24	100.99	-5.75	0.019993046	Static		
GWSS1	GWSS2	71.699	100.63	100.996	-0.366	0.005104674		Excluding GW1	
					Max	0.095420975		Max	0.019993
					Min	0.005104674		Min	0.005105
					Mean	0.038062343		Mean	0.014224
					Median	0.043484848		Median	0.017574
GW1	GWSS1P	437	121.08	93.97	27.11	0.062036613	Pumping		
GW1	GWSS2P	462	121.08	99.12	21.96	0.047532468	Pumping		
GW2	GWSS1P	306.7	95.24	93.97	1.27	0.004140854	Pumping		
GW2	GWSS2P	287.6	95.24	99.12	-3.88	0.01349096	Pumping		
GWSS1	GWSS2	71.699	93.97	99.16	-5.19	0.072385947		Excluding GW1	
					Max	0.072385947		Max	0.072386
					Min	0.004140854		Min	0.004141
					Mean	0.039917368		Mean	0.030006
					Median	0.030511714		Median	0.013491

Approximate Travel Times		v =K/n_e			Approximate Travel Times		v =K/n_e		
		Units					**Units**		
K (estimate from T)	**2**	**[m/day]**			**K (estimate fr**	**2**	**[m/day]**		
n_e Estimate	**0.05**	**[ ]**			**n_e Estimate**	**0.04**	**[ ]**		
i	**0.035**	**[ ]**			**i**	**0.015**	**[ ]**		
v=	**1.4**	**[m/day]**			**v=**	**0.75**	**[m/day]**		
Travel Times					**Travel Times**				
From	**to**	**Distance**	**Days**		**From**	**to**	**Distance**	**Days**	
GW1	GW2	270.8	193.4286		GW1	GW2	270.8	361.0667	
GW1	GWSS1	437	312.1429		GW1	GWSS1	437	582.6667	
GW1	GWSS2	462	330		GW1	GWSS2	462	616	
GW2	GWSS1	306.7	219.0714		GW2	GWSS1	306.7	408.9333	
GW2	GWSS2	287.6	205.4286		GW2	GWSS2	287.6	383.4667	
Monitoring period			182.5						
Flow Beneath the Site		**q=wTi**							
width of site (w)	150	m							
T(Logan)	50	m2/day							
i	0.035								
	262.5	**m3/day**	flow beneath site						

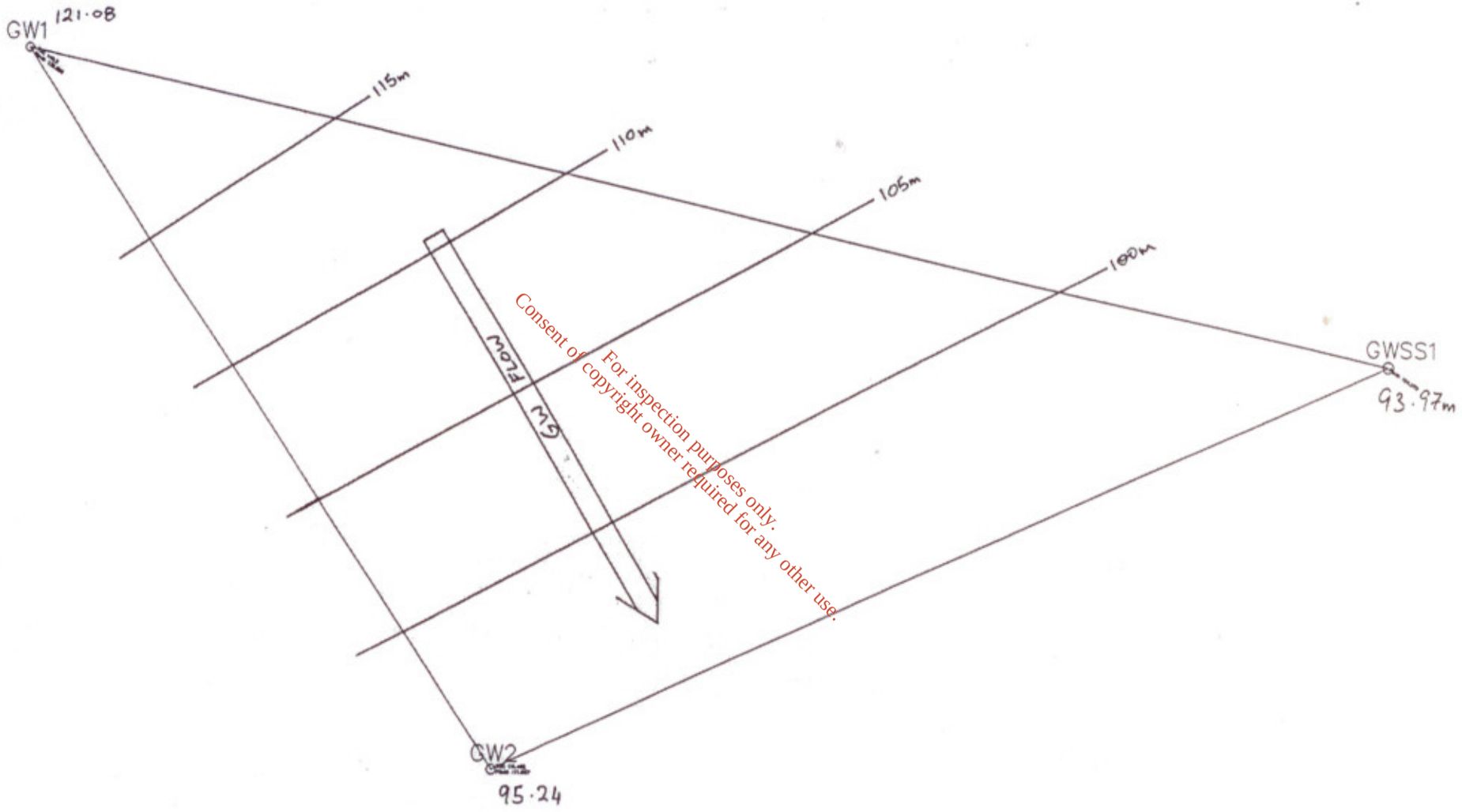
Appendix III
Flow Direction Diagrams



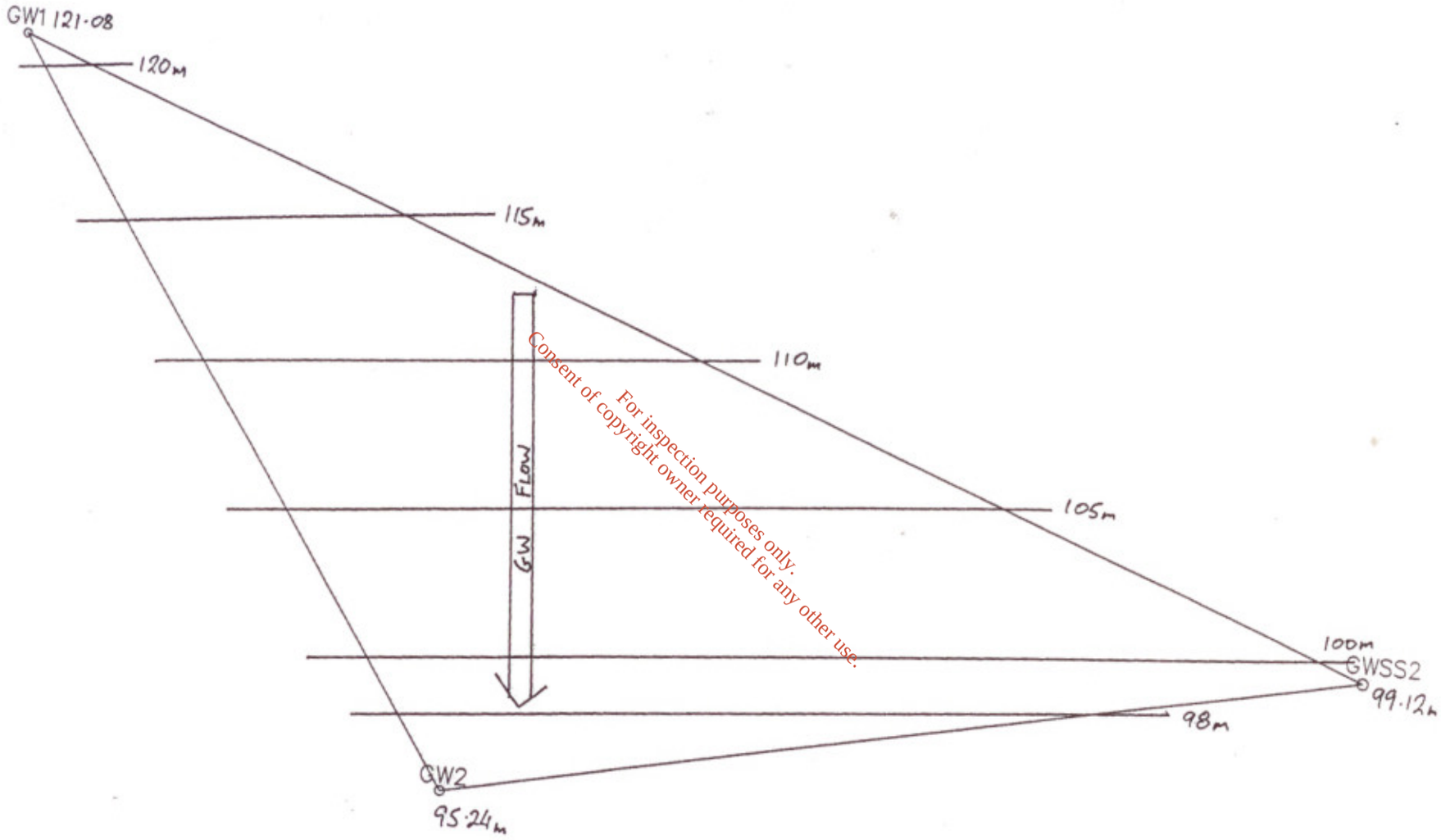
Appendix III Figure No. 1 Static Water Levels using GWSS1



Appendix III Figure No. 2 Static Water Levels using GWSS2



Appendix III Figure No. 3 Pumping Water Levels using GWSS1



Appendix III Figure No. 4 Pumping Water Levels using GWSS2

Appendix IV
Borehole Logs

RPS McHugh
PLANNING & ENVIRONMENT

Innishmore
Ballincollig
Co. Cork
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FAX: (021) 4872997

BOREHOLE LOG

Borehole GW1

Sheet No. 1 of 3

Client: Mr. Binman	Site: Luddenmore, Grange, Kilmallock, Co. Limerick	Job No.: IR1137B	Scale: 1:100

Grid Reference Easting: 164605 Northing: 147209	Elevation: 139.59 aTBM Borehole Diameter (Subsoil): 200mm Borehole Diameter (Rock): 150mm Borehole Depth (m): 50.0m	Date Started: 20/10/2003 Date Completed: 20/10/2003

Depth m	Description of Strata	Legend	OD Level m	Water Inflows	Samples Type	Samples Ref. No.	BH Tests Type & Ref.	Completion Details Lining:	Completion Details Backfill:
0.0									
	SILT/CLAY "Boulder CLAY"							50MM uPVC CASING	CONCRETE BENTONITE
2.0									
	Amygdaloidal Basalt							50MM uPVC SCREEN	WASHED PEA GRAVEL
12.0									
	Brown Vitric Tuff								
13.5									
	Basalt (occ. amygdaloidal)								
18.0									

Remarks:

1. Rockhead encontered at 2 m.
2. SWL at 19.12 mbgl or 121.88m aTBM on 26/11/2003
3. Borehole retrofitted with 150mm uPVC screen and casing.
4. No inflows encountred during drilling.
5. Borehole dry during drilling, but SWL reached overnight.

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BOREHOLE LOG

Borehole GW1

Sheet No. 2 of 3

Client: Mr. Binman	Site: Luddenmore, Grange, Kilmallock, Co. Limerick	Job No.: IR1137B	Scale: 1:100

Grid Reference Easting: 164605 Northing: 147209	Elevation: 139.59 aTBM Borehole Diameter (Subsoil): 200mm Borehole Diameter (Rock): 150mm Borehole Depth (m): 50.0m	Date Started: 20/10/2003 Date Completed: 20/10/2003	Drill Contractor: Glovers SI Ltd. Drill Method: Air Rotary Logged by: KM

Depth m	Description of Strata	Legend	OD Level m	Water Inflows	Samples Type	Samples Ref. No.	BH Tests Type & Ref.	Completion Details Lining:	Completion Details Backfill:
18.0									
	Basalt (occ. amygdaloidal)							50MM uPVC SCREEN	WASHED PEA GRAVEL
36.0									

Remarks:

RPS McHugh
PLANNING & ENVIRONMENT
Unit 3a
University Technology Park
Curraheen Road
Cork
TEL: (021) 4346005 FAX: (021) 4346016

BOREHOLE LOG

Borehole GW2

Sheet No. 3 of 3

Client: Mr. Binman	Site: Luddenmore, Grange, Kilmallock, Co. Limerick	Job No.: IR1037B	Scale: 1:100

Grid Reference Easting: 164754 Northing: 146985	Elevation: 111.03 aTBM Borehole Diameter (Subsoil): 200mm Borehole Diameter (Rock): 150mm Borehole Depth (m):37.0	Date Started: 20/10/2003 Date Completed: 20/10/2003	Drill Contractor: GLOVERS SI LTD Drill Method: Air Rotary Logged by: KM (TES)

Depth m	Description of Strata	Legend	OD Level m	Water Inflows	Samples Type	Samples Ref. No.	BH Tests Type & Ref.	Completion Details Lining:	Completion Details Backfill:
0.0									
37.0	Basalt (occ. amygdaloidal)							50 mm uPVC SCREEN	WASHED PEA GRAVEL
	END of BOREHOLE								

50MM uPVC SCREEN

WASHED PEA GRAVEL

Remarks:

RPS McHugh
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BOREHOLE LOG

Borehole GW2

Sheet No. 2 of 3

Client: Mr. Binman	Site: Luddenmore, Grange, Kilmallock, Co. Limerick	Job No.: IR1037B	Scale: 1:100

Grid Reference Easting: 164754 Northing: 146985	Elevation: 111.03 aTBM Borehole Diameter (Subsoil): 200mm Borehole Diameter (Rock): 150mm Borehole Depth (m):37.0	Date Started: 20/10/2003 Date Completed: 20/10/2003	Drill Contractor: Hilliard Ltd. Drill Method: Air Rotary Logged by: KM (TES)

Depth m	Description of Strata	Legend	OD Level m	Water Inflows	Samples Type	Samples Ref. No.	BH Tests Type & Ref.	Completion Details Lining:	Completion Details Backfill:
18.0									
	SILT/CLAY "Boulder CLAY"								
20.0									
	damp brown CLAY								
24.0									
26.0				▼				50MM uPVC SCREEN	WASHED PEA GRAVEL
	Basalt (occ. amygdaloidal)								
36.0									

Remarks:

RPS McHugh
PLANNING & ENVIRONMENT

BOREHOLE LOG

Borehole GW2

Sheet No. 1 of 3

Client: Mr. Binman	Site: Luddenmore, Grange, Kilmallock, Co. Limerick	Job No.: IR1137	Scale: 1:100

Grid Reference Easting: 164754 Northing: 146985	Elevation: 111.03 aTBM Borehole Diameter (Subsoil): 200mm Borehole Diameter (Rock): 150mm Borehole Depth (m):37.0	Date Started: 20/10/2003 Date Completed: 20/10/2003	Drill Contractor: Glovers SI Ltd. Drill Method: Air Rotary Logged by: KM (TES)

Depth m	Description of Strata	Legend	OD Level m	Water Inflows	Samples Type	Samples Ref. No.	BH Tests Type & Ref.	Completion Details Lining:	Completion Details Backfill:
0.0									
	SILT/CLAY "Boulder CLAY"							50MM uPVC CASING	CONCRETE BENTONITE
8.5								50MM uPVC SCREEN	WASHED PEA GRAVEL
18.0									

Remarks:

1. Rockhead encountered at 24.0 m
2. SWL at 16.22 mbgl or 95.24 m aTBM on 26/11/2003
3. Borehole retrofitted with 150mm uPVC screen and casing
4. Water inflow encounted at 26.0 m
5. End of Hole 37.0 m

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BOREHOLE LOG

Borehole GW1

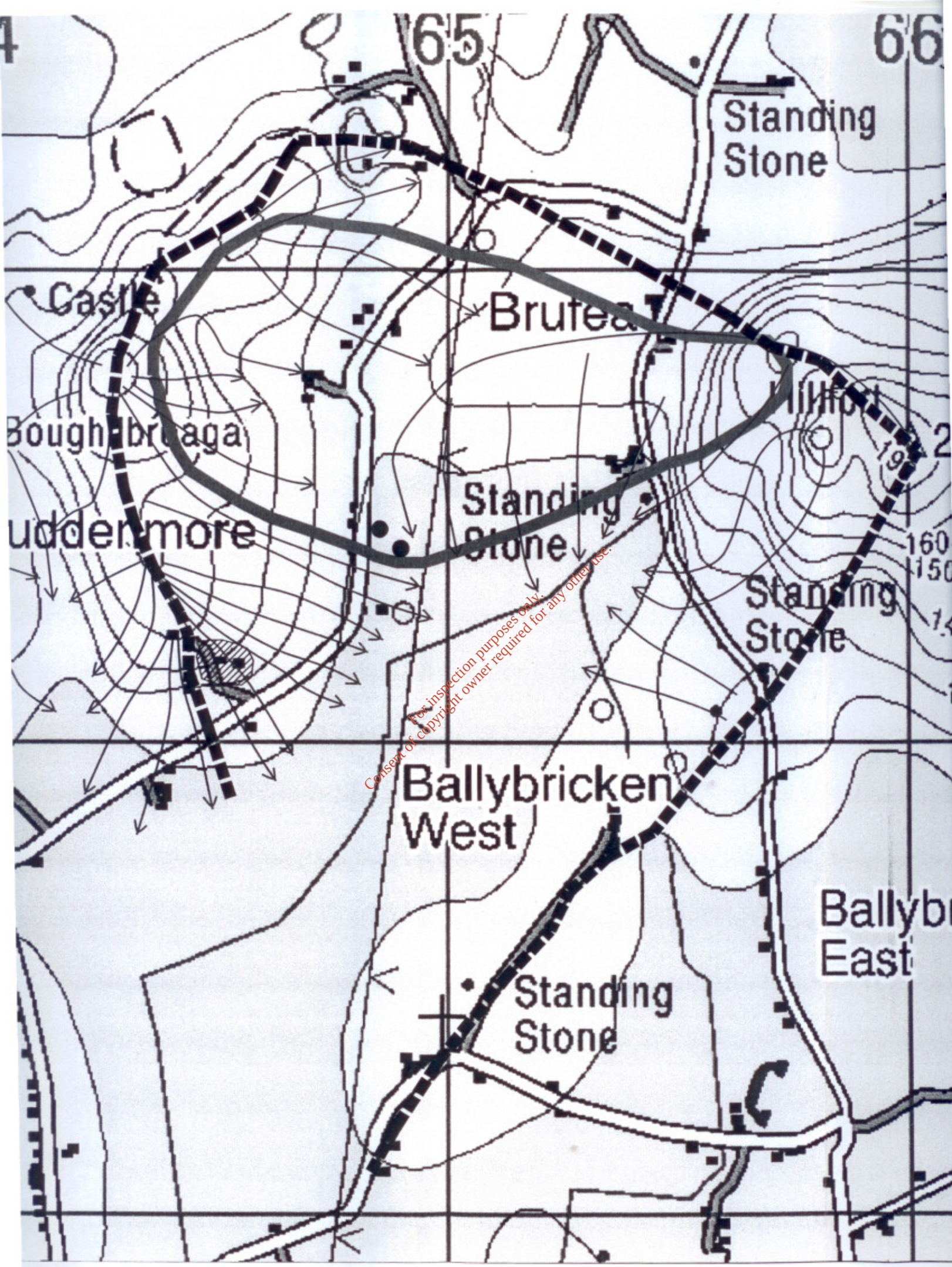
Sheet No. 3 of 3

Client: Mr. Binman	Site: Luddenmore, Grange, Kilmallock, Co. Limerick	Job No.: IR1137B	Scale: 1:100

Grid Reference Easting: 164605 Northing: 147209	Elevation: 139.59 aTBM Borehole Diameter (Subsoil): 200mm Borehole Diameter (Rock): 150mm Borehole Depth (m): 50.0m	Date Started: 20/10/2003 Date Completed: 20/10/2003	Drill Contractor: Glovers SI Ltd. Drill Method: Air Rotary Logged by: KM

Depth m	Description of Strata	Legend	OD Level m	Water Inflows	Samples Type	Samples Ref. No.	BH Tests Type & Ref.	Completion Details Lining:	Completion Details Backfill:
0.0									
	Basalt (occ. amygdaloidal)							50MM uPVC SCREEN	WASHED PEA GRAVEL
50.0	END of BOREHOLE								

Remarks:



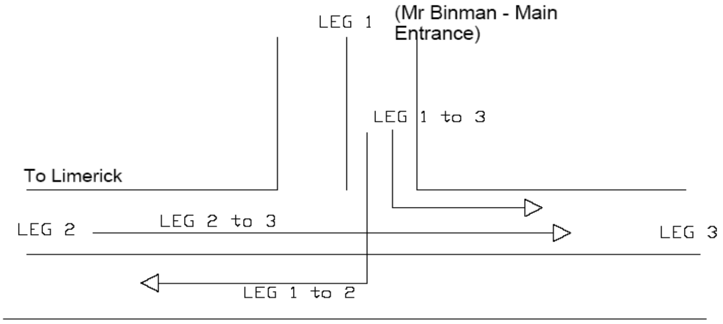
Appendix VII (A)

Traffic Survey

MR BINMAN MAIN ENTRANCE
From LEG 1 to 2, 1 to 3, 2 to 3 and 3 to 2

Survey Date: **27/11/2008**
Day: **Thursday**

Class of Vehicle			LEG 3 to 2	LEG 2 to 3	LEG 1 to 2	LEG 1 to 3	LEG 2 to 1	LEG 3 to 1
1	**MOTOR CARS**		08:00-08:15	1	5			3	4
			08:15-08:30	1	1	2	1	1	
			08:30-08:45	5	2			2	1
	Private cars, taxis, estate cars, station wagons, bubble cars, car towing caravans, boats or trailers		08:45-09:00	3	1	1	1	2	
			09:00-09:15	1	2			2	
			09:15-09:30	3	2				
			09:30-09:45	3		1		1	
			09:45-10:00	1	2			1	
			Totals	**18**	**15**	**4**	**2**	**12**	**5**
2	**HEAVY GOODS**	**Truck**	08:00-08:15		2	1		4	
			08:15-08:30						
			08:30-08:45	2	1	4		1	
			08:45-09:00				2	1	
			09:00-09:15	2	1	2			
			09:15-09:30		2	1	1	1	
			09:30-09:45	1	1	2		1	
			09:45-10:00		1			2	
			Totals	**5**	**8**	**10**	**3**	**10**	**0**
		Artic	08:00-08:15					1	
			08:15-08:30		1		2		
			08:30-08:45						
			08:45-09:00					1	
			09:00-09:15			2			1
			09:15-09:30			2			1
			09:30-09:45	1	1			1	
			09:45-10:00				1		1
			Totals	**1**	**2**	**4**	**3**	**3**	**3**
		Truck & Trailer							
			Totals	**0**	**0**	**0**	**0**	**0**	**0**
3	**LIGHT GOODS**		08:00-08:15						
	Vans, pick-ups		08:15-08:30						
	(vehicles having 4 tyres only)		08:30-08:45			2		1	
			08:45-09:00		1		1		
			09:00-09:15	1		1			
			09:15-09:30		1				
			09:30-09:45						
			09:45-10:00	1				2	
			Totals	**2**	**2**	**3**	**1**	**3**	**0**
4	**AGRICULTURAL TRACTORS**		09:30-09:45	1	1				
			Totals	**1**	**1**	**0**	**0**	**0**	**0**
5	**MISCELLANEOUS**								
	horse-drawn vehicles, ambulances		**Totals**	**0**	**0**	**0**	**0**	**0**	**0**
6	**BUSES**		09:00-09:15	1	1				
	Buses, school buses, coaches		**Totals**	**1**	**1**	**0**	**0**	**0**	**0**
7	**PEDAL CYCLES**		08:15-08:30		2				
			Totals	**0**	**2**	**0**	**0**	**0**	**0**
8	**MOTOR CYCLES**		08:00-08:15						
	including autocycles, scooters		08:15-08:30		1				
			08:30-08:45						
			08:45-09:00						
			09:00-09:15						
			09:15-09:30			1			
			09:30-09:45					1	
			09:45-10:00						
			Totals	**0**	**1**	**1**	**0**	**1**	**0**

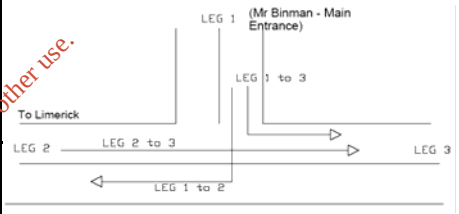


MR BINMAN MAIN ENTRANCE
From LEG 1 to 2, 1 to 3, 2 to 3 and 3 to 2

Survey Date: 27/11/2008

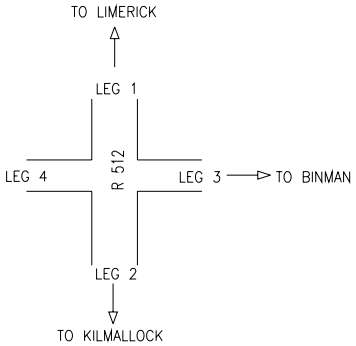
Day: Thursday

Class of Vehicle		LEG 3 to 2	LEG 2 to 3	LEG 1 to 2	LEG 1 to 3	LEG 2 to 1	LEG 3 to 1
1 **MOTOR CARS**	3.00-3.15	1	2	2	2	0	1
	3.15-3.30	2	2	0	0	0	0
	3.30-3.45	5	2	4	0	0	0
	3.45-4.00	4	2	4	2	0	0
	4.00-4.15	1	6	3	1	0	0
	4.15-4.30	1	5	5	1	0	0
	4.30-4.45	1	6	8	2	0	0
Private cars, taxis, estate cars, station wagons, bubble cars, car towing caravans, boats or trailers	4.45-5.00	3	2	7	1	0	0
	5.00-5.15	0	1	5	2	1	0
	5.15-5.30	2	4	3	3	0	0
	5.30-5.45	1	2	3	0	0	0
	5.45-6.00	0	5	3	0	0	0
	6.00-6.15	3	3	9	0	0	0
	6.15-6.30	3	7	4	0	0	0
	Totals	**27**	**49**	**60**	**14**	**1**	**1**
2 **HEAVY GOODS** **Truck**	3.00-3.15	1	0	1	0	3	3
	3.15-3.30	1	1	1	0	0	0
	3.30-3.45	0	2	0	0	5	0
	3.45-4.00	0	3	1	0	2	0
	4.00-4.15	2	1	1	0	4	0
	4.15-4.30	1	0	0	0	2	0
	4.30-4.45	1	1	1	0	2	0
	4.45-5.00	0	0	0	0	1	0
	5.00-5.15	0	1	0	0	0	0
	5.15-5.30	0	1	1	0	2	0
	5.30-5.45	1	2	0	0	0	0
	5.45-6.00	0	1	0	0	1	0
	6.00-6.15	0	1	1	0	1	0
	6.15-6.30	0	0	0	0	1	0
	Totals	**7**	**14**	**7**	**0**	**24**	**4**
Artic	3.00-3.15	0	0	1	0	2	0
	3.15-3.30	0	0	0	0	0	0
	3.30-3.45	0	0	0	0	1	0
	3.45-4.00	0	1	2	0	1	0
	4.00-4.15	0	1	1	0	0	0
	4.15-4.30	0	0	0	0	1	0
	4.30-4.45	1	0	0	0	1	0
	4.45-5.00	2	0	0	0	0	0
	5.00-5.15	0	0	1	0	0	0
	5.15-5.30	0	0	0	0	1	0
	5.30-5.45	0	0	0	0	1	0
	5.45-6.00	0	0	0	0	0	0
	6.00-6.15	0	0	0	0	0	0
	6.15-6.30	0	0	0	0	0	0
	Totals	**3**	**2**	**5**	**0**	**8**	**0**
Truck & Trailer							
	Totals	**0**	**0**	**0**	**0**	**0**	**0**
3 **LIGHT GOODS**	3.00-3.15	0	0	1	0	0	0
Vans, pick-ups	3.15-3.30	0	0	0	1	1	0
(vehicles having 4 tyres only)	3.30-3.45	0	0	0	0	0	0
	3.45-4.00	0	0	0	0	0	0
	4.00-4.15	1	1	1	0	0	0
	4.15-4.30	1	1	1	0	0	0
	4.30-4.45	0	1	0	0	2	0
	4.45-5.00	1	0	2	2	0	1
	5.00-5.15	0	1	0	0	0	0
	5.15-5.30	3	1	0	0	0	0
	5.30-5.45	4	0	1	0	0	0
	5.45-6.00	0	0	1	0	0	0
	6.00-6.15	1	0	3	1	0	0
	6.15-6.30	0	0	0	0	0	0
	Totals						
4 **AGRICULTURAL TRACTORS**							
	Totals	**0**	**0**	**0**	**0**	**0**	**0**
5 **MISCELLANEOUS**							
horse-drawn vehicles, ambulances	**Totals**	**0**	**0**	**0**	**0**	**0**	**0**
6 **BUSES**	3.00-3.15	1	1				
Buses, school buses, coaches	**Totals**	**1**	**1**	**0**	**0**	**0**	**0**
7 **PEDAL CYCLES**			1				
	Totals	**0**	**1**	**0**	**0**	**0**	**0**
8 **MOTOR CYCLES**				1			
including autocycles, scooters	**Totals**	**0**	**0**	**1**	**0**	**0**	**0**



R512 JUNCTION
From Legs 2 and 3 in all directions

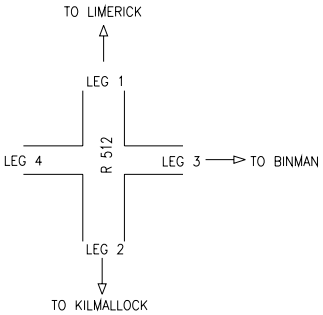
Survey Date: 27/11/2008
Day: Thursday



Class of Vehicle		LEG 2 to 1	LEG 2 to 3	LEG 2 to 4	LEG 3 to 4	LEG 3 to 1	LEG 3 to 2
1 MOTOR CARS	08:00-08:15	141	1	5	1	4	1
	08:15-08:30	127	1	3	4	8	0
	08:30-08:45	110	0	8	4	4	3
Private cars, taxis, estate cars, station	08:45-09:00	78	3	7	2	3	0
wagons, bubble cars, car towing caravans,	09:00-09:15	96	4	2	1	6	1
boats or trailers	09:15-09:30	69	0	9	1	3	1
	09:30-09:45	58	0	8	0	2	0
	09:45-10:00	38	0	2	1	5	2
	Totals	717	9	44	14	35	8
2 HEAVY GOODS Truck	08:00-08:15	5	1	0	0	2	0
	08:15-08:30	0	0	0	0	0	1
	08:30-08:45	1	0	0	0	2	0
	08:45-09:00	1	0	0	0	0	0
	09:00-09:15	1	0	0	0	1	0
	09:15-09:30	2	1	0	0	0	0
	09:30-09:45	1	0	0	1	0	0
	09:45-10:00	0	0	0	0	1	0
	Totals	11	2	0	1	6	1
Artic	08:00-08:15	0	0	0	0	1	0
	08:15-08:30	0	0	0	0	0	0
	08:30-08:45	0	0	0	0	1	0
	08:45-09:00	0	0	0	0	1	0
	09:00-09:15	0	0	0	0	0	0
	09:15-09:30	0	0	0	0	1	0
	09:30-09:45	0	0	0	0	1	0
	09:45-10:00	1	1	0	0	0	0
	Totals	1	1	0	0	5	0
Truck & Trailer	08:00-08:15	1	0	0	0	0	0
	08:15-08:30	2	0	0	0	0	0
	08:30-08:45	0	0	0	0	0	0
	08:45-09:00	0	0	0	0	0	0
	09:00-09:15	0	0	1	0	0	0
	09:15-09:30	0	0	0	0	0	0
	09:30-09:45	0	0	0	1	0	0
	09:45-10:00	0	0	1	1	2	0
	Totals	3	0	2	2	2	0
3 LIGHT GOODS	08:00-08:15	21	0	4	0	0	3
Vans, pick-ups	08:15-08:30	12	0	2	0	0	2
(vehicles having 4 tyres only)	08:30-08:45	11	0	3	1	1	1
	08:45-09:00	13	0	0	0	4	0
	09:00-09:15	10	1	0	0	0	1
	09:15-09:30	7	0	1	0	0	0
	09:30-09:45	8	1	0	0	0	0
	09:45-10:00	8	1	0	0	1	1
	Totals	90	3	10	1	6	8
4 AGRICULTURAL TRACTORS							
	Totals	0	0	0	0	0	0
5 MISCELLANEOUS							
horse-drawn vehicles, ambulances	Totals	0	0	0	0	0	0
6 BUSES	08:00-08:15	1	1				
Buses, school buses, coaches	08:30-08:45	1					
	Totals	2	1	0	0	0	0
7 PEDAL CYCLES							
	Totals	0	0	0	0	0	0
8 MOTOR CYCLES							
including autocycles, scooters	Totals	0	0	0	0	0	0

R512 JUNCTION
From Legs 2 and 3 in all directions

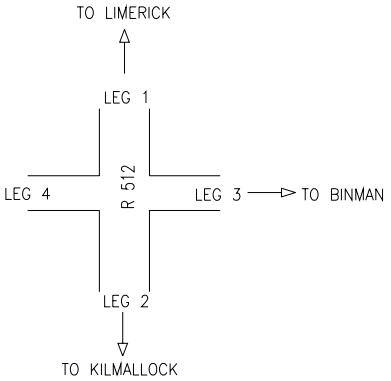
Survey Date: 27/11/2008
Day: Thursday



	Class of Vehicle		LEG 2 to 1	LEG 2 to 3	LEG 2 to 4	LEG 3 to 4	LEG 3 to 1	LEG 3 to 2
1	MOTOR CARS	3.30-3.45	33	1	4	2	1	0
		3.45-4.00	21	0	5	2	6	0
		4.00-4.15	28	1	1	1	4	2
		4.15-4.30	19	1	1	0	1	1
		4.30-4.45	25	1	2	1	7	1
		4.45-5.00	22	0	3	0	3	2
		5.00-5.15	28	2	2	2	10	4
	Private cars, taxis, estate cars,	5.15-5.30	39	1	2	0	3	0
	station wagons, bubble cars, car	5.30-5.45	23	0	2	2	4	2
	towing caravans, boats or trailers	5.45-6.00	18	1	3	0	7	0
		6.00-6.15	23	0	4	2	8	0
		6.15-6.30	16	0	5	2	4	2
		Totals	**295**	**8**	**34**	**14**	**58**	**14**
2	HEAVY GOODS Truck	3.30-3.45	0	0	1	0	1	1
		3.45-4.00	3	0	0	0	0	0
		4.00-4.15	2	0	0	0	1	0
		4.15-4.30	0	1	0	0	1	2
		4.30-4.45	2	0	0	0	1	1
		4.45-5.00	2	1	0	0	1	0
		5.00-5.15	1	0	0	0	1	1
		5.15-5.30	0	1	0	0	0	0
		5.30-5.45	1	0	0	0	2	0
		5.45-6.00	0	0	0	0	0	0
		6.00-6.15	0	0	0	0	0	0
		6.15-6.30	0	0	0	0	0	0
		Totals	**11**	**3**	**1**	**0**	**8**	**5**
	Artic	3.30-3.45		0			0	
		3.45-4.00		0			0	
		4.00-4.15		1			2	
		4.15-4.30		0			0	
		4.30-4.45		0			0	
		4.45-5.00		0			1	
		5.00-5.15		0			1	1
		5.15-5.30		0			0	
		5.30-5.45		0			0	
		5.45-6.00		0			0	
		6.00-6.15		0			0	
		6.15-6.30		0			0	
		Totals	**0**	**1**	**0**	**0**	**4**	**1**
	Truck & Trailer			1				
		Totals	**0**	**1**	**0**	**0**	**0**	**0**
3	LIGHT GOODS	3.30-3.45	3	0	1	0	1	
	Vans, pick-ups	3.45-4.00	1	1	1	0	0	
	(vehicles having 4 tyres only)	4.00-4.15	9	0	1	0	1	
		4.15-4.30	6	0	0	0	0	
		4.30-4.45	5	0	1	0	3	
		4.45-5.00	4	0	0	1	3	
		5.00-5.15	11	1	0	0	2	
		5.15-5.30	5	1	0	0	1	
		5.30-5.45	5	1	0	0	1	
		5.45-6.00	4	1	0	1	0	
		6.00-6.15	1	0	1	3	2	
		6.15-6.30	2	0	1	0	0	
		Totals	**56**	**5**	**6**	**5**	**14**	**0**
4	AGRICULTURAL TRACTORS							
		Totals	**0**	**0**	**0**	**0**	**0**	**0**
5	MISCELLANEOUS							
	horse-drawn vehicles, ambulances	**Totals**	**0**	**0**	**0**	**0**	**0**	**0**
6	BUSES	5.00-5.15	1					
	Buses, school buses, coaches	**Totals**	**1**	**0**	**0**	**0**	**0**	**0**
7	PEDAL CYCLES							
		Totals	**0**	**0**	**0**	**0**	**0**	**0**
8	MOTOR CYCLES	4.45-5.00					1	
	including autocycles, scooters	**Totals**	**0**	**0**	**0**	**0**	**1**	**0**

R512 JUNCTION
From Legs 1 and 4 in all directions

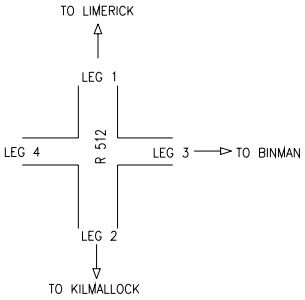
Survey Date: **27/11/2008**
Day: **Thursday**



Class of Vehicle		LEG 1 to 2	LEG 1 to 3	LEG 1 to 4	LEG 4 to 3	LEG 4 to 2	LEG 4 to 1
1 MOTOR CARS	08:00-08:15	21	5	2	0	0	13
	08:15-08:30	30	0	0	0	1	8
	08:30-08:45	30	5	2	0	1	6
Private cars, taxis, estate cars, station	08:45-09:00	21	7	1	0	4	3
wagons, bubble cars, car towing	09:00-09:15	21	4	1	4	1	8
caravans, boats or trailers	09:15-09:30	18	3	2	0	4	6
	09:30-09:45	18	1	1	2	0	4
	09:45-10:00	18	4	2	0	2	3
	Totals	**177**	**29**	**11**	**6**	**13**	**51**
2 HEAVY GOODS **Truck**	08:00-08:15	2	0	0	0	0	0
	08:15-08:30	0	1	0	0	0	0
	08:30-08:45	1	0	0	0	0	0
	08:45-09:00	0	2	0	0	0	0
	09:00-09:15	3	0	0	1	0	0
	09:15-09:30	0	2	0	0	0	0
	09:30-09:45	1	2	0	1	0	0
	09:45-10:00	0	0	0	0	0	0
	Totals	**7**	**7**	**0**	**2**	**0**	**0**
Artic	08:00-08:15	0	0	0	0	0	0
	08:15-08:30	0	0	0	0	0	0
	08:30-08:45	0	1	0	0	0	0
	08:45-09:00	0	0	0	0	0	0
	09:00-09:15	0	0	0	0	0	0
	09:15-09:30	0	0	0	0	0	0
	09:30-09:45	0	0	0	0	0	0
	09:45-10:00	0	0	0	0	0	0
	Totals	**0**	**1**	**0**	**0**	**0**	**0**
Truck & Trailer		0	1	0	0	0	0
	Totals						
3 LIGHT GOODS	08:00-08:15	6	3	0	1	2	0
Vans, pick-ups	08:15-08:30	6	0	0	0	1	2
(vehicles having 4 tyres only)	08:30-08:45	1	1	1	1	0	2
	08:45-09:00	0	0	2	1	0	0
	09:00-09:15	3	1	0	0	0	2
	09:15-09:30	0	1	0	0	1	2
	09:30-09:45	1	0	1	1	0	2
	09:45-10:00	0	3	1	0	1	1
	Totals	**17**	**9**	**5**	**4**	**5**	**11**
4 AGRICULTURAL TRACTORS							
	Totals	**0**	**0**	**0**	**0**	**0**	**0**
5 MISCELLANEOUS							
horse-drawn vehicles, ambulances	**Totals**	**0**	**0**	**0**	**0**	**0**	**0**
6 BUSES	08:30-08:45	1					
Buses, school buses, coaches	09:00-09:15	1					
	09:30-09:45	1					
	Totals	**3**	**0**	**0**	**0**	**0**	**0**
7 PEDAL CYCLES							
	Totals	**0**	**0**	**0**	**0**	**0**	**0**
8 MOTOR CYCLES							
including autocycles, scooters	**Totals**	**0**	**0**	**0**	**0**	**0**	**0**

R512 JUNCTION
From Legs 1 and 4 in all directions

Survey Date: **27/11/2008**
Day: **Thursday**



	Class of Vehicle		LEG 1 to 2	LEG 1 to 3	LEG 1 to 4	LEG 4 to 3	LEG 4 to 2	LEG 4 to 1
1	**MOTOR CARS**	3.30-3.45	47	4	1	2	2	3
		3.45-4.00	26	4	3	2	6	5
		4.00-4.15	41	4	3	1	3	1
		4.15-4.30	58	3	5	1	6	2
		4.30-4.45	65	6	5	2	6	0
	Private cars, taxis, estate cars, station	4.45-5.00	74	5	2	4	8	1
	wagons, bubble cars, car towing	5.00-5.15	83	2	4	0	2	1
	caravans, boats or trailers	5.15-5.30	138	0	3	2	8	3
		5.30-5.45	90	9	7	1	1	2
		5.45-6.00	89	3	5	1	4	1
		6.00-6.15	84	4	4	0	3	2
		6.15-6.30	85	2	2	3	8	3
		Totals	**880**	**46**	**44**	**19**	**57**	**24**
2	**HEAVY GOODS** **Truck**	3.30-3.45	1	1	0	0	0	0
		3.45-4.00	2	4	0	1	0	0
		4.00-4.15	0	1	0	0	0	0
		4.15-4.30	2	3	0	2	2	0
		4.30-4.45	1	2	0	0	1	1
		4.45-5.00	0	1	1	0	0	0
		5.00-5.15	2	1	0	0	0	0
		5.15-5.30	0	2	0	1	0	0
		5.30-5.45	0	1	0	0	0	0
		5.45-6.00	1	1	0	1	0	0
		6.00-6.15	1	0	1	1	0	0
		6.15-6.30	0	0	2	1	0	0
		Totals	**10**	**17**	**4**	**7**	**3**	**1**
	Artic	3.30-3.45		1				
		3.45-4.00		0				
		4.00-4.15		1				
		4.15-4.30		1				
		4.30-4.45	1	0				
		4.45-5.00		1				
		5.00-5.15		0				
		5.15-5.30		0				
		5.30-5.45		1				
		5.45-6.00		0				
		6.00-6.15		0				
	Truck & Trailer	6.15-6.30		0				
		Totals	**1**	**5**	**0**	**0**	**0**	**0**
3	**LIGHT GOODS**	3.30-3.45	8	1	0	0	0	0
	Vans, pick-ups	3.45-4.00	7	0	0	0	0	1
	(vehicles having 4 tyres only)	4.00-4.15	7	2	0	0	0	2
		4.15-4.30	5	2	1	1	0	0
		4.30-4.45	9	0	0	0	1	1
		4.45-5.00	4	1	0	0	2	0
		5.00-5.15	10	0	0	0	2	3
		5.15-5.30	4	0	0	0	0	0
		5.30-5.45	6	0	0	0	0	0
		5.45-6.00	8	0	0	0	2	1
		6.00-6.15	3	0	0	0	3	1
		6.15-6.30	4	12	0	0	1	1
		Totals	**75**	**18**	**1**	**1**	**11**	**10**
4	**AGRICULTURAL TRACTORS**	4.30-4.45			1			
		4.45-5.00					1	
		Totals	**0**	**0**	**1**	**0**	**1**	**0**
5	**MISCELLANEOUS**							
	horse-drawn vehicles, ambulances	**Totals**	**0**	**0**	**0**	**0**	**0**	**0**
6	**BUSES**	3.30-3.45	1	1				
	Buses, school buses, coaches	4.30-4.45	1					1
		6.15-6.30	1					
		Totals	**3**	**1**	**0**	**0**	**0**	**1**
7	**PEDAL CYCLES**							
		Totals						
8	**MOTOR CYCLES**	5.15-5.30	1					
	including autocycles, scooters	**Totals**	**1**	**0**	**0**	**0**	**0**	**0**

Appendix VII (B)

PICADY Analysis

TRL LIMITED

CAPACITIES, QUEUES, AND DELAYS AT 3 OR 4-ARM MAJOR/MINOR PRIORITY JUNCTIONS

PICADY 5.1 ANALYSIS PROGRAM
RELEASE 4.0 (SEPT 2008)

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PROGRAM ADVICE AND MAINTENANCE CONTACT:
TRL SOFTWARE BUREAU
TEL: CROWTHORNE (01344) 770758, FAX: 770356
EMAIL: Software@trl.co.uk

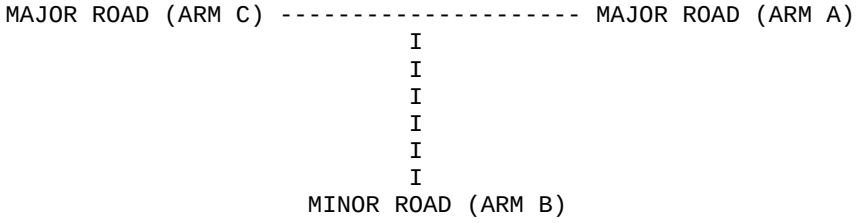
Run with file:-
"I:\CST\108\301-350\108320\calcs\2025 AM Peak - with Development.vpi"
(drive-on-the-left) at 16:23:44 on Friday, 19 December 2008

.RUN INFORMATION
****

RUN TITLE	:	**108320 2025 AM Peak Hour - Waste Facility Fully Operational**
LOCATION	:	Luddenmore, Co Limerick
DATE	:	05/12/08
CLIENT	:	Mr Binman
ENUMERATOR	:	F Fidgeon
JOB NUMBER	:	108320
STATUS	:	EIA
DESCRIPTION	:	

.MAJOR/MINOR JUNCTION CAPACITY AND DELAY
****

INPUT DATA



ARM A IS County Road to Southwest
ARM B IS Waste Facility Access
ARM C IS County Road to Northeast

.STREAM LABELLING CONVENTION

STREAM A-B CONTAINS TRAFFIC GOING FROM ARM A TO ARM B
STREAM B-AC CONTAINS TRAFFIC GOING FROM ARM B TO ARM A AND TO ARM C
ETC.

.GEOMETRIC DATA

DATA ITEM	MINOR ROAD B
TOTAL MAJOR ROAD CARRIAGEWAY WIDTH	(W) 6.00 M.
CENTRAL RESERVE WIDTH	(WCR) 0.00 M.
MAJOR ROAD RIGHT TURN - WIDTH	(WC-B) 2.20 M.
- VISIBILITY	(VC-B) 90.00 M.
- BLOCKS TRAFFIC	YES
MINOR ROAD - VISIBILITY TO LEFT	(VB-C) 10.0 M.
- VISIBILITY TO RIGHT	(VB-A) 10.0 M.
- LANE 1 WIDTH	(WB-C) 3.00 M.
- LANE 2 WIDTH	(WB-A) 0.00 M.

.SLOPES AND INTERCEPT

(NB:Streams may be combined, in which case capacity will be adjusted)

Intercept For STREAM B-C	Slope For Opposing STREAM A-C	Slope For Opposing STREAM A-B
630.23	0.24	0.10

Intercept For STREAM B-A	Slope For Opposing STREAM A-C	Slope For Opposing STREAM A-B	Slope For Opposing STREAM C-A	Slope For Opposing STREAM C-B
485.86	0.22	0.09	0.14	0.32

Intercept For STREAM C-B	Slope For Opposing STREAM A-C	Slope For Opposing STREAM A-B
626.08	0.24	0.24

(NB These values do not allow for any site specific corrections)

.TRAFFIC DEMAND DATA

ARM	FLOW SCALE(%)
A	100
B	100
C	100

.Demand set: 2025 AM Peak Hour - Waste Facility Fully Operational

TIME PERIOD BEGINS 08.15 AND ENDS 09.45

LENGTH OF TIME PERIOD - 90 MIN.
LENGTH OF TIME SEGMENT - 15 MIN.

.DEMAND FLOW PROFILES ARE SYNTHESISED FROM TURNING COUNT DATA

ARM	NUMBER OF MINUTES FROM START WHEN FLOW STARTS TO RISE	TOP OF PEAK IS REACHED	FLOW STOPS FALLING	RATE OF FLOW (VEH/MIN) BEFORE PEAK	AT TOP OF PEAK	AFTER PEAK
ARM A	15.00	45.00	75.00	2.45	3.68	2.45
ARM B	15.00	45.00	75.00	1.41	2.12	1.41
ARM C	15.00	45.00	75.00	1.48	2.21	1.48

.Demand set: 2025 AM Peak Hour - Waste Facility Fully Operational

TIME	FROM/TO	TURNING PROPORTIONS / TURNING COUNTS (PERCENTAGE OF H.V.S) ARM A	ARM B	ARM C
08.15 - 08.30	ARM A	0.000	0.719	0.281
		0.0	141.0	55.0
		(0.0)	(0.0)	(0.0)
	ARM B	0.708	0.000	0.292
		80.0	0.0	33.0
		(0.0)	(0.0)	(0.0)
	ARM C	0.373	0.627	0.000
		44.0	74.0	0.0
		(0.0)	(0.0)	(0.0)

TURNING PROPORTIONS ARE CALCULATED FROM TURNING COUNT DATA

. QUEUE AND DELAY INFORMATION FOR EACH 15 MIN TIME SEGMENT

FOR COMBINED DEMAND SETS
AND FOR TIME PERIOD 1

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
08.15-08.30									
B-AC	1.42	8.05	0.176		0.00	0.21	3.0		0.15
C-AB	0.98	10.21	0.096		0.00	0.11	1.7		0.11
C-A	0.50								
A-B	1.77								
A-C	0.69								

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
08.30-08.45									
B-AC	1.69	7.92	0.214		0.21	0.27	3.9		0.16
C-AB	1.19	10.17	0.117		0.11	0.14	2.1		0.11
C-A	0.58								
A-B	2.11								
A-C	0.82								

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
08.45-09.00									
B-AC	2.07	7.75	0.267		0.27	0.36	5.2		0.18
C-AB	1.48	10.11	0.146		0.14	0.18	2.8		0.12
C-A	0.69								
A-B	2.59								
A-C	1.01								

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
09.00-09.15									
B-AC	2.07	7.75	0.268		0.36	0.36	5.4		0.18
C-AB	1.48	10.11	0.146		0.18	0.18	2.8		0.12
C-A	0.69								
A-B	2.59								
A-C	1.01								

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
09.15-09.30									
B-AC	1.69	7.92	0.214		0.36	0.28	4.3		0.16
C-AB	1.19	10.17	0.117		0.18	0.14	2.1		0.11
C-A	0.58								
A-B	2.11								
A-C	0.82								

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
09.30-09.45									
B-AC	1.42	8.05	0.176		0.28	0.22	3.3		0.15
C-AB	0.98	10.21	0.096		0.14	0.11	1.7		0.11
C-A	0.50								
A-B	1.77								
A-C	0.69								

WARNING NO MARGINAL ANALYSIS OF CAPACITIES AS MAJOR ROAD BLOCKING MAY OCCUR

QUEUE FOR STREAM B-AC

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE
08.30	0.2
08.45	0.3
09.00	0.4
09.15	0.4
09.30	0.3
09.45	0.2

QUEUE FOR STREAM C-AB

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE
08.30	0.1
08.45	0.1
09.00	0.2
09.15	0.2
09.30	0.1
09.45	0.1

QUEUEING DELAY INFORMATION OVER WHOLE PERIOD

STREAM	TOTAL DEMAND (VEH)	TOTAL DEMAND (VEH/H)	* QUEUEING * DELAY * (MIN)	* QUEUEING * DELAY * (MIN/VEH)	* INCLUSIVE QUEUEING * DELAY * (MIN)	* INCLUSIVE QUEUEING * DELAY * (MIN/VEH)
B-AC	155.5	103.7	25.2	0.16	25.2	0.16
C-AB	109.3	72.9	13.2	0.12	13.2	0.12
C-A	53.1	35.4				
A-B	194.1	129.4				
A-C	75.7	50.5				
ALL	587.7	391.8	38.4	0.07	38.4	0.07

* DELAY IS THAT OCCURRING ONLY WITHIN THE TIME PERIOD
* INCLUSIVE DELAY INCLUDES DELAY SUFFERED BY VEHICLES WHICH ARE STILL QUEUEING AFTER THE END OF THE TIME PERIOD
* THESE WILL ONLY BE SIGNIFICANTLY DIFFERENT IF THERE IS A LARGE QUEUE REMAINING AT THE END OF THE TIME PERIOD.

*******END OF RUN*******

TRL LIMITED

CAPACITIES, QUEUES, AND DELAYS AT 3 OR 4-ARM MAJOR/MINOR PRIORITY JUNCTIONS

PICADY 5.1 ANALYSIS PROGRAM
RELEASE 4.0 (SEPT 2008)

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EMAIL: Software@trl.co.uk

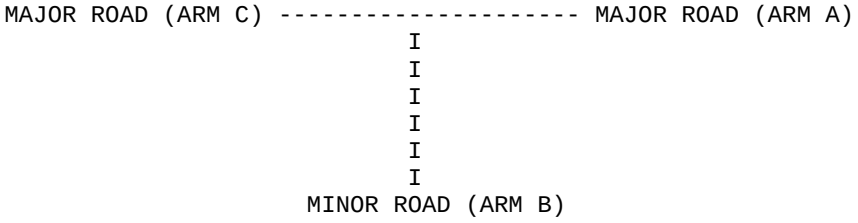
Run with file:-
"I:\CST\108\301-350\108320\calcs\2025 PM Peak - with Development.vpi"
(drive-on-the-left) at 16:26:43 on Friday, 19 December 2008

.RUN INFORMATION
****

RUN TITLE : **108320 2025 PM Peak Hour - Waste Facility Fully Operational**
LOCATION : Luddenmore, Co Limerick
DATE : 05/12/08
CLIENT : Mr Binman
ENUMERATOR : F Fidgeon
JOB NUMBER : 108320
STATUS : EIA
DESCRIPTION :

.MAJOR/MINOR JUNCTION CAPACITY AND DELAY
****

INPUT DATA



ARM A IS County Road to Southwest
ARM B IS Waste Facility Access
ARM C IS County Road to Northeast

.STREAM LABELLING CONVENTION

STREAM A-B CONTAINS TRAFFIC GOING FROM ARM A TO ARM B
STREAM B-AC CONTAINS TRAFFIC GOING FROM ARM B TO ARM A AND TO ARM C
ETC.

.GEOMETRIC DATA

DATA ITEM	MINOR ROAD B
TOTAL MAJOR ROAD CARRIAGEWAY WIDTH	(W) 6.00 M.
CENTRAL RESERVE WIDTH	(WCR) 0.00 M.
MAJOR ROAD RIGHT TURN - WIDTH	(WC-B) 2.20 M.
- VISIBILITY	(VC-B) 90.00 M.
- BLOCKS TRAFFIC	YES
MINOR ROAD - VISIBILITY TO LEFT	(VB-C) 10.0 M.
- VISIBILITY TO RIGHT	(VB-A) 10.0 M.
- LANE 1 WIDTH	(WB-C) 3.00 M.
- LANE 2 WIDTH	(WB-A) 0.00 M.

.SLOPES AND INTERCEPT

(NB:Streams may be combined, in which case capacity will be adjusted)

Intercept For STREAM B-C	Slope For Opposing STREAM A-C	Slope For Opposing STREAM A-B
630.23	0.24	0.10

Intercept For STREAM B-A	Slope For Opposing STREAM A-C	Slope For Opposing STREAM A-B	Slope For Opposing STREAM C-A	Slope For Opposing STREAM C-B
485.86	0.22	0.09	0.14	0.32

Intercept For STREAM C-B	Slope For Opposing STREAM A-C	Slope For Opposing STREAM A-B
626.08	0.24	0.24

(NB These values do not allow for any site specific corrections)

.TRAFFIC DEMAND DATA

ARM	FLOW SCALE(%)
A	100
B	100
C	100

.Demand set: 2025 PM Peak Hour - Waste Facility Fully Operational

TIME PERIOD BEGINS 15.30 AND ENDS 17.00

LENGTH OF TIME PERIOD - 90 MIN.
LENGTH OF TIME SEGMENT - 15 MIN.

.DEMAND FLOW PROFILES ARE SYNTHESISED FROM TURNING COUNT DATA

ARM	NUMBER OF MINUTES FROM START WHEN FLOW STARTS TO RISE	NUMBER OF MINUTES FROM START WHEN TOP OF PEAK IS REACHED	NUMBER OF MINUTES FROM START WHEN FLOW STOPS FALLING	RATE OF FLOW (VEH/MIN) BEFORE PEAK	RATE OF FLOW (VEH/MIN) AT TOP OF PEAK	RATE OF FLOW (VEH/MIN) AFTER PEAK
ARM A	15.00	45.00	75.00	1.69	2.53	1.69
ARM B	15.00	45.00	75.00	2.65	3.98	2.65
ARM C	15.00	45.00	75.00	0.76	1.14	0.76

.Demand set: 2025 PM Peak Hour - Waste Facility Fully Operational

TIME	TURNING PROPORTIONS / TURNING COUNTS (PERCENTAGE OF H.V.S) FROM/TO	ARM A	ARM B	ARM C
15.30 - 15.45	ARM A	0.000	0.615	0.385
		0.0	83.0	52.0
		(0.0)	(10.0)	(10.0)
	ARM B	0.854	0.000	0.146
		181.0	0.0	31.0
		(10.0)	(0.0)	(10.0)
	ARM C	0.705	0.295	0.000
		43.0	18.0	0.0
		(10.0)	(10.0)	(0.0)

TURNING PROPORTIONS ARE CALCULATED FROM TURNING COUNT DATA
DEFAULT PROPORTIONS OF HEAVY VEHICLES ARE USED

. QUEUE AND DELAY INFORMATION FOR EACH 15 MIN TIME SEGMENT

FOR COMBINED DEMAND SETS
AND FOR TIME PERIOD 1

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
15.30-15.45									
B-AC	2.66	7.24	0.367		0.00	0.57	8.0		0.21
C-AB	0.24	9.44	0.025		0.00	0.03	0.4		0.11
C-A	0.53								
A-B	1.04								
A-C	0.65								

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
15.45-16.00									
B-AC	3.18	7.16	0.443		0.57	0.77	11.1		0.25
C-AB	0.29	9.43	0.031		0.03	0.04	0.5		0.11
C-A	0.62								
A-B	1.24								
A-C	0.78								

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
16.00-16.15									
B-AC	3.89	7.06	0.551		0.77	1.18	16.5		0.31
C-AB	0.36	9.42	0.038		0.04	0.05	0.7		0.11
C-A	0.76								
A-B	1.52								
A-C	0.95								

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
16.15-16.30									
B-AC	3.89	7.06	0.551		1.18	1.20	17.8		0.31
C-AB	0.36	9.42	0.038		0.05	0.05	0.7		0.11
C-A	0.76								
A-B	1.52								
A-C	0.95								

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
16.30-16.45									
B-AC	3.18	7.16	0.443		1.20	0.82	13.0		0.25
C-AB	0.29	9.43	0.031		0.05	0.04	0.5		0.11
C-A	0.62								
A-B	1.24								
A-C	0.78								

TIME	DEMAND (VEH/MIN)	CAPACITY (VEH/MIN)	DEMAND/ CAPACITY (RFC)	PEDESTRIAN FLOW (PEDS/MIN)	START QUEUE (VEHS)	END QUEUE (VEHS)	DELAY (VEH.MIN/ TIME SEGMENT)	GEOMETRIC DELAY (VEH.MIN/ TIME SEGMENT)	AVERAGE DELAY PER ARRIVING VEHICLE (MIN)
16.45-17.00									
B-AC	2.66	7.24	0.368		0.82	0.59	9.3		0.22
C-AB	0.24	9.44	0.025		0.04	0.03	0.4		0.11
C-A	0.53								
A-B	1.04								
A-C	0.65								

WARNING NO MARGINAL ANALYSIS OF CAPACITIES AS MAJOR ROAD BLOCKING MAY OCCUR

.

QUEUE FOR STREAM B-AC

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE	
15.45	0.6	*
16.00	0.8	*
16.15	1.2	*
16.30	1.2	*
16.45	0.8	*
17.00	0.6	*

QUEUE FOR STREAM C-AB

TIME SEGMENT ENDING	NO. OF VEHICLES IN QUEUE
15.45	0.0
16.00	0.0
16.15	0.0
16.30	0.0
16.45	0.0
17.00	0.0

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QUEUEING DELAY INFORMATION OVER WHOLE PERIOD

STREAM	TOTAL DEMAND		* QUEUEING * DELAY *		* INCLUSIVE QUEUEING * DELAY *	
	(VEH)	(VEH/H)	(MIN)	(MIN/VEH)	(MIN)	(MIN/VEH)
B-AC	291.8	194.5	75.7	0.26	75.8	0.26
C-AB	26.7	17.8	3.3	0.12	3.3	0.12
C-A	57.3	38.2				
A-B	114.2	76.2				
A-C	71.6	47.7				
ALL	561.6	374.4	79.1	0.14	79.1	0.14

* DELAY IS THAT OCCURRING ONLY WITHIN THE TIME PERIOD
* INCLUSIVE DELAY INCLUDES DELAY SUFFERED BY VEHICLES
WHICH ARE STILL QUEUEING AFTER THE END OF THE TIME PERIOD
* THESE WILL ONLY BE SIGNIFICANTLY DIFFERENT IF THERE IS
A LARGE QUEUE REMAINING AT THE END OF THE TIME PERIOD.

*******END OF RUN******