CURRAGHA WATER SUPPLY

GROUNDWATER SOURCE PROTECTION ZONES

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CURRAGHA WATER SUPPLY

1. WELL LOCATION AND SITE DESCRIPTION

This source is the main public water supply well for Ashbourne village and its surrounding hinterland. The wells are located 4.5 km north of Ashbourne, off the N2, and 150m north of the crossroads in Curragha village, on the northern bank of the River Hurley. The two production wells, PW No.1 (drilled August-October 1987) and PW No.2 (drilled April 1984) are approximately 10 metres and 5 metres respectively from the river bank and both are completed below ground level, each with a manhole covering the well. The production wells are located beside the pumphouse and all are fenced off from the adjacent field. PW 2 is now the main producer, while No.1 acts as a backup production well. The Curragha groundwater is chlorinated, filtered and fluoridated in the pumphouse before being pumped to the Rath Reservoir, adjacent to Ashbourne. Very few private wells are in use near this source.

2. WELL DETAILS

PRODUCTION WELL NO.2 (Originally Trial Well No.1)

GSI no.:	2925SW102
Grid ref.:	30332 25572
Owner:	Meath County Council
Well type:	Borehole
Elevation (top of casing):	79.73 m OD (Poolbeg). Ground level is 79.73 m OD.
Depth:	40 m
Depth of casing:	6m
Diameter:	150 mm (6")
Depth-to-rock:	1.8 m
Static water level:	0.75 m b.g.l. (7-5-84); 24.12 m b.g.l.(20-9-95)
Pumping water level:	14.20 m b.g.l. (7-5-84); 31.62 m b.g.l (20-9-95)
Drawdown:	13.45 m (7-5-84); 7.50 m b.g.l (20-9-95)
Pumping rate:	1855 m^3/d (17,000 gal/hr); 1250 m^3/d (11,500 gal/hr) from PW No.2
Normal consumption:	1250m^3/d (275,000 gal/d on average, over 24 hrs)

Pumping test summary:

(i) abstraction rate: 1250 m^3/d (PW No.2)
(ii) specific capacity: 120m^3/d/m (7-5-84) 130m^3/d/m (extrapolated to 1 week)
(iii) transmissivity: 60 - 130m^2/d

PRODUCTION WELL NO.1 (Originally PW No.2)

GSI no.:	2925SW103
Grid ref.:	30334 25573
Owner:	Meath Co. Co.
Well type:	Borehole
Elevation (top of casing):	79.54 m OD (Poolbeg). Ground level is 79.54 m OD.
Depth:	43.5 m
Depth of casing:	10 m
Diameter:	250 mm (10")
Depth-to-rock:	1.8 m
Static water level:	11.85 m b.g.l. (27-10-87); 23.90 m b.g.l.(20-9-95)

Pumping water level:	30.4m b.g.l. (27-10-87);	34.50 m b.g.l. (20-9-95)
Drawdown:	18.5m (27-10-87);	10.60m (20-9-95)
Abstraction rate:	1200 m^3/d (11,000 gal/hr)	1250 m^3/d (11,500 gal/hr)
Normal consumption:	1250 m^3/d (275,000 gal/d on average, over 24 hrs)	

Pumping test summary:

(i) abstraction rate: 1250m^3/d

(ii) specific capacity: 60 m^3/d/m (27-10-87), 120m^3/d/m (12 hours);
90 m^3/d/m (20-9-95) (extrapolated to 1 week)

(iii) transmissivity: 60 - 130 m^2/d

3. METHODOLOGY

There were three stages involved in assessing the area: (a) detailed desk study, (b) site visits and fieldwork, and (c) analysis of the data. The desk study compiled the geology from all available data sources. Basic public supply well details were obtained from Council personnel which included precise locations and any relevant borehole, chemistry and pumping test data available.

The second stage comprised site visits and fieldwork in the surrounding area. The GSI drilled a monitoring borehole in July 1995. A twelve hour pumping test with a recovery test was carried out to examine the aquifer characteristics. Subsequently, the area around the sources was surveyed with regard to geology, hydrogeology, vulnerability to pollution and current pollution loading. Raw water samples were taken in March, June, and September 1995 and January 1996 for full suites of chemical and bacterial analyses. Regular conductivity measurements were taken from early 1995 to mid-1996.

The assessment stage used analytical equations and hydrogeological mapping to delineate protection zones.

4. TOPOGRAPHY, DRAINAGE AND LAND USE

The topography is slightly undulating, ranging from 78 m OD (255 ft) to around 90 m OD (300 ft). The River Hurley flows in a northwesterly direction, with some smaller streams draining the area. Drainage is only moderate with numerous small drainage ditches, particularly to the east of Curragha.

Excluding the village and its immediate surrounds, the land use in the area is primarily tillage and pasture. The field around the wells is permanently in grassland.

5. GEOLOGY

5.1 Bedrock geology

The geology in the immediate vicinity of the pumping wells is given by borehole logs from the production wells, which indicate 1.8 m of till overlying a black and grey calcarenite limestone (Calp Limestone). The limestone bedrock is extensively fissured and highly broken, particularly between 32 to 35 metres b.g.l. which provides large inflows of water.

The Calp Limestone at Curragha outcrops along the Hurley River and the limestone is faulted and highly fractured. The limestones in this area tend to be cleaner in nature than the more typical Calp Limestones and the faulting and the associated folding result in higher than usual groundwater yields.

A GSI observation borehole 53 m deep (Curragha D/H 106) was drilled in July 1995 approximately 36 m from the main production well, and encountered 51.5 m of light grey to black limestone and shales. The black limestone was predominantly fine grained, with some coarser units. The lighter grey limestone is medium grained and highly broken and fractured. Numerous calcite veins were noted, and their thickness increased with depth, with major fracturing and cavities being encountered below

30 metres. The return water was lost during drilling from 33 m below ground level, suggesting higher permeabilities occur in this zone, due to increased fracturing. The loss of drilling fluid resulted in the termination of the borehole at 53 m. The bedrock geology is shown in Figure 1.

5.2 Quaternary (subsoils) geology

Two types of Quaternary deposits are present in the vicinity of the Curragha source (Figure 2).

Along the river valley, near the wells, is an area of lacustrine sediments varying in width from zero around the wells to 500 metres directly upgradient. The lacustrine deposits are clayey to marly in texture, and are 1 to 3 metres deep. Some fine sand lenses are found.

Flanking the lacustrine deposits is an extensive area of limestone dominated till which is generally clayey in texture. The till is interpreted as a lodgement till deposited during the last glacial period. In places the till has a gravelly texture but clay dominates the matrix in all cases investigated.

5.3 Soils

The soils information is taken from the soil map of Co. Meath (Finch *et al*, 1983). Soils in the area are primarily derived from a parent material consisting primarily of limestone and shale till. The Great Soil Group is the Gley Group and the Soil Series is Ashbourne. Gleys develop under poor drainage conditions with permanent or intermittent water logging usually due to a high water table. The soil parent material is very fine grained with an abundance of clay, which gives rise to low permeability and poor drainage even on slopes.

Associated with the Ashbourne Soil Series is the Dunboyne Soil Series (Grey Brown Podzolic Group) which is found around Curragha Village. These soils are well to moderately drained and have a wide range of uses but are best suited to grassland.

5.4 Depth-to-rock

Rock outcrops along the banks of the River Hurley and to the north at Robinson's Cross Roads. Depth-to-rock in the public supply boreholes is 1.8 m and in the adjacent GSI observation well 1.5 m.

Throughout the remainder of the area the subsoils are on average much thicker, generally more than 10 metres thick. The depth to rock contours are based on very limited data and may need refining as further depth to bedrock records become available (see Figure 3).

6. HYDROGEOLOGY

6.1 Data availability

Hydrogeological data for the Curragha pumping wells are reasonably good, although lacking in the area adjacent to the source. A 12 hour pumping test was carried out in September 1995 and a survey of wells and pollution sources was conducted within a kilometre of the source (Figure 4). Water levels in private wells were measured and a water table map drawn to ascertain the groundwater flow direction. The wellheads were all accurately levelled in but as the survey included dug wells which may tap a perched water table within the till, these water level readings were used with caution. The production wells have produced a large cone of depression around Curragha which has affected the groundwater flow in their vicinity. Most wells in the area are disused shallow dug wells.

A trial well was drilled in April 1984 for the County Council to test the groundwater potential of the fractured and faulted limestones that outcrop in the Hurley River. Trial Well No.1 was beside the bridge and was completed at 150 mm with casing to 6 m. The well was drilled to 40 m with major inflows at 24 m and at 34 m where a large cavity was located. The pumping test results (May 1984) were good and subsequently a production well was drilled 3 metres away to a total depth of 41 m. Two metres of 300 mm casing and 9 metres of 250 mm steel casing were installed and grouted. A

length of 200mm well screen designed for the bottom of the well became lodged at 15 metres b.g.l. during installation, and this production well was abandoned.

A second production well was drilled and tested in August-October 1987. This well, now called PW No. 1, was completed at a depth of 43.5 m, with a diameter of 250 mm. The main inflows were at 27 metres and in a fracture zone between 32 and 35 m. This well now acts as the standby pumping well, while the original Trial Well No. 1 is now the main production well and is called PW No. 2. Short reports on the drilling and testing of these wells were prepared by K.T. Cullen.

The GSI drilled a monitoring borehole (July 1995) with an open hole diameter of 75.7 mm (47.6 mm core) and 60 mm plastic pipes were installed in the borehole. The bottom pipes were slotted to allow water entry. The core is stored in the GSI core store. This well is labelled GSI OW No.1.

6.2 Groundwater levels

Groundwater is generally close to the surface especially along the River Hurley. The static water level in the wells on 20-9-95, following overnight recovery, and the pumping water levels after 12 hours pumping are shown below.

Date	Well Number	Static Water Level, m (b.g.l)	Metres OD	Pumping Water Level, m (b.g.l)	Metres OD
7-6-95	PW No.1	24.12	55.61	31.62	48.11
7-6-95	PW No.2	23.90	55.64	34.50	45.04
7-6-95	GSI OW No.1	24.22	55.58	27.52	52.28

The unsaturated zone was originally relatively thin (<2 metres), but is now much greater, ranging 20-35 m thick, as a result of the continuous pumping.

6.3 Groundwater flow directions and gradients

Regional groundwater flow is generally towards the River Hurley and westward, but locally it is dependent on topography. The exact flow direction was difficult to assess due to the flat lying ground near the well, but flow to the wells is probably from the northeast. The river may be in hydraulic continuity with the water table, at least near the wells. Summer flow in the river is minimal.

Groundwater gradients in the general area may range from approximately 0.01 to 0.02.

6.4 Rainfall, Evaporation and Recharge

Rainfall data for the area are taken from the nearest rainfall stations, at Garristown, Co. Dublin (5 km northeast) and Dunshaughlin (7 km southwest). The mean annual rainfall as recorded by Met Eireann for 195180 was 867 mm. Potential evapotranspiration (P.E.) is estimated from a Met Eireann contoured map as 550 mm/yr. Actual evapotranspiration (A.E.) is estimated at 522 mm/yr by calculating 95% of the P.E., to allow for seasonal soil moisture deficits.

Using the above figures the effective rainfall (E.R.) is taken to be approximately 345 mm/yr. As there are no drainage ditches or streams in the immediate area of the supply and the Quaternary deposits are free draining and generally thin, a high proportion of the effective rainfall infiltrates to the water table. Estimating run off to be of the order of 10%, recharge to the aquifer is estimated at 310 mm/yr.

These calculations are summarised below:

Average annual rainfall	867 mm
Estimated P.E.	550 mm
Estimated A.E. (95% P.E.)	522 mm
Effective rainfall	345 mm
Recharge (90% E.R.)	310 mm

6.5 Hydrochemistry and Water Quality

The chemical analyses of groundwater at the source in Curragha (samples from PW No.2) indicate a very hard water (355-435 mg/l $CaCO_3$), with a high alkalinity (310-325 mg/l $CaCO_3$). Conductivities are also high, ranging 520-810 μS/cm (Table 1). This groundwater can be classed as a calcium bicarbonate water. The groundwater analyses are in the Appendices.

The water quality at Curragha is good with no bacterial contamination (except for naturally occurring background Coliforms) and all the major cations, anions and trace elements are within the Irish Drinking Water Standards and the EU limits except for iron and manganese which are naturally high. Calcium and sulphate levels are above the guide values. The high sulphates, in the absence of oxygen, are reduced to sulphides and are contributing to the odour problem at this site.

Table 1. Conductivity readings from the Curragha Source

	Production Well No.2	
Date	**Conductivity**	**Temperature**
	(μS/cm)	**(^{O}C)**
8-3-95	543	8.6
13-3-95	586	12.4
+20-3-95	556	9.8
19-5-95	555	11.6
2-6-95	654	12.5
+12-6-95	550	11.5
7-7-95	553	12.8
18-7-95	569	13.1
4-8-95	552	12.5
15-9-95	545	12.5
+25-9-95	534	11.7
17-10-95	534	11.9
11-11-95	518	10.8
8-12-95	678	10.5
2-1-96	696	10.7
+8-1-96	717	10.5
25-1-96	725	10.1
20-2-96	717	10.2
20-3-96	712	10.6
7-5-96	713	11.3
29-5-96	700	12.0

+ Full analyses

Historical Data

Raw water samples from the Trial Well, PW No.1 and the river were analysed in 1984. The results indicated that the groundwater from the wells was of excellent quality except for the iron and manganese levels. The analyses of the river showed that the chemistry was similar, although there was some evidence of organic contamination. The groundwater from PW No.2 in 1987 was of excellent quality, again apart from the high iron concentration.

There has been no significant change in the hydrochemistry since 1987. Further comparative analyses of the river water are required to establish the degree of connection between the river and the supply wells as bedrock is exposed in the river banks. The quality of the water in the river during recharging of the aquifer is very important and may affect the overall quality of the pumping wells.

6.6 Aquifer coefficients

The pumping test analyses provided apparent transmissivity values of 60-130 m^2/d from the 12 hour pumping test and 120-135 m^2/d from the 72 hour pumping test.

The specific capacity calculated was around 120 $m^3/d/m$ after 12 hours pumping of PW No.2 and 160-180 $m^3/d/m$ from the original tests.

During the pumping test the drawdown increased gradually over the 12 hours. From the plotted graph a steady state pumping water level was not attained during the test, although the continuous pumping water level was reached, thus steady state may have actually been obtained. The yield of the well is at maximum, for during very dry summers the pumping water level is close to the pump intake.

The specific yield of 0.002 was calculated from the late data from the GSI Observation Well No.2 and indicated that the aquifer is unconfined.

Analyses of the original pumping test for PW No.2 in 1987 with a pumping rate of 1200m^3/d and a drawdown of 18 metres indicated apparent transmissivities of around 90 m^2/d from the 72 hour pumping test. The specific capacity calculated was 65 $m^3/d/m$. These figures are similar to those obtained from the 12 hour test. The pumping tests indicate that the permeability zone permeability decreases with increasing depth below ground level.

The pumping test data are in the Appendices.

6.7 Conceptual Model

The aquifer feeding the Curragha source is the Calp Limestone. This is overlain by a very thin till cover, which is moderately permeable, in the vicinity of the production wells, and the aquifer is considered to be unconfined, at least near the wells. The thick unsaturated zone (20 to 35 m) in this unconfined aquifer (in the vicinity of the well) has developed as a direct result of the pumping and the aquifer has been dewatered by approximately 20 metres. The aquifer is very permeable in the upper part and this is supported by the high yields from the wells. Permeabilities within the bedrock are increased by joints and fractures which are directly related to the faulting close to the wells. During the drilling of the well major inflows of groundwater were recorded in the fissured limestone at 27 metres and from the area between 32 and 35 metres below ground level (47.5 and 44.5 m O.D), a cavernous fissure zone.

Groundwater flow is influenced by topography and mirrors the ground levels, flowing from the higher ground, down along the Hurley Valley and discharging into the river. A groundwater divide can be deduced along the top of topographical ridges. The groundwater flow to the public supply is presumed to be from the northeast, which is confirmed by the groundwater table.

The limestone outcrops in the river banks, implying that the river is hydraulically connected to the aquifer. The main inflow into the well is through the screened fissured limestone at depth. Direct inflows from the subsoils are prevented by the steel casing, which is grouted in the production wells.

Further investigations are required to determine the amount of recharge from the river and the distance over which this recharge occurs.

6.8 Aquifer category

The aquifer supplying the Curragha source is the Calp Limestone, which seems to be receiving additional recharge from the river. In this area, the aquifer is classed as a **locally important aquifer which is generally moderately productive (Lm).**

7. GROUNDWATER VULNERABILITY

The catchment area for the Curragha source displays a wide variation in vulnerability, with all vulnerability classes from ‘Extreme’ to ‘Low’. The subsoil in the vicinity of the pumping wells is

very thin, less than 2 metres, and moderately permeable. Since it is probable that a significant proportion of flow to the well may be from the river, the vulnerability of the source catchment to pollution is as important as the river water quality.

Under the GSI vulnerability mapping guidelines, areas where rock is less than 3 m below surface are mapped as having 'extreme vulnerability', especially along the banks of the River Hurley. The surrounding area is classified as 'highly vulnerable' to 'moderately vulnerable' due to the shallow cover. The remainder of the area is classified as 'low vulnerability'. The vulnerability zones are shown on Figure 5.

8. DELINEATION OF SOURCE PROTECTION AREAS

Source protection areas are delineated for the maximum output (1250 m^3/d) which is that currently abstracted, and allows for expansion of the zone of contribution during dry weather.

8.1 Inner Protection Area (SI)

The Inner Protection Area is the area defined by a 100 day time of travel to the source and is delineated to protect against the effects of potentially contaminating activities which may have an immediate influence on water quality at the source, in particular from microbial contamination.

As a result of the inferred highly permeable zone close to the surface (upper 20 metres) in the vicinity of the source, high aquifer coefficients are used to determine the 100 day time of travel distance.

Using the following aquifer coefficients: permeability (k) = 30 m/d, porosity = 0.04, and the hydraulic gradient (i) = 0.01, the 100 day time of travel distance to the well is estimated to be approximately 750 metres (Figure 6).

8.2 Outer Protection Area (SO)

The Outer Protection Area includes the remainder of the catchment area of the source, i.e. the zone of contribution (ZOC), and is defined as the area required to support an abstraction from long-term recharge. The ZOC at Curragha is derived from hydrogeological mapping techniques and is controlled primarily by the groundwater divides and the groundwater flow direction (Figure 6). The size of the ZOC is based largely on the Recharge Equation. Taking the average annual recharge to be 310 mm as previously indicated, the area required to supply the pumping rate of 1250 m^3/d is calculated to be 1.5 km^2. The null point or down-gradient boundary of the ZOC (the distance down-gradient beyond which water is not contributing to the well) is approximately 200 to 250 metres. A buffer (safety margin) is included in the final ZOC by incorporating a 20^o error margin for the estimated groundwater flow direction. In addition the wells are recharged by water from the River Hurley, thus the ZOC is conservative.

9. GROUNDWATER SOURCE PROTECTION ZONES

Combining the Source Protection Areas with the vulnerability ratings produces eight groundwater protection zones for the source at Curragha. These are listed here in order of decreasing degree of protection required and are shown in Figure 7:

- Inner Protection Area /Extreme (SI/E)
- Inner Protection Area / High (SI/H)
- Inner Protection Area / Moderate (SI/M)
- Inner Protection Area / Low (SI/L)
- Outer Protection Area / Extreme (SO/E)
- Outer Protection Area / High (SO/H)
- Outer Protection Area / Moderate (SO/M)
- Outer Protection Area / Low (SO/L)

10. POTENTIAL POLLUTION SOURCES

The primary threat to the public supply at Curragha is the quality of the water in the river upstream of the source. Surface water quality may be affected in particular, by surface run off, septic tanks and farm effluent. All potentially polluting activities within the River Hurley catchment upstream of Curragha could affect the quality of this groundwater source and should be controlled and monitored.

A few houses are present in the general area of the well. Several old farmyards are located up-gradient of the wells. These farms at present do not store silage nor have cattle feeding yards and do not pose a risk to the wells if the present farmyard activities are maintained. There is no mains sewerage scheme in Curragha village, thus all the houses are served by septic tanks which if not adequately controlled may pose a risk to the groundwater.

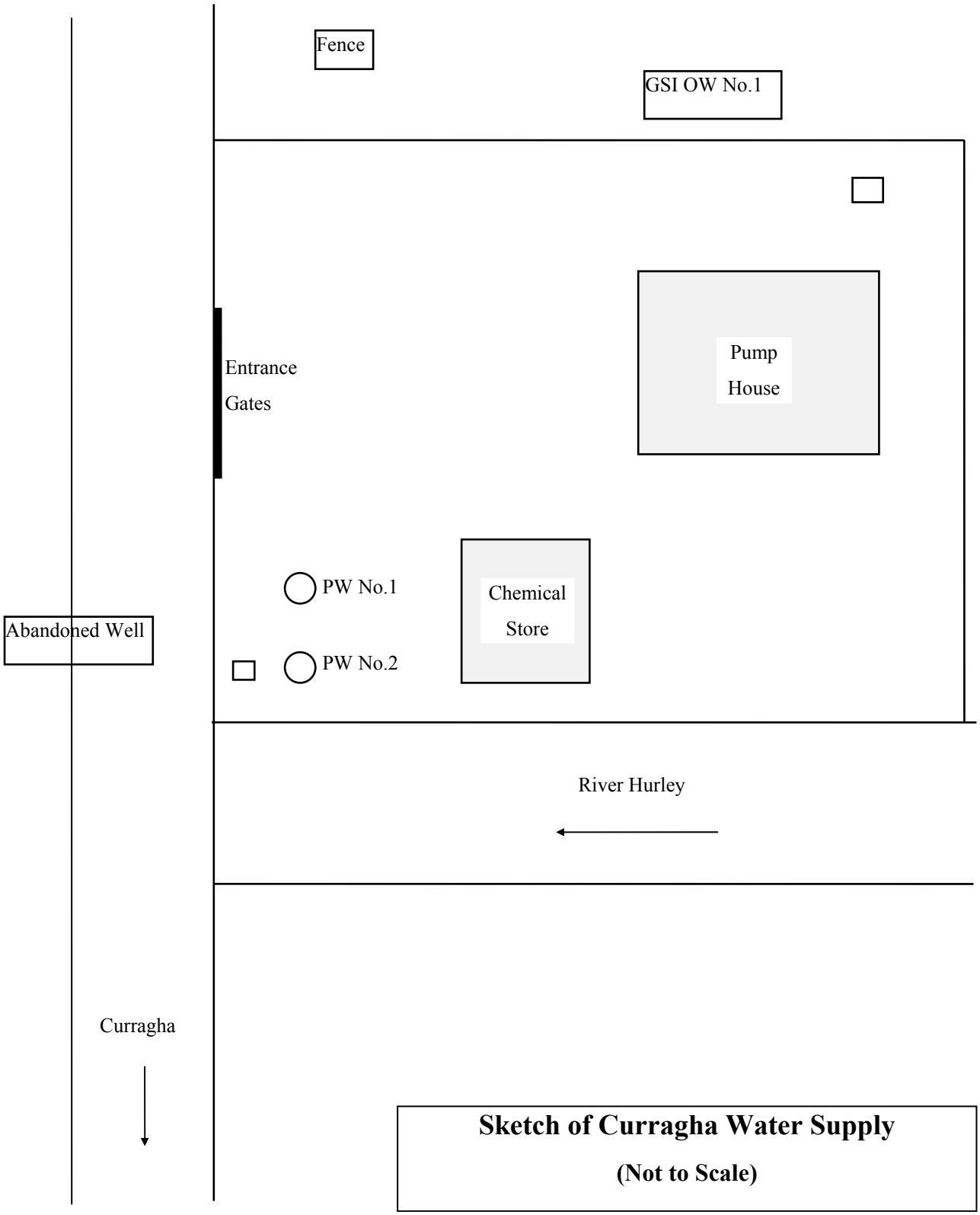
11. CONCLUSIONS AND RECOMMENDATIONS

Overall the source at Curragha is very high yielding and is presently pumping at the well's maximum capacity. An increased yield could only be obtained by drilling a deeper production well or by the installation of a second pumping location adjacent to the pumphouse. The water analyses indicate that there were no water quality problems at this source, except for the natural high iron and manganese. However the source catchment is extremely to moderately vulnerable to pollution due to the thickness and permeability of the subsoils in the immediate vicinity of the supply. The groundwater quality is also dependent on the river water quality as they are hydraulically connected. The backwash water from the filters is presently discharged into the River Hurley and this should be discontinued as soon as possible to prevent recirculation.

It is recommended that the Council sample the raw water from the Curragha source to monitor the nitrate, potassium, chloride and conductivity levels, and to examine the effects of the potentially polluting activities near to the well. In addition it is recommended that the Council control and monitor potentially polluting activities within the delineated groundwater source protection zones and within the catchment to the River Hurley, particularly farmyard activities up-gradient from the well and all industrial and commercial developments.

The groundwater source protection zones for the Curragha source extend into County Dublin. Control of potentially polluting activities in the protection zones and within the catchment of the River Hurley will require co-operation from Fingal County Council.

Further investigations should be conducted to establish the amount of recharge from the River Hurley.



Sketch of Curragha Water Supply

(Not to Scale)

Appendix 1
Pump Test Data

PUMPING TEST DATA SHEET

Location : CURRAGHA **Borehole name : PW No.1** **Date : 19-09-95**

Test : Recovery Data from PW No.1 while PW No.2 is pumping.

Duration : 9hrs. Weather : Fine

Distance from Pumping Well : 5m. Well depth : 40m.

Height of datum point above ground level : 0.03m Datum Point : Wooden plank across manhole.

Date	Time	Time since pumping ended (min.)	Water level below datum (metres)	Drawdown (metres)	Discharge m3/d	Temperature C	Conductivity uS/cm @20 C
19-09-95	21:00	0	31.9	0			
		0.5	31.85	0.05			
		1	31.3	0.6			
		1.5	30.8	1.1			
		2	30.6	1.3			
		2.5	30.5	1.4			
		3	30.41	1.49			
		3.5	30.39	1.51			
		4	30.29	1.61			
		4.5	30.27	1.63			
		5	30.13	1.77			
		6	30.05	1.85			
		12	29.2	2.7			
		14	29.05	2.85			
		16	28.93	2.97			
		18	28.85	3.05			
		20	28.72	3.18			
		22	28.61	3.29			
		24	28.48	3.42			
		26	28.39	3.51			
		28	28.33	3.57			
		30	28.24	3.66			
		35	28.02	3.88			
		40	27.89	4.01			
		45	27.78	4.12			
		50	27.65	4.25			
		55	27.54	4.36			
	22:00	60 (1hr)	27.46	4.44			
		75	27.17	4.73			
		90	27.08	4.82			
		105	26.74	5.16			
	23:00	120 (2hrs)	26.6	5.3			
		135	26.4	5.5			
		150	26.28	5.62			
		165	26.16	5.74			
	24:00	180 (3hrs)	26.04	5.86			
		200	25.88	6.02			
		220	25.72	6.18			
	01:00	240 (4hrs)	25.57	6.33			
	02:00	300 (5hrs)	25.2	6.7			
	03:00	360 (6hrs)	24.87	7.03			
		525	24.17	7.73			
	06:00	540 (9hrs)	24.12	7.78			

PUMPING TEST DATA SHEET

Location : CURRAGHA **Borehole name : PW No.1** **Date : 20-09-95**

Test : Drawdown Data from PW No.1 while PW No.2 is pumping.

Duration : 12hrs. Weather : Fine

Distance from Pumping Well : 5m. Well depth : 40m.

Height of datum point above ground level : 0.03m Datum Point : Wooden plank across manhole.

Date	Time	Time since pumping began (min.)	Water level below datum (metres)	Drawdown (metres)	Discharge m3/d	Temperature C	Conductivity uS/cm @20 C
20-09-95	06:00	0	24.12	0			
		0.5	24.48	0.36			
		1	24.71	0.59			
		1.5	24.95	0.83			
		2	25.17	1.05			
		2.5	25.38	1.26			
		3	25.54	1.42			
		3.5	25.7	1.58			
		4	25.84	1.72			
		4.5	25.92	1.8			
		5	26.04	1.92			
		6	26.26	2.14			
		7	26.5	2.38			
		8	26.65	2.53			
		9	26.84	2.72			
		10	26.94	2.82			
		12	27.25	3.13			
		14	27.32	3.2			
		16	27.47	3.35			
		18	27.53	3.41			
		20	27.74	3.62			
		22	27.83	3.71			
		24	27.95	3.83			
		26	28.05	3.93			
		28	28.1	3.98			
		30	28.15	4.03			
		35	28.28	4.16			
		40	28.47	4.35			
		45	28.58	4.46			
		50	28.61	4.49			
		55	28.77	4.65			
	07:00	60 (1hr)	28.9	4.78			
		75	29.15	5.03			
		90	29.38	5.26			
		105	29.6	5.48			
	08:00	120 (2hrs)	29.74	5.62			
		135	29.86	5.74			
		150	29.99	5.87			
		165	30.1	5.98			
	09:00	180 (3hrs)	30.19	6.07			
		200	30.34	6.22			
		220	30.44	6.32			
	10:00	240 (4hrs)	30.53	6.41			
		20	30.67	6.55			
	11:00	300 (5hrs)	30.82	6.7			
		330	30.88	6.76			
	12:00	360 (6hrs)	30.96	6.84			
		390	31.05	6.93			
	13:00	420 (7hrs)	31.14	7.02			
		450	31.21	7.09			
	14:00	480 (8hrs)	31.26	7.14			
		510	31.32	7.2			
	15:00	540 (9hrs)	31.38	7.26			
		570	31.42	7.3			
	16:00	600 (10hrs)	31.47	7.35			
		630	31.52	7.4			
	17:00	660 (11hrs)	31.55	7.43			
		690	31.6	7.48			
	18:00	720 (12hrs)	31.62	7.5			

PUMPING TEST DATA SHEET

Location : CURRAGHA **Borehole name : GSI OW No.1** **Date : 19-09-95**

Test : Recovery Data from GSI OW No.1

Duration : 9hrs. Weather : Fine

Distance from Pumping Well : 36.3m. Well depth : 53m.

Height of datum point above ground level : 0.15m Datum Point : Top of casing.

Date	Time	Time since pumping ended (min.)	Water level below datum (metres)	Drawdown (metres)	Discharge m3/d	Temperature C	Conductivity uS/cm @20 C
19-09-95	21:00	0	28.25	4.03			
		0.5	28.21	3.99			
		1	28.18	3.96			
		1.5	28.15	3.93			
		2	28.13	3.91			
		2.5	28.11	3.89			
		3	28.08	3.86			
		3.5	28.07	3.85			
		4	28.05	3.83			
		4.5	28.03	3.81			
		5	28.02	3.8			
		6	27.98	3.76			
		7	27.96	3.74			
		8	27.93	3.71			
		9	27.91	3.69			
		10	27.89	3.67			
		12	27.84	3.62			
		14	27.8	3.58			
		16	27.76	3.54			
		18	27.76	3.54			
		20	27.68	3.46			
		22	27.67	3.45			
		24	27.59	3.37			
		26	27.56	3.34			
		28	27.52	3.3			
		30	27.49	3.27			
		35	27.41	3.19			
		40	27.32	3.1			
		45	27.26	3.04			
		50	27.18	2.96			
		55	27.12	2.9			
	22:00	60	27.06	2.84			
		75	26.94	2.72			
		90	26.7	2.48			
		105	26.56	2.34			
	23:00	120	26.43	2.21			
		135	26.29	2.07			
		150	26.18	1.96			
		165	26.08	1.86			
	24:00	180	25.96	1.74			
		200	25.82	1.6			
		220	25.69	1.47			
20/09/95	01:00	240	25.56	1.34			
	02:00	300	25.22	1			
	03:00	360	24.93	0.71			
		525	24.28	0.06			
	06:00	540	24.22	0			

PUMPING TEST DATA SHEET

Location : CURRAGHA **Borehole name : PW No.1 (now abandoned)**

Test : Drawdown Data from PW No.1** Weather : Fair **Date: 07/08/84**

Duration : 72hrs Well depth : 41m

Date	Time	Time since pumping began (min.)	Water level below datum (metres)	Drawdown (metres)	Discharge m3/d	Conductivity uS/cm @20 C
07-08-84	15:30	0	1.38	0	2090	
		0.5	4.27	2.89		
		1	5.18	3.8		
		1.5	5.68	4.3		
		2	5.92	4.54		
		2.5	6.16	4.78		
		3	6.33	4.95		
		3.5	6.55	5.17		
		4	6.69	5.31		
		4.5	6.78	5.4		
		5	6.92	5.54		
		6	7.12	5.74		
		7	7.29	5.91		
		8	7.39	6.01		
		9	7.51	6.13		
		10	7.63	6.25	2090	
		12	9.11	7.73	2618	
		14	9.52	8.14		
		16	9.7	8.32		
		18	9.86	8.48		
		20	10	8.62		
		22	10.21	8.83		
		24	10.44	9.06		
		26	10.6	9.22		
		28	10.73	9.35		
		30	10.84	9.46		
		35	11.11	9.73		
		40	11.32	9.94		
		45	11.5	10.12		
		50	11.66	10.28		
		55	11.82	10.44		
	16:30	60 (1hr)	11.91	10.53		
		75	12.28	10.9		
		90	12.53	11.15		
		105	12.65	11.27		
	17:30	120 (2hrs)	12.9	11.52		
		150	12.96	11.58		
	18:30	180 (3hrs)	13.39	12.01		
		210	13.65	12.27		
	19:30	240 (4hrs)	13.8	12.42		
	20:30	300 (5hrs)	14.1	12.72		
	21:30	360 (6hrs)	14.37	12.99		
	22:30	420 (7hrs)	14.78	13.4	2618	
	23:30	480 (8hrs)	15.09	13.71	2618	
08-08-84	00:30	540 (9hrs)	15.28	13.9		
	01:30	600 (10hrs)	15.4	14.02		
	03:30	720 (12hrs)	15.8	14.42		
	05:30	840 (14hrs)	16.16	14.78		
	07:30	960 (16hrs)	16.43	15.05		
	09:30	1080 (18hrs)	16.5	15.12		
	11:30	1200 (20hrs)	16.67	15.29		
	15:30	1440 (24hrs)	16.66	15.28		
	17:30	1560 (26hrs)	16.78	15.4		
	19:30	1680 (28hrs)	16.86	15.48		
	22:30	1860 (31hrs)	17.08	15.7		
	23:30	1920 (32hrs)	17.18	15.8		
09-08-84	01:30	2040 (34hrs)	17.3	15.92		
	03:30	2160 (36hrs)	17.33	15.95		
	09:30	2520 (42hrs)	17.59	16.21		
	15:30	2880 (48hrs)	17.58	16.2		
	21:30	3240 (54hrs)	18.84	16.46		
10-08-84	03:30	3600 (60hrs)	18.1	16.72		
	09:30	3960 (66hrs)	18.2	16.82		
	15:30	4320 (72hrs)	18.29	16.91	2618	

PUMPING TEST DATA SHEET

Location : CURRAGHA **Borehole name : TW No.1 *** **Date : 07-05-84**

Test : Drawdown Data from TW No.1 * Weather : Fine

Duration Time : 71hrs Well depth : 40m

Height of datum point above ground level : ? Datum Point : ?

Date	Time	Time since pumping began (min.)	Water level below datum (metres)	Drawdown (metres)	Discharge m3/d	Temperature C	Conductivity uS/cm @20 C
07-05-84	14:00	0	0.75	0	1560		
		0.5	3.53	2.78			
		1	4.22	3.47			
		1.5	4.51	3.76			
		2	4.78	4.03			
		2.5	4.95	4.2			
		3	5.09	4.34			
		3.5	5.23	4.48			
		4	5.34	4.59			
		4.5	5.44	4.69			
		5	5.57	4.82			
		6	5.72	4.97			
		7	5.86	5.11			
		8	5.97	5.22			
		9	6.09	5.34			
		12	6.09	5.34			
		14	6.45	5.7			
		16	6.62	5.87			
		18	6.78	6.03			
		20	6.91	6.16			
		22	7.05	6.3			
		24	7.28	6.53			
		26	7.38	6.63			
		28	7.49	6.74			
		30	7.6	6.85			
		35	7.82	7.07			
		55	8.45	7.7	1560		
	15:00	60 (1hr)	8.58	7.83	1855		
		60.5	9.34	8.59			
		61	9.36	8.61			
		61.5	9.23	8.48			
		62	9.04	8.29			
		62.5	8.89	8.14			
		63	8.79	8.04			
		63.5	8.69	7.94			
		64.5	8.93	8.18			
		65	8.67	7.92			
		86	9.9	9.15			
		88	9.94	9.19			
		90	9.98	9.23			
		95	10.07	9.32			
		100	10.15	9.4			
		105	10.2	9.45	1855		
		110	10.33	9.58	1855		
		115	10.4	9.65			
	16:00	120 (2hrs)	10.53	9.78			
		150	10.94	10.19			
		165	11.05	10.3			
	17:00	180 (3hrs)	11.13	10.38			
		210	11.33	10.58			
	18:00	240 (4hrs)	11.34	10.59			
	19:00	300 (5hrs)	11.43	10.68			
	20:00	360(6hrs)	11.48	10.73			
	21:00	420 (7hrs)	11.55	10.8			
	22:00	480 (8hrs)	11.81	11.06			
	23:00	540 (9hrs)	11.91	11.16			
08-05-84	24:00	600 (10hrs)	11.9	11.15			
	01:00	660 (11hrs)	12	11.25			
	03:00	780 (13hrs)	12.14	11.69			
	05:00	900 (15hrs)	12.25	11.5			

PUMPING TEST DATA SHEET

Location : CURRAGHA **Borehole name : TW No.1 *** **Date : 07-05-84**

Test : Drawdown Data from TW No.1 * Weather : Fine

Duration Time : 71hrs Well depth : 40m

Height of datum point above ground level : ? Datum Point : ?

Date	Time	Time since pumping began (min.)	Water level below datum (metres)	Drawdown (metres)	Discharge m3/d	Temperature C	Conductivity uS/cm @20 C
	07:00	1020 (17hrs)	12.44	11.69			
	09:00	1140 (19hrs)	12.48	11.73			
	11:00	1260 (21hrs)	12.6	11.85			
	12:00	1320 (22hrs)	12.89	12.14			
	17:00	1620 (27hrs)	12.87	12.12			
	19:00	1740 (29hrs)	13.02	12.27			
	22:00	1920 (32hrs)	13.02	12.27			
	23:00	1980 (33hrs)	13.07	12.32			
09-05-84	01:00	2100 (35hrs)	13.12	12.37			
	03:00	2220 (37hrs)	13.34	12.59			
	09:00	2580 (43hrs)	13.47	12.72			
	15:00	2940 (49hrs)	13.69	12.84			
	21:00	3300 (55hrs)	12.77	12.92			
10-05-84	03:00	3660 (61hrs)	14	13.25			
	09:00	4020 (67hrs)	14.11	13.36			
	13:00	4260 (71hrs)	14.19	13.44	1855		

* TW No. 1 is now called PW No. 2.

PUMPING TEST DATA SHEET

Location : CURRAGHA **Borehole name : PW No.2** **Date : 19-09-95**

Test : Recovery Data from PW No.2 Weather : Fine

Duration : 9hrs. Well depth : 43.5m.

Height of datum point above ground level : 0m Datum Point : Inside rim of manhole cover.

Date	Time	Time since pumping ended (min.)	Water level below datum (metres)	Drawdown (metres)	Discharge m3/d	Temperature C	Conductivity uS/cm @20 C
19-09-95	21:00	0	34.5	10.6			
		0.5	32.1	8.2			
		1	31.9	8			
		1.5	31.6	7.7			
		2	31.3	7.4			
		2.5	31.1	7.2			
		3	30.95	7.05			
		3.5	30.8	6.9			
		4	30.7	6.8			
		4.5	30.58	6.68			
		5	30.48	6.58			
		6	30.3	6.4			
		7	30.1	6.2			
		8	29.96	6.06			
		9	29.85	5.95			
		10	29.72	5.82			
		12	29.5	5.6			
		14	29.33	5.43			
		16	29.15	5.25			
		18	29	5.1			
		20	28.85	4.95			
		22	28.7	4.8			
		24	28.52	4.62			
		26	28.45	4.55			
		28	28.35	4.45			
		30	28.29	4.39			
		35	28.03	4.13			
		40	27.84	3.94			
		45	27.73	3.83			
		50	27.59	3.69			
		55	27.44	3.54			
	22:00	60 (1hr)	27.36	3.46			
		75	27.04	3.14			
		90	26.75	2.85			
		105	26.54	2.64			
	23:00	120 (2hrs)	26.4	2.5			
		135	26.21	2.31			
		150	26.06	2.16			
		165	25.95	2.05			
	24:00	180 (3hrs)	25.78	1.88			
		200	25.54	1.64			
		220	25.49	1.59			
20/09/95	01:00	240 (4hrs)	25.35	1.45			
	02:00	300 (5hrs)	24.98	1.08			
	03:00	360 (6hrs)	24.65	0.75			
		525	23.96	0.06			
	06:00	540 (9hrs)	23.9	0			

PUMPING TEST DATA SHEET

Location : CURRAGHA **Borehole name : PW No.2 #** **Date : 27-10-87**

Test : Drawdown Data from PW No.2 #
Weather :

Duration : 72hrs
Well depth : 43.5m

Height of datum point above ground level : ?
Datum Point : ?

Date	Time	Time since pumping began (min.)	Water level below datum (metres)	Drawdown (metres)	Discharge m3/d	Temperature C	Conductivity uS/cm @20 C
27-10-87		0	11.85	0			
		1	24.98	13.13			
		2	30.75	18.9			
		3	32.85	21			
		5.3	33.15	21.3			
		8	33.15	21.3			
		10	33.15	21.3			
		13	33.15	21.3			
		15	22.21	10.36			
		18	22.65	10.8			
		21	22.6	10.75			
		22	22.6	10.75			
		24	22.5	10.65			
		26	22.6	10.75			
		28	22.65	10.8			
		30	22.75	10.9			
		35	22.75	10.9			
		52	22.33	10.48			
		60 (1hr)	22.79	10.94			
		75	22.68	10.83			
		90	22.87	11.02			
		105	22.73	10.88			
		120 (2hrs)	22.79	10.94			
		150	22.89	11.04			
		180 (3hrs)	28.35	16.5			
		210	28.68	16.83			
		240 (4hrs)	28.78	16.93			
		300 (5hrs)	29.18	17.33			
		360 (6hrs)	28.94	17.09			
		420 (7hrs)	29.16	17.31			
		660 (11hrs)	29.78	17.93			
		1020 (17hrs)	30.44	18.59			
		1320 (22hrs)	30.35	18.5			
		1380 (23hrs)	30.59	18.74			
28-10-87		1440 (24hrs)	30.55	18.7			
		1560 (26hrs)	30.49	18.64			
		1680 (28hrs)	30.48	18.63			
		1860 (31hrs)	30.48	18.63			
		2100 (35hrs)	30.22	18.37			
		2640 (44hrs)	30	18.15			
29-10-87		2940 (49hrs)	29.88	18.03			
		3240 (54hrs)	29.8	17.95			
		3600 (66hrs)	29.97	18.12			
		4165	30.18	18.33			
30-10-87		4320 (72hrs)	30.4	18.55			

PW No. 2 is now called PW No. 1.

PUMPING TEST DATA SHEET

Location : CURRAGHA **Borehole name : GSI OW No.1** **Date : 20-09-95**

Test : Drawdown Data from GSI OW No.1 while PW No.2 is pumping.

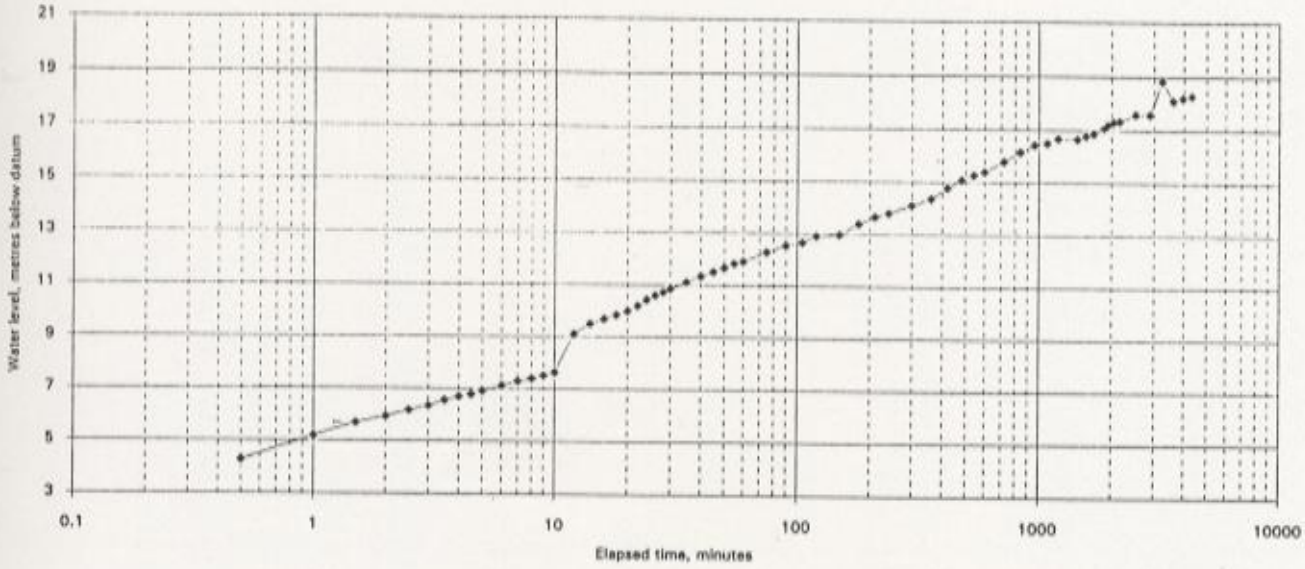
Duration : 12hrs. Weather : Fine

Distance from Pumping Well : 36.3m. Well depth : 53m.

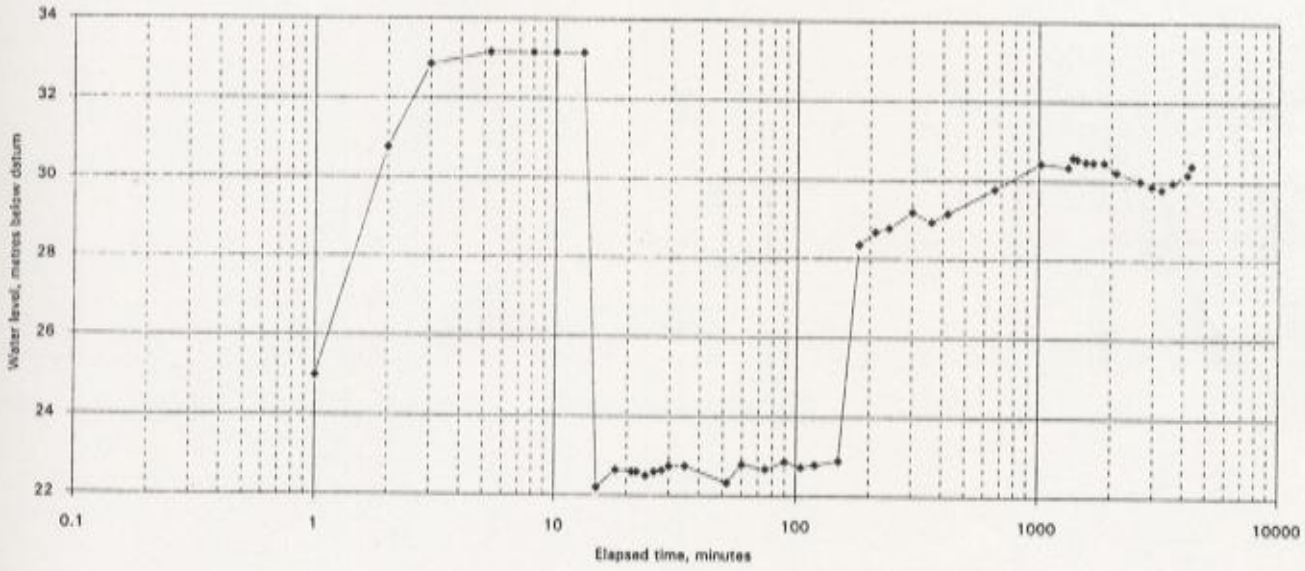
Height of datum point above ground level : 0.15m Datum Point : Top of casing.

Date	Time	Time since pumping began (min.)	Water level below datum (metres)	Drawdown (metres)	Discharge m3/d	Temperature C	Conductivity uS/cm @20 C
20-09-95	06:00	0	24.22	0			
		0.5	24.29	0.07			
		1	24.36	0.14			
		1.5	24.42	0.2			
		2	24.5	0.28			
		2.5	24.55	0.33			
		3	24.58	0.36			
		3.5	24.6	0.38			
		4	24.67	0.45			
		4.5	24.7	0.48			
		5	24.75	0.53			
		6	24.77	0.55			
		7	24.8	0.58			
		8	24.87	0.65			
		9	24.9	0.68			
		10	24.93	0.71			
		12	24.98	0.76			
		14	25.04	0.82			
		16	25.1	0.88			
		18	25.14	0.92			
		20	25.18	0.96			
		22	25.23	1.01			
		24	25.24	1.02			
		26	25.28	1.06			
		28	25.32	1.1			
		30	25.35	1.13			
		35	25.43	1.21			
		40	25.48	1.26			
		45	25.54	1.32			
		50	25.58	1.36			
		55	25.64	1.42			
	07:00	60 (1hr)	25.69	1.47			
		75	25.81	1.59			
		90	25.93	1.71			
		105	26.06	1.84			
	08:00	120 (2hrs)	26.13	1.91			
		140	26.25	2.03			
		150	26.3	2.08			
		165	26.37	2.15			
	09:00	180 (3hrs)	26.43	2.21			
		200	26.53	2.31			
		220	26.61	2.39			
	10:00	240 (4hrs)	26.67	2.45			
		270	26.76	2.54			
	11:00	300 (5hrs)	26.84	2.62			
		330	26.92	2.7			
	12:00	360 (6hrs)	26.98	2.76			
		390	27.05	2.83			
	13:00	420 (7hrs)	27.11	2.89			
		450	27.16	2.94			
	14:00	480 (8hrs)	27.21	2.99			
		510	27.26	3.04			
	15:00	540 (9hrs)	27.3	3.08			
		570	27.33	3.11			
	16:00	600 (10hrs)	27.38	3.16			
		630	27.42	3.2			
	17:00	660 (11hrs)	27.44	3.22			
		690	27.48	3.26			
	18:00	720 (12hrs)	27.52	3.3			

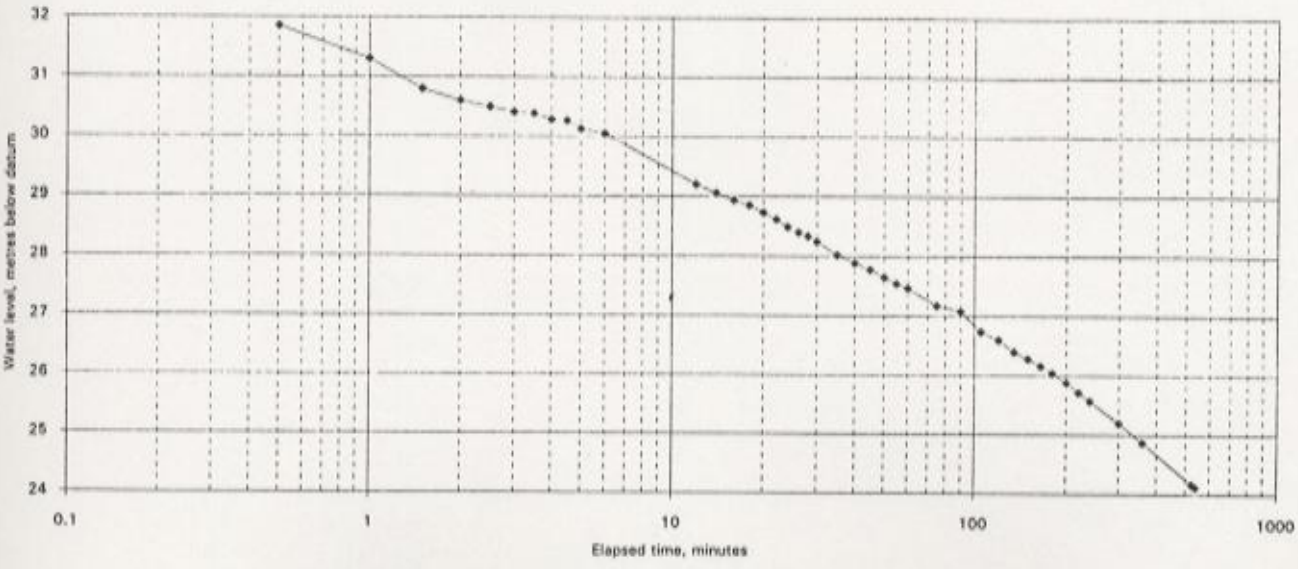
Curragha pumping test PW No.1, 7 August '84



Curragha pumping test PW No. 2, 27 October '87



Curragha recovery test PW No.1, 19 September '95



PUMPING TEST DATA SHEET

Location : CURRAGHA Borehole name : PW No.1 Date : 20-09-95

Test : Drawdown Data from PW No.1 while PW No.2 is pumping.

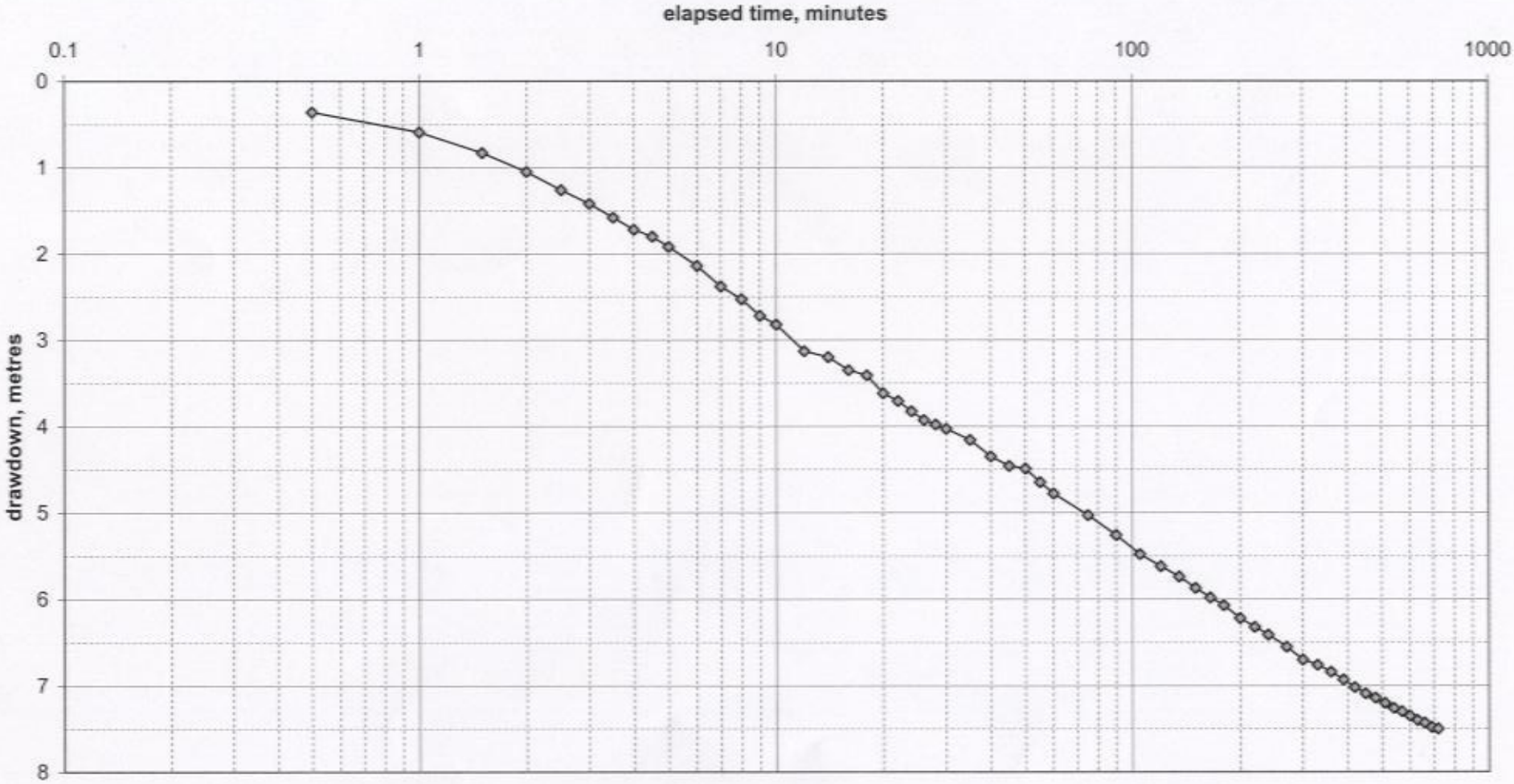
Duration Time : 12hrs. Weather : Fine

Distance from Pumping Well : 5m. Well depth : 40m.

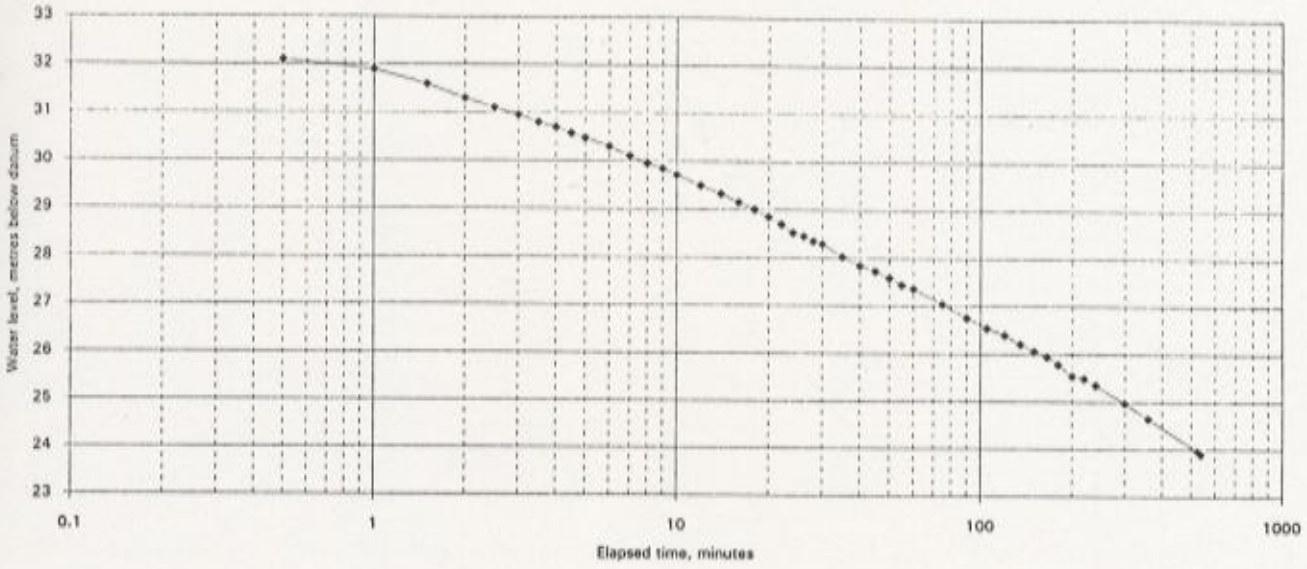
Height of datum point above ground level : 0.03m Datum Point : Wooden plank across manhole.

Date	Time	Time since pumping began/ended	Water level below datum (metres)	Drawdown (metres)	Discharge m3/d	Temperature C	Conductivity µS/cm @20 C
20-09-95	06:00	0	24.12	0			
		0.5	24.48	0.36			
		1	24.71	0.59			
		1.5	24.95	0.83			
		2	25.17	1.05			
		2.5	25.38	1.26			
		3	25.54	1.42			
		3.5	25.7	1.58			
		4	25.84	1.72			
		4.5	25.92	1.8			
		5	26.04	1.92			
		6	26.26	2.14			
		7	26.5	2.38			
		8	26.65	2.53			
		9	26.84	2.72			
		10	26.94	2.82			
		12	27.25	3.13			
		14	27.32	3.2			
		16	27.47	3.35			
		18	27.53	3.41			
		20	27.74	3.62			
		22	27.83	3.71			
		24	27.95	3.83			
		26	28.05	3.93			
		28	28.1	3.98			
		30	28.15	4.03			
		35	28.28	4.16			
		40	28.47	4.35			
		45	28.58	4.46			
		50	28.61	4.49			
		55	28.77	4.65			
	07:00	60	28.9	4.78			
		75	29.15	5.03			
		90	29.38	5.26			
		105	29.6	5.48			
	08:00	120	29.74	5.62			
		135	29.86	5.74			
		150	29.99	5.87			
		165	30.1	5.98			
	09:00	180	30.19	6.07			
		200	30.34	6.22			
		220	30.44	6.32			
	10:00	240	30.53	6.41			
		270	30.67	6.55			
	11:00	300	30.82	6.7			
		330	30.88	6.76			
	12:00	360	30.96	6.84			
		390	31.05	6.93			
	13:00	420	31.14	7.02			
		450	31.21	7.09			
	14:00	480	31.26	7.14			
		510	31.32	7.2			
	15:00	540	31.38	7.26			
		570	31.42	7.3			
	16:00	600	31.47	7.35			
		630	31.52	7.4			
	17:00	660	31.55	7.43			
		690	31.6	7.48			
	18:00	720	31.62	7.5			

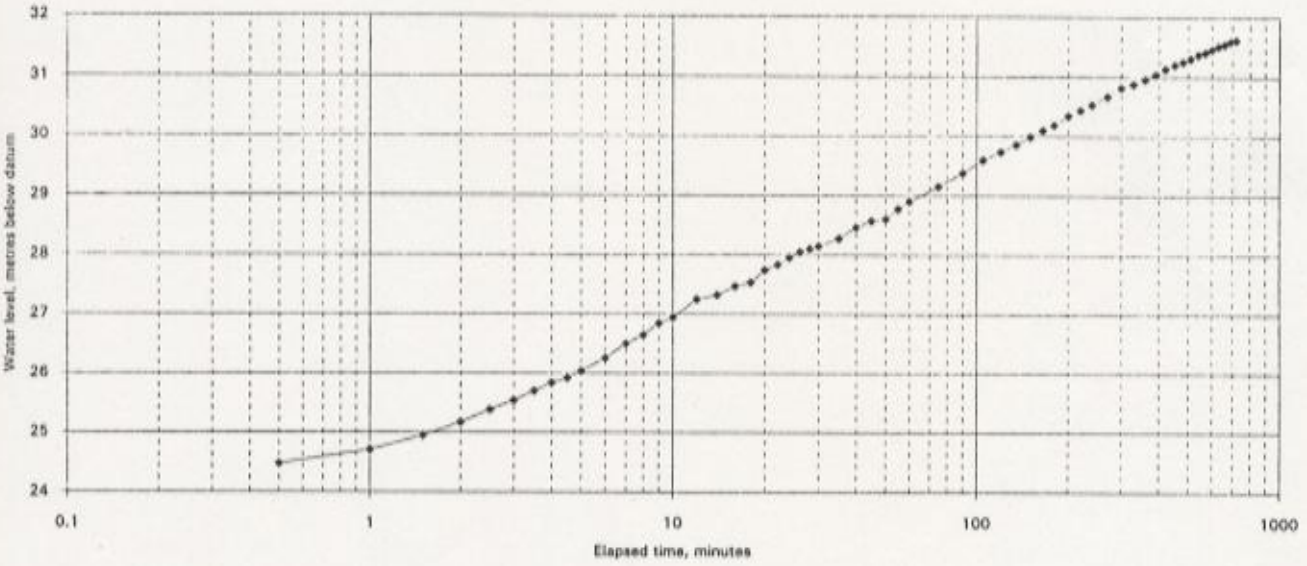
Curragha WSS, pumping test 20 September 1995
Data from PW1 (Obs Well) 5 metres from pumped well PW2



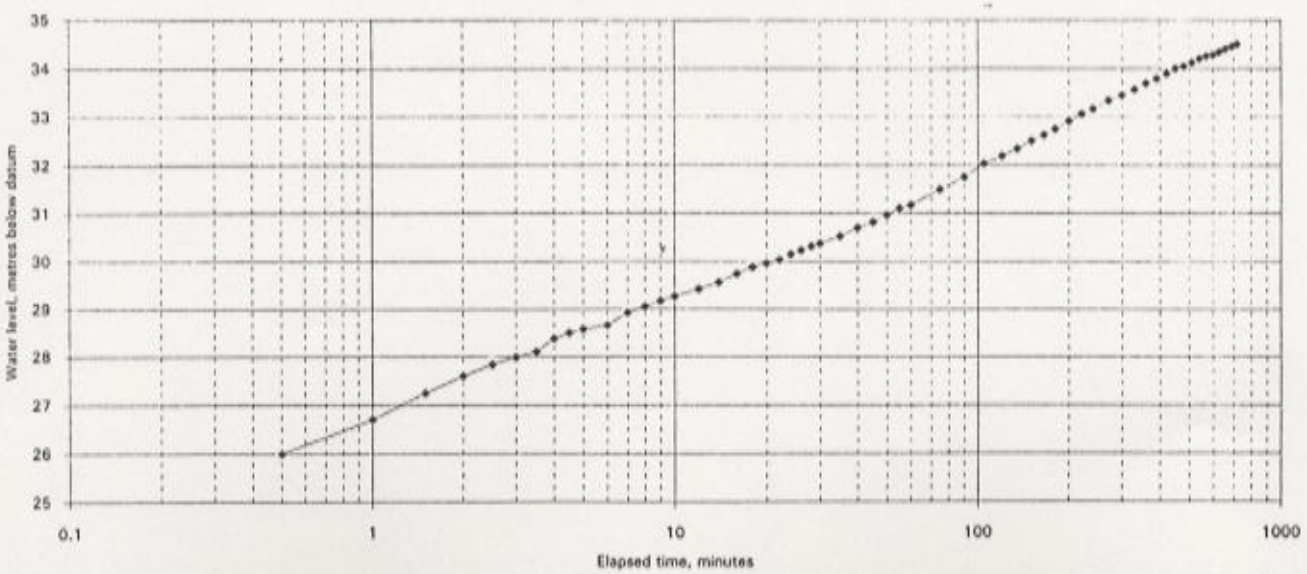
Curragha recovery test PW No.2, 19 September '95



Curragha pumping test PW No. 1, 20 September '95



Curragha pumping test PW No.2, 20 September '95



Groundwater Quality Analyses

Groundwater Source : Curragha

Sample Location : / **Date :**		*TW No.1 8/5/84	*TW No.1 10/5/84	R. Hurley 10/5/84	**PW No.1 10/8/84	***PW No.2 ??/10/87	PW No. 2 19/4/93
Parameters	**Units**						
Alkalinity	mg/l	297	291	278	296	300	
Aluminium	mg/l						
Ammonium	mg/l	0.13	0.26	0.45	0.26	<0.01	0.07
Ammonium as Nitrogen	mg/l						
Arsenic	mg/l						
Barium	mg/l						
Bicarbonate	mg/l	410	422	407	424	366	
Boron	mg/l						
Cadmium	mg/l						
Calcium	mg/l	119	118	122	122	120	
Calcium Hardness	mg/l						
Total Hardness	mg/l	336	346	334	348	330	
Chloride	mg/l	22	22	30	20	16	
Chromium	mg/l						
Copper	mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	
Cyanide	mg/l						
Electrical Conductivity	mS/cm	0.6	0.6	0.58	0.58	0.64	0.788
Fluoride	mg/l						
Iron (total)	mg/l	0.4	0.9	0.3	0.9	1.4	0.002
Lead	mg/l						
Magnesium	mg/l	9	13	7	11	7	
Magnesium Hardness	mg/l						
Manganese	mg/l	0.1	0.1	0.1	0.2	0.24	
Mercury	mg/l						
Nickel	mg/l						
Nitrate	mg/l	17.3	4.9	13.3	0.7	0.3	0.77
Nitrite	mg/l	<0.01	0.03	0.16	<0.002	<0.01	0
pH		7.2	7.6	7.6	6.9	7	6.8
Phosphate	mg/l						
Phosphorus	mg/l						
Potassium	mg/l	1.3	1.4	2.3	1.1	1.3	
Selenium	mg/l						
Silver	mg/l						
Sodium	mg/l	9	10	9	11	7.8	
Strontium	mg/l						
Sulphate	mg/l	37	32	28	32	40	
Temperature	C	11	11		11		14
Total dissolved solids	mg/l						
Zinc	mg/l						
Total Coliforms	/100 m	0	0	25	0	0	0
E. coli	/100 m	0	0	25	0	0	0

* TW No. 1 is now called PW No.2
** PW No. 1 is now abandoned
*** PW No. 2 is now called PW No. 1

Groundwater Quality Analyses

Groundwater Source : Curragha

Sample Location :	**	PW No. 2	PW No. 2	PW No.2	PW No.2	PW No.2	PW No.2
Date :		17/6/93	17/8/93	20/3/95	12/6/95	25/9/95	8/1/96
Parameters	**Units**						
Alkalinity	mg/l			326	324	318	312
Aluminium	mg/l			<0.02	<0.02	<0.02	<0.02
Ammonium	mg/l	0.09	0.007				
Ammonium as Nitrogen	mg/l			0.045	0.064	0.065	0.076
Arsenic	mg/l			<0.25		<0.05	<0.05
Barium	mg/l			0.071	0.083	0.083	0.09
Bicarbonate	mg/l						
Boron	mg/l			0.06	<0.02	0.026	0.036
Cadmium	mg/l			<0.025	<0.025	<0.005	<0.005
Calcium	mg/l			100	131	126	152.3
Calcium Hardness	mg/l			250	327	315	380
Total Hardness	mg/l			335	375	365	434
Chloride	mg/l			19.9	17.3	15.7	21.5
Chromium	mg/l			<0.025	<0.025	<0.005	<0.005
Copper	mg/l			<0.01	<0.01	<0.005	<0.005
Cyanide	mg/l			<0.01	<0.01	<0.01	<0.01
Electrical Conductivity	mS/cm	0.788	0.773	0.786	0.734	0.736	0.811
Fluoride	mg/l			<0.25	0.27	0.26	<0.25
Iron (total)	mg/l	0.001	0.001	0.075	1.153	1.2	1.201
Lead	mg/l			<0.25	<0.25	<0.02	<0.02
Magnesium	mg/l			21.1	12	12.2	13.13
Magnesium Hardness	mg/l			87	49	50	54
Manganese	mg/l			0.1	0.322	0.296	0.336
Mercury	mg/l						<0.02
Nickel	mg/l			<0.05	<0.05	<0.01	0.017
Nitrate	mg/l	0	0.08	<0.1	<0.1	<0.1	<0.1
Nitrite	mg/l	<0.01	<0.01	<0.1	<0.1	<0.1	<0.1
pH		7.7	7.21	7	7.2	7.2	6.8
Phosphate	mg/l			<0.5	<0.5	<0.5	<0.5
Phosphorus	mg/l			<0.25	<0.25	<0.25	<0.25
Potassium	mg/l			1.5	1.4	1	1.413
Selenium	mg/l						<0.05
Silver	mg/l			<0.01	<0.01	<0.005	<0.005
Sodium	mg/l			16.8	10.1	11.39	10.98
Strontium	mg/l			1.23	0.672	0.654	0.738
Sulphate	mg/l			100.5	74	62	99.9
Temperature	C	15	12	10.2	11.5	12	10.7
Total dissolved solids	mg/l			586	572	548	613
Zinc	mg/l			<0.01	<0.01	0.016	0.028
Total Coliforms	/100 ml		0	0	0	0	3
E. coli	/100 ml		0	0	0	0	0

** PW No. 2 was originally the Trial Well TW No. 1

Appendix 2
Maps


Co. Dublin
Calp Limestone
North
BALTRASNA
BORRASTOWN
KNAVINSTOWN
CORICKSTOWN
BALBLY
Curragha
St. Andrew's R. C. Ch.
Parochial Ho.
Cricketown House
Cricketown Cottage
Kilbride House
Laurel Mount
The Bungalow
Liable to Floods
Blackwater Br.
Scale: 6 Inches to 1 Mile
CURRAGHA GROUNDWATER SOURCE PROTECTION
Public supply wells
Geological Boundary
Geological Fault
Direction and Dip of Bedding
FIG. 1 GEOLOGY


North
Co. Dublin
Limestone Till
Lacustrine Clay
Lacustrine Clay/ Marl
Co. Dublin
Limestone Till
Co. Dublin
Limestone Till
Co. Dublin
Limestone Till
Lacustrine Clay
Limestone Till
Lacustrine Clay/ Marl
Limestone Till
Lacustrine Clay/ Marl
Co. Dublin
Lacustrine Clay
Limestone Till
Limestone Till
Limestone Till
Scale: 6 Inches to 1 Mile
CURRAGHA GROUNDWATER SOURCE PROTECTION
Subsoil boundaries
Outcrop
Quarry (used or disused)
FIG. 2 SUBSOILS

FIG. 3 DEPTH TO BEDROCK

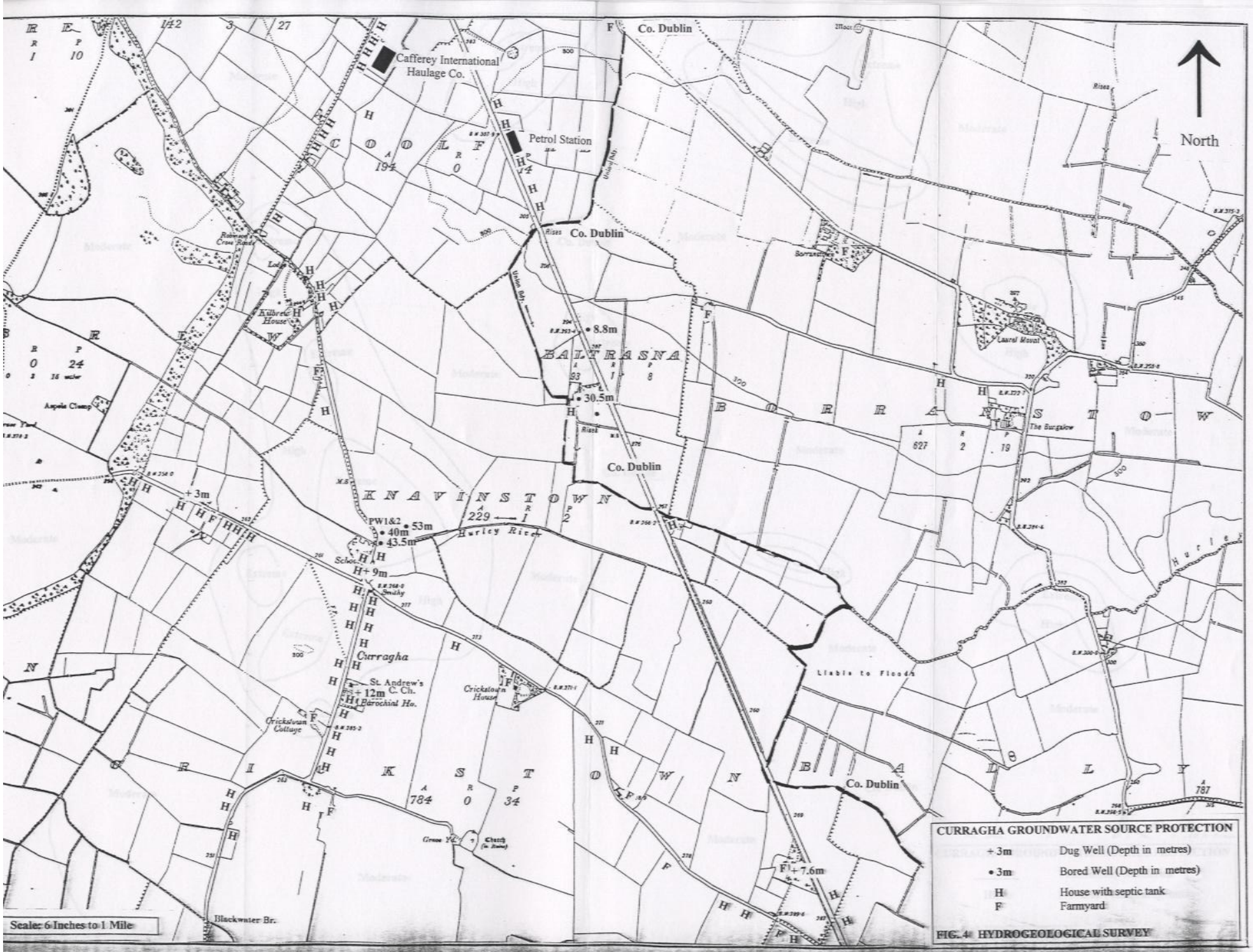
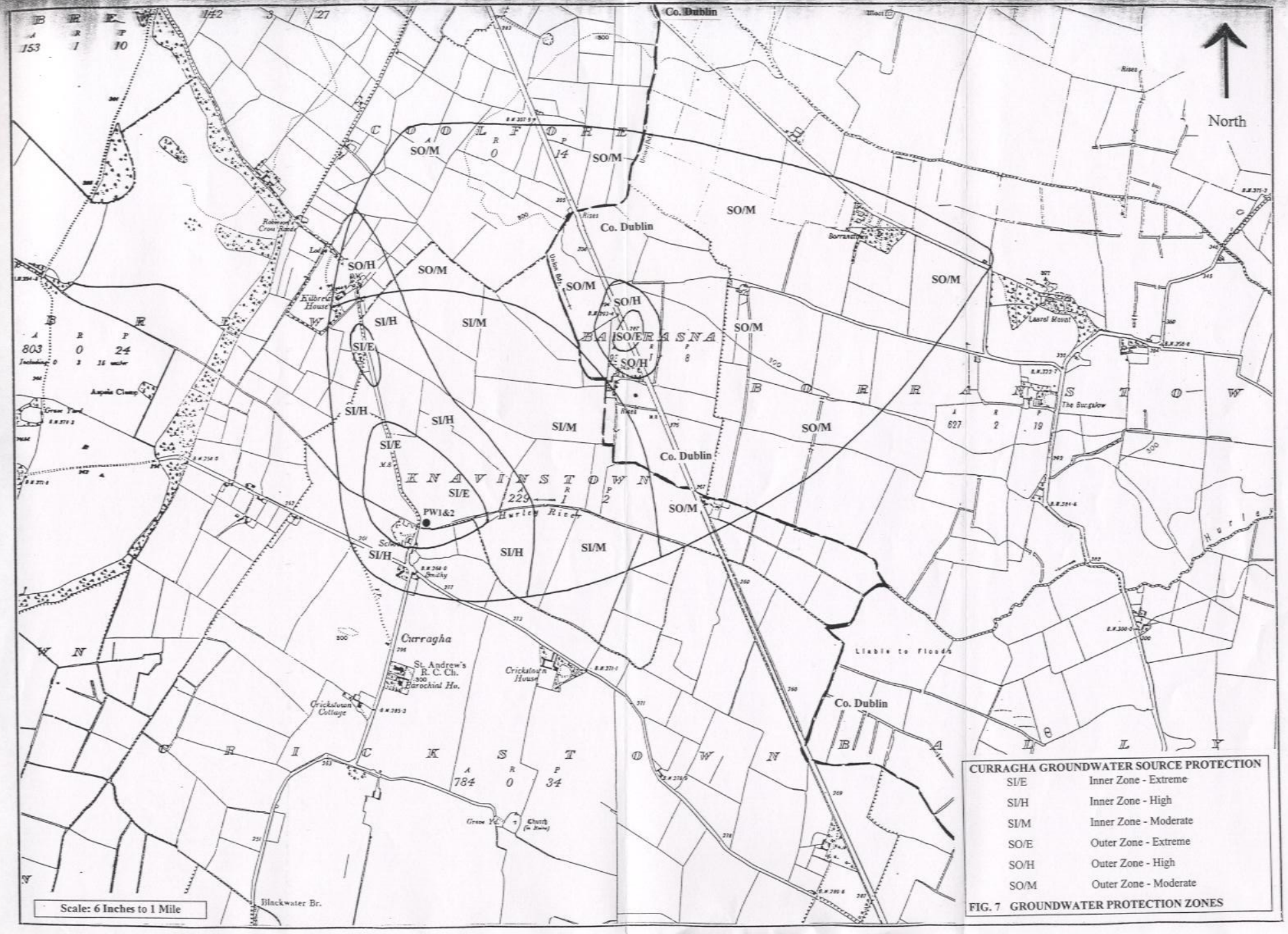


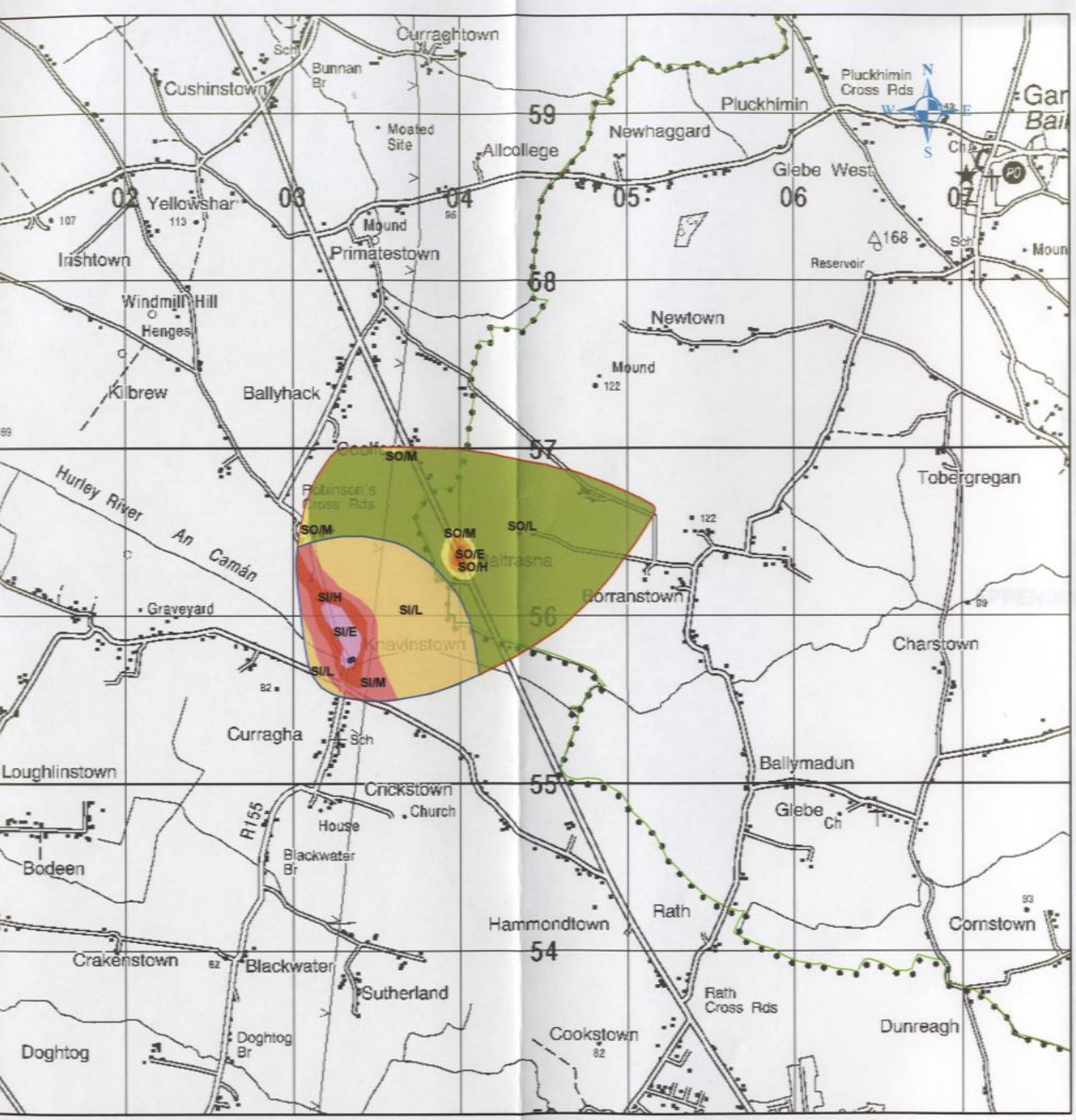
FIG. 4 HYDROGEOLOGICAL SURVEY

CURRAGHA GROUNDWATER SOURCE PROTECTION
Vulnerability boundaries
High
Probable Vulnerability Rating
FIG. 5 VULNERABILITY
Scale: 6 Inches to 1 Mile
North
Co. Dublin
Extreme
High
Moderate
PW1&2
Curragha
St. Andrew's R. C. Ch.
Parochial Ho.
Crickstown House
Crickstown Cottage
School
Smithy
Hurley River
Liable to Floods
Blackwater Br.
Laurel Mount
The Bungalow
Kilbrew House
Lodge
Aspole Clump
KNAVINSTOWN
COOLFORE
BALTRASNA
BORRANSTOW
CRICKSTOWN


North
Co. Dublin
Co. Dublin
Co. Dublin
Co. Dublin
COLFORE
BALTRASNA
BORRANSTOWN
KNAVINSTOWN
CRICKSTOWN
BALDLY
PW1&2
School
Smithy
Curragha
St. Andrew's R. C. Ch.
Parochial Ho.
Crickstown House
Crickstown Cottage
Kilbrew House
Robinson's Cross Roads
Lodge
Laurel Mount
The Bungalow
Hurley River
Liable to Floods
Blackwater Br.
Grave Yd.
Church
Scale: 6 Inches to 1 Mile
CURRAGHA GROUNDWATER SOURCE PROTECTION
Zone of Contribution (with buffer)
100 Day Time of Travel Distance

FIG.6 ZONE OF CONTRIBUTION AND 100 DAY TIME OF TRAVEL


North
Co. Dublin
SO/M
SO/H
SI/H
SI/E
SI/M
BALLYBODEN
BERRYSTOWN
KNAVINSTOWN
CRICKSTOWN
BALLY
Curragha
PW1&2
Hurley River
Liable to Floods
St. Andrew's R. C. Ch.
Parochial Ho.
Cricketown House
Cricketown Cottage
Blackwater Br.
Scale: 6 Inches to 1 Mile
CURRAGHA GROUNDWATER SOURCE PROTECTION
SI/E Inner Zone - Extreme
SI/H Inner Zone - High
SI/M Inner Zone - Moderate
SO/E Outer Zone - Extreme
SO/H Outer Zone - High
SO/M Outer Zone - Moderate
FIG. 7 GROUNDWATER PROTECTION ZONES



COUNTY MEATH
GROUNDWATER PROTECTION SCHEME
SOURCE PROTECTION ZONES

Vulnerability Rating	Source Protection Zones	
	Inner (SI)	Outer (SO)
Extreme (E)	SI/E	SO/E
High (H)	SI/H	SO/H
Moderate (M)	SI/M	SO/M
Low (L)	SI/L	SO/L

- Zone of Contribution of Wells (SO)
- Inner protection area (SI)
- County Boundary
- Public Supply Well

Project Hydrogeologist: Coran Kelly
Project Manager: Geoff Wright
Digital Map Production: Silvia Caloca

This Source Protection Zone map is designed for general information and strategic planning usage. The boundaries are based on the available evidence and local details have been generalised to fit the map scale. Evaluation of specific sites and circumstances will normally require further and more detailed assessements and will frequently require site investigations to determine the risk to groundwater.

The map is intended for use in conjunction with groundwater protection responses for potentially polluting activities, which lists the degree of acceptability of these activities in each zone and describes the control measures necessary to prevent pollution.

GEOLOGICAL SURVEY OF IRELAND
Suirbhéireacht Gheolaíochta Éireann
Beggars Bush, Haddington Rd, Dublin 4

Curragha

1:25,000

0 0.5 1 2 Kilometres