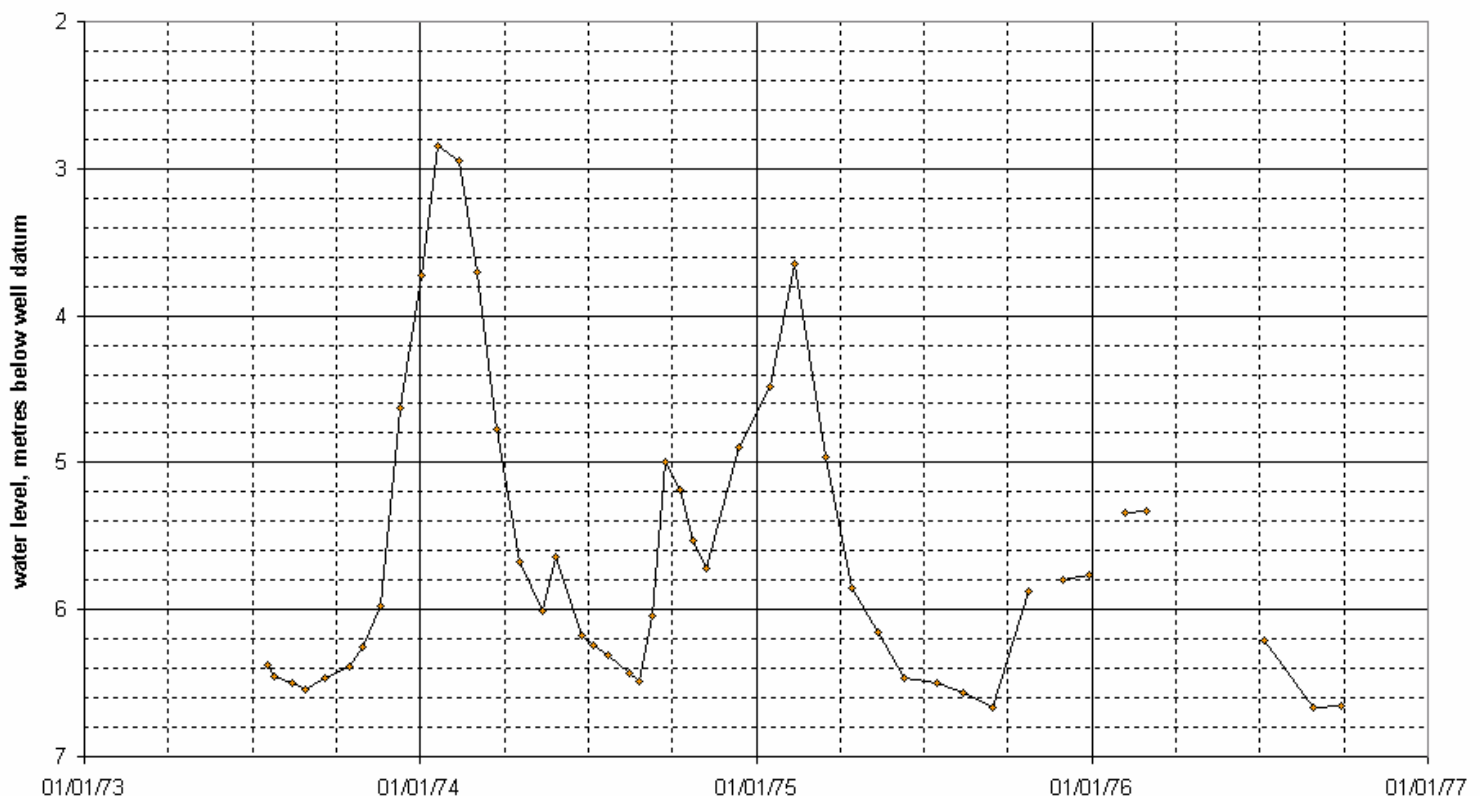


### Durrow GWB: Summary of Initial Characterisation.

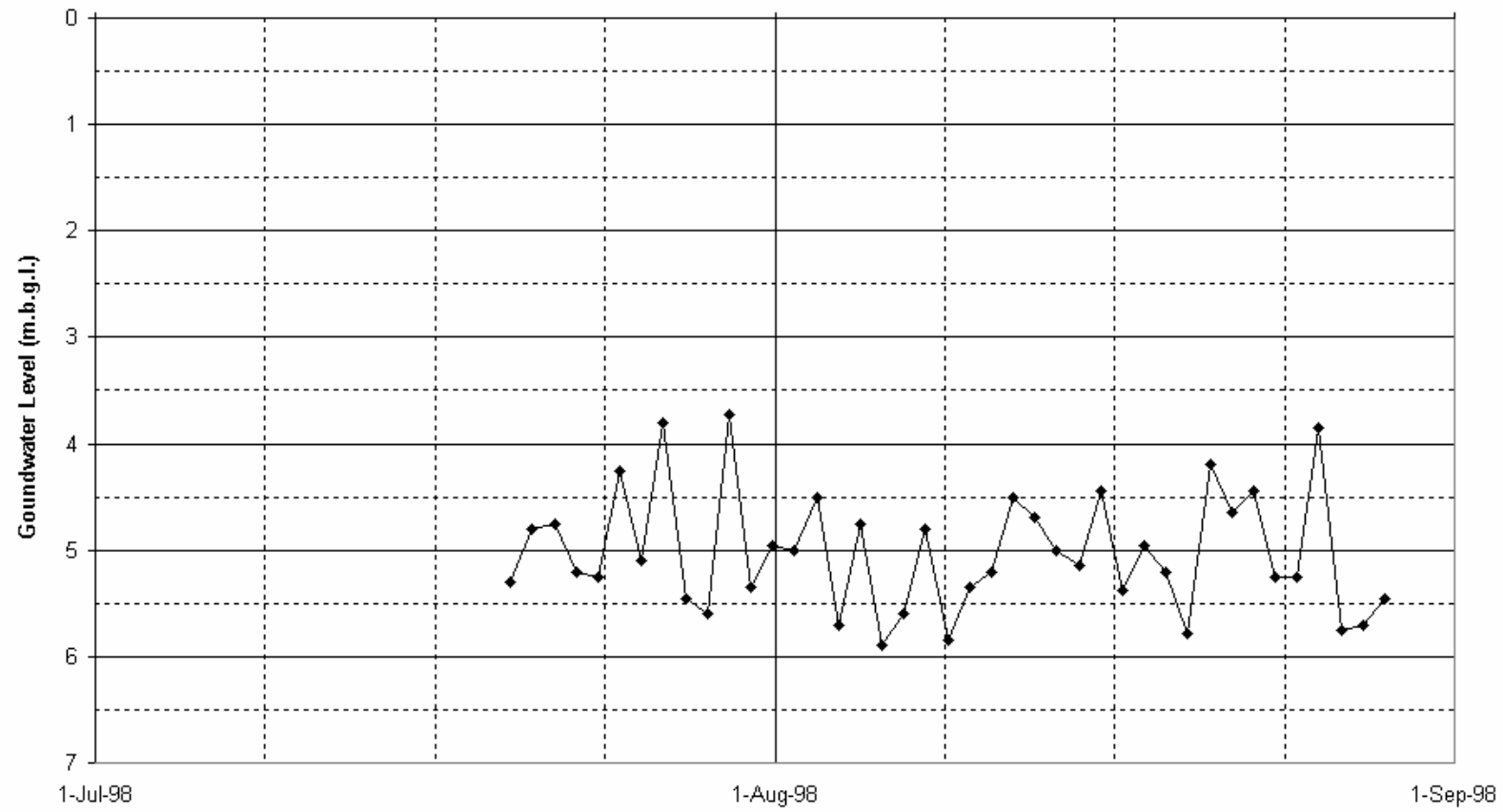
Hydrometric Area Local Authority		Associated surface water bodies	Associated terrestrial ecosystems	Area (km <sup>2</sup> )
15 – Nore Kilkenny Co Co Laois Co Co Tipperary Co Co		Goul, Nuenna, Gorteenahilla, Arigna, Lisdowney Stream, Nore, Erkina, Gully, Owveg,	The Loughans, Inchbeg, Ardloo Fen, River Nore/Abbeyleix Woods Complex.	217
<b>Topography</b>		Cullahill Mountain, which is located at the centre of the body, dominates the topography of this area. The hills, whose elevations reach up to 350m OD, are actually outside the groundwater body but the surface drainage from these hills flows towards this body.		
<b>Geology and Aquifers</b>	Aquifer type(s)	<b>Rk:</b> Regionally Important Karstified Aquifer.		
	Main aquifer lithologies	BM: Ballyadams Formation - Pale-grey thick-bedded pure fossiliferous limestone. CL: Clogrenan Formation - Thinly bedded bluish-grey pure limestones, regularly cherty. Both formations comprise pure limestones, with beds becoming slightly thinner and somewhat cherty in the Clogrenan.		
	Key structures.	The pure nature of the limestone means that the deformation brought about by the Variscan folding episode will have resulted in extensive brittle fracturing.		
	Key properties	As with most karstic systems, permeability and transmissivity data are very variable. Daly (1994) cites a range in permeability of 0.1 m/day to 100 m/day, and a range in transmissivity of 5 m <sup>2</sup> /day to 3000 m <sup>2</sup> /day. Groundwater gradients are ??????		
	Thickness	Karstification is predominantly a near-surface phenomenon, and is likely to concentrate within 20 m of the top of the rock in this formation (Cawley, 1990). Most groundwater flow is likely to be concentrated in this upper zone; E.P. Daly (1994) estimated that the maximum saturated and permeable part of the aquifer is 75 m thick.		
<b>Overlying Strata</b>	Lithologies	This groundwater body is overlain by glacial till but in much of the area towards the central hills this thins to outcrop. There are also large areas of gravel deposits in the east of the body along the course of the Nore, Erkina, & Nuenna rivers.		
	Thickness	There is a thin covering of subsoil over the majority of the aquifer. The subsoil thickness increases away from the Cullahill Mountains, which lie at the centre of this groundwater body. There is a thicker layer of gravels to the east and in some areas in the north.		
	% area aquifer near surface	There is a large area of aquifer near surface towards the centre of the body.		
	Vulnerability	The vulnerability is mostly EXTREME and reduces to HIGH away from the centre of the groundwater body and also to the north.		
<b>Recharge</b>	Main recharge mechanisms	There is both diffuse and point recharge to this body. Sswallowholes are recorded southeast of Durrow at Ballynaslee, the southwest of the mountains at Sevensisters and also to the extreme southeast of the aquifer. Recharge will also occur at the contact with the Namurian shales where there are likely to be streams flowing over outcrop; such rivers may not sink completely but will lose some flow as they cross the boundary onto the limestones. The occurrence of point recharge greatly complicates the estimation of total recharge to the groundwater body.		
	Est. recharge rates	<i>[Recharge rates will be included at a later date]</i>		
<b>Discharge</b>	Springs and large known abstractions	Tullore (Ballyroan WS) (450), Cloghoe (Ballinakill WS) (100), Fermoyle (Durrow/Ballinakill WS) (164), Durrow Convent (Durrow WS) (159), Kildrinagh, Woodsgift, St. Patrick's Well, Clonmantagh (Spring), Clomantagh, Carrigeen (Threecastle Farms (23)), Ballyconra (Avenmore Creamery- 3409), Ballyragget WS (590), Durton WS (Spring - 320),		
	Main discharge mechanisms	The aquifer discharges via numerous large springs close to the main river channels or directly into the rivers. In a mathematical analysis of the spring and stream flows in the Nuenna Valley, Cawley (1990) describes a significant portion (??%) of the groundwater discharge from this karstic area, particularly in winter, as "quickflow". This is essentially conduit flow and confirms the visual and other evidence of this type of flow in this aquifer.		
	Hydrochemical Signature	Waters are typically 'hard' to 'very hard', with a neutral pH and calcium and bicarbonate as the dominant ions. This signature is thought to reflect the generally shallow nature of flows within the karst aquifer. The average conductivity is 643 µs/cm. The aquifer is <b>Calcareous</b> .		
<b>Groundwater Flow Paths</b>		In karstic areas, groundwater flow velocities can be tens of metres per hour. Though the groundwater flow system is karstic, Cawley's 1990 study of 43 wells in the aquifer showed that a continuous watertable does exist, indicating that flow in the aquifer may be through a diffuse network of conduits. Due to the predominance of conduit flow in karst systems, large fluctuations in watertable levels are expected, particularly in areas of elevated topography. These very high annual fluctuations are considered indicative of relatively low groundwater storage potential.		

<b>Groundwater &amp; surface water interactions.</b>	Where the aquifer occurs close to the surface, stream densities are low. Surface water sinks underground in many areas where the aquifer is at surface e.g. sinking streams in the Borrismore and Nuenna catchments, near Freshford. Cawley (1990) found that the upper portions of the main channels frequently go dry in the summer months. These occur where streams, flowing off areas of thicker subsoil to the west, meet an area where the karst aquifer comes very close to the surface. This aquifer makes a major contribution to the baseflow of the Nore River (Daly 1994).
<b>Conceptual model</b>	The groundwater body is defined to the southwest and northeast by the boundary of the Nore Basin. The extent of the Ballyadams and Clogrenan formations define the other boundaries of the body. The elevated areas are characterised by a thin layer of subsoil and deep water tables (up to 90m) with an annual fluctuation of 10-20m (see hydrographs for KNY 12/8 and KNY 13/42 below) and in extreme cases up to 30m. Here the bulk of groundwater flow occurs above the deepest water table level. Beneath this level the permeability and specific yield are very low. There are some large patches of dolomite particularly in these upland areas. The pure nature of the limestone also means that the rocks are susceptible to dissolution. Coupled with the probability of extensive fracturing, this means that the aquifer is likely to be karstified. This is supported by the presence of many recorded karst features. Some portions of the Ballyadams Formation are dolomitised, which is likely to enhance the development of permeability. Where the aquifer is protected from dissolution by the presence of the Namurian shale above it, significant karstification and permeability is not believed to exist (Daly, E.P., 1994). Similarly, where the Namurian has been eroded away in only recent geological times, karstification and permeability are likely to be limited.
<b>Attachments</b>	GSI and EPA Well Hydrographs.
<b>Instrumentation</b>	Stream gauge: 15032, 15037, 15004, 15034, 15005, 15012, 15039 ,  EPA Borehole Hydrograph: Kildrinagh Cross (KIK110 - S336598), Freshford to Johnstown Rd.(KIK108 - S313660), Ballyragget Glanbia Factory (KIK104 - S438718), Attanagh (LAO063 - S440761),  GSI Borehole Hydrograph : Durrow (LS 29/1 - S408771), Grenan (LS 35/23 - S430761), Cloghmantagh Lowe (KNY 13/42 - S397640) , Tubbrid (KNY 12/34 - S342620), Borrismore Creek (KNY 12/8 - S330615),  EPA Representative Monitoring boreholes: Clomantagh (#42 - 352632),
<b>Information Sources</b>	
<b>Disclaimer</b>	Note that all calculation and interpretations presented in this report represent estimations based on the information sources described above and established hydrogeological formulae

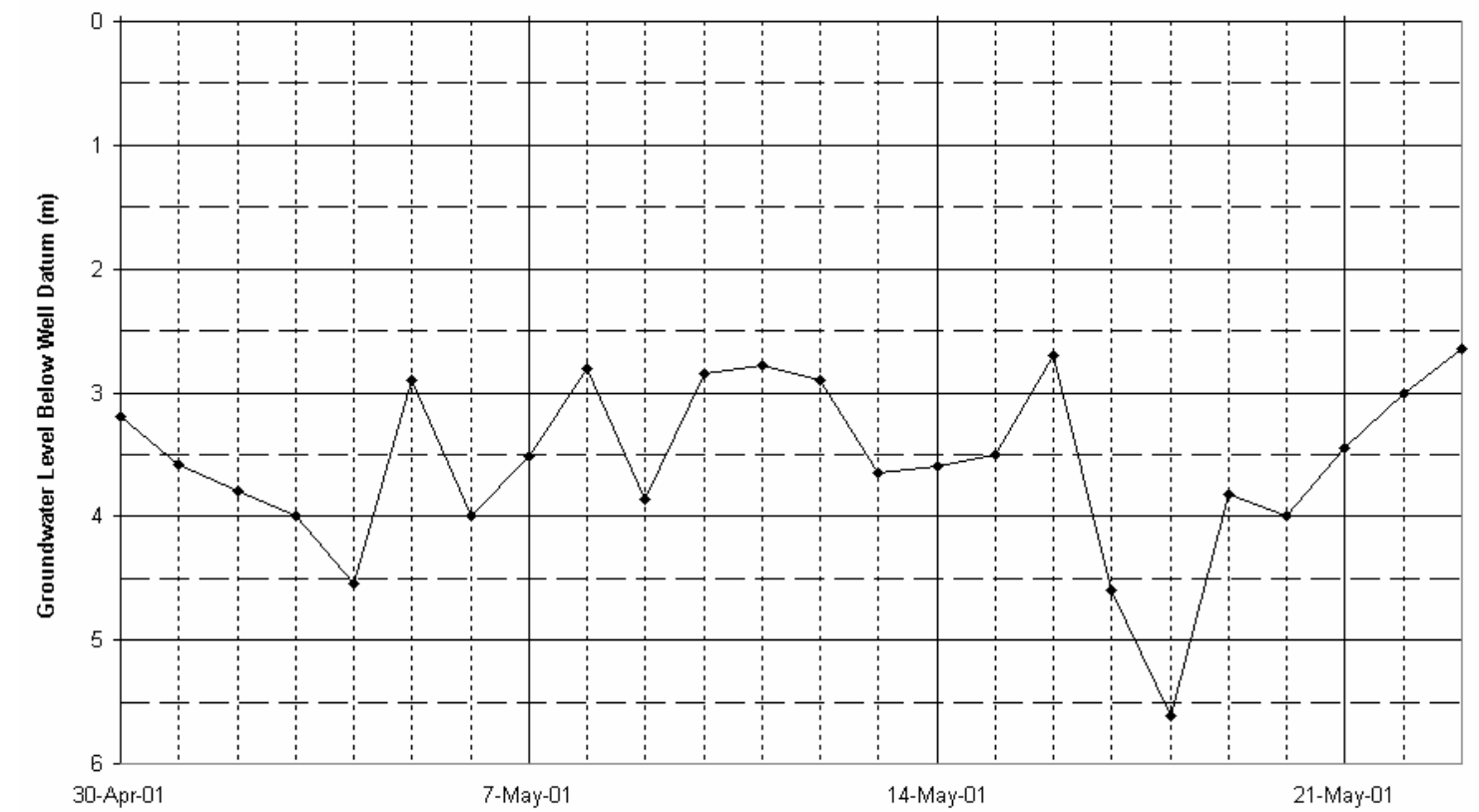
**GSI Well Hydrograph, LS 29/1**



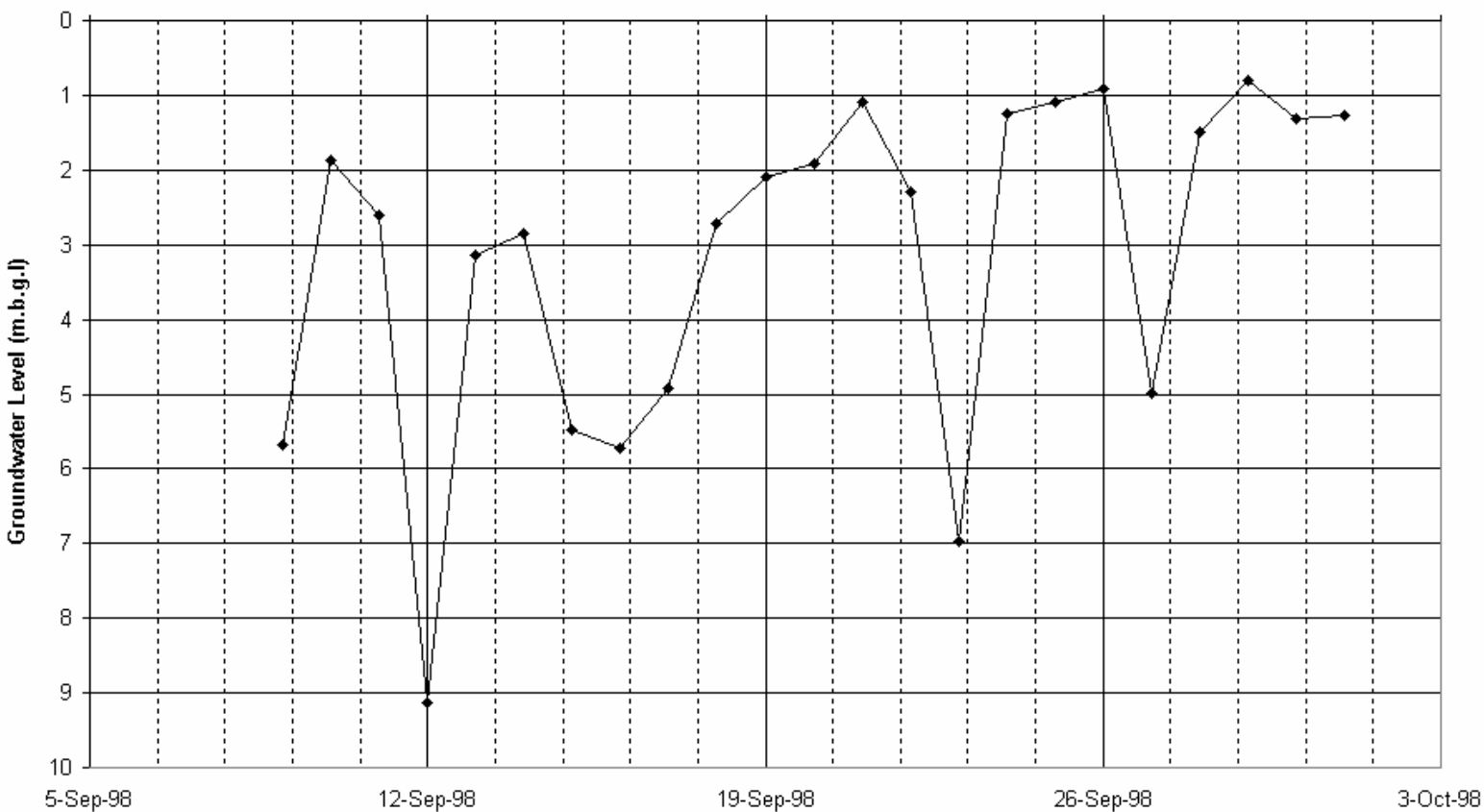
Well Hydrograph at EPA Station LAO063



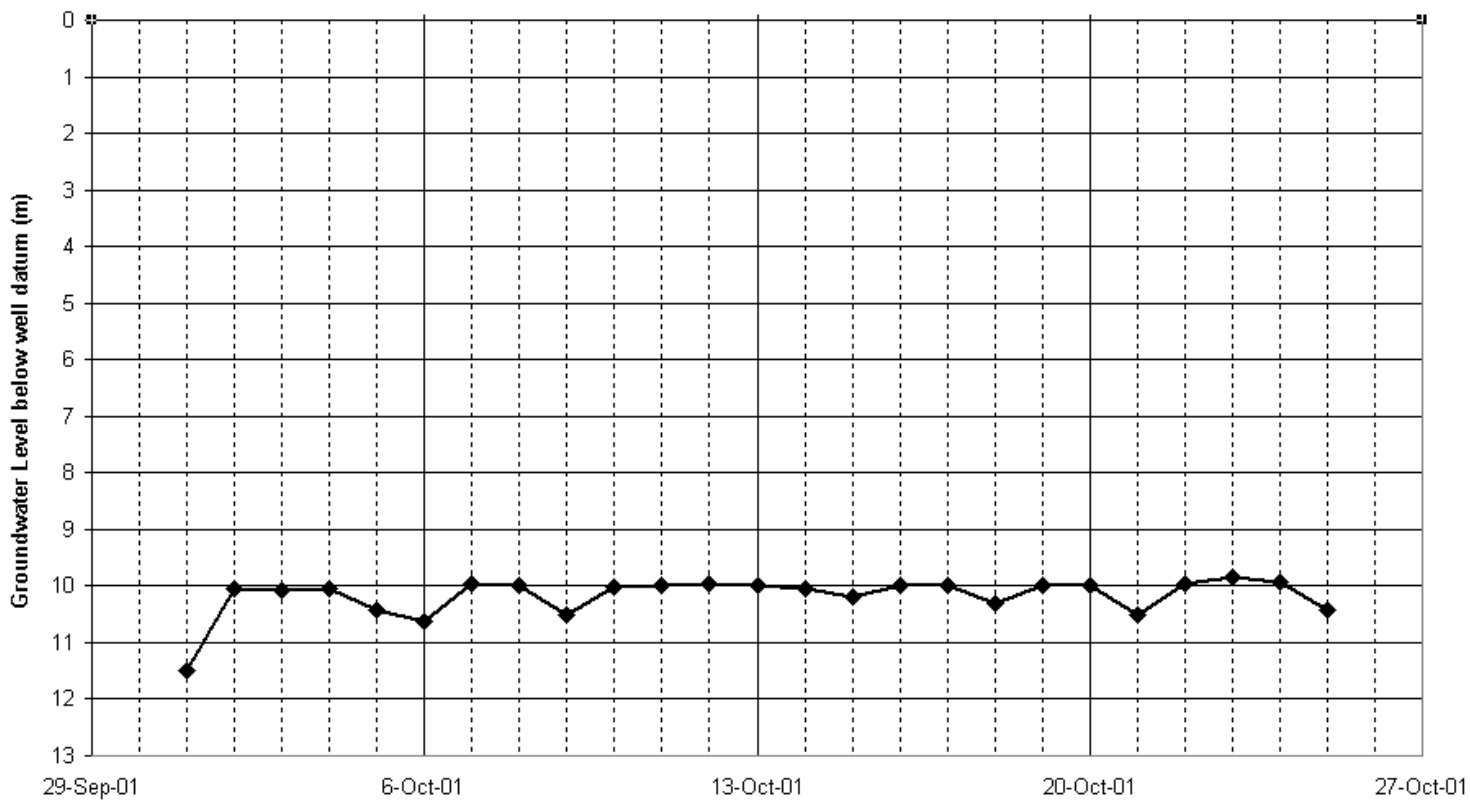
Well Hydrograph for EPA Station KIK104



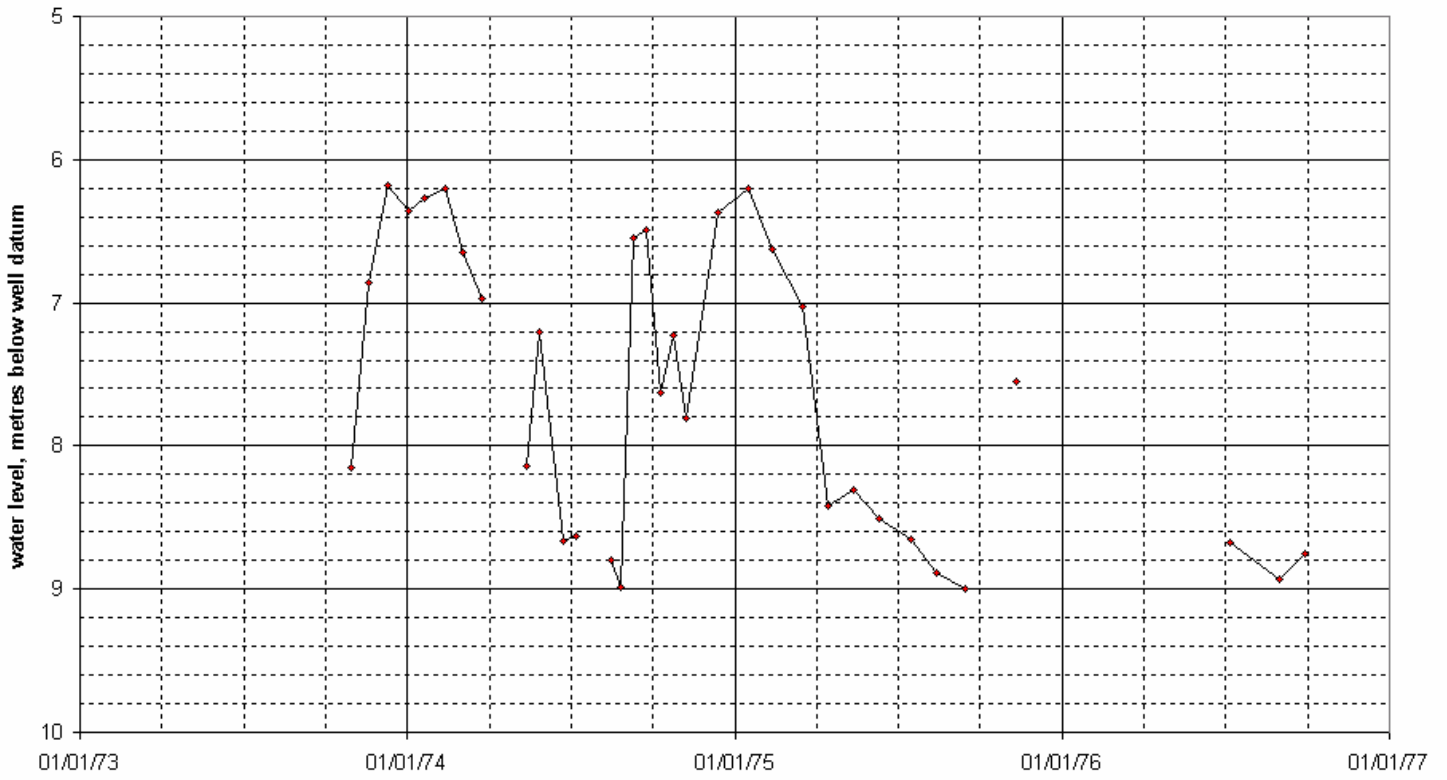
Well Hydrograph at EPA Station KIK110



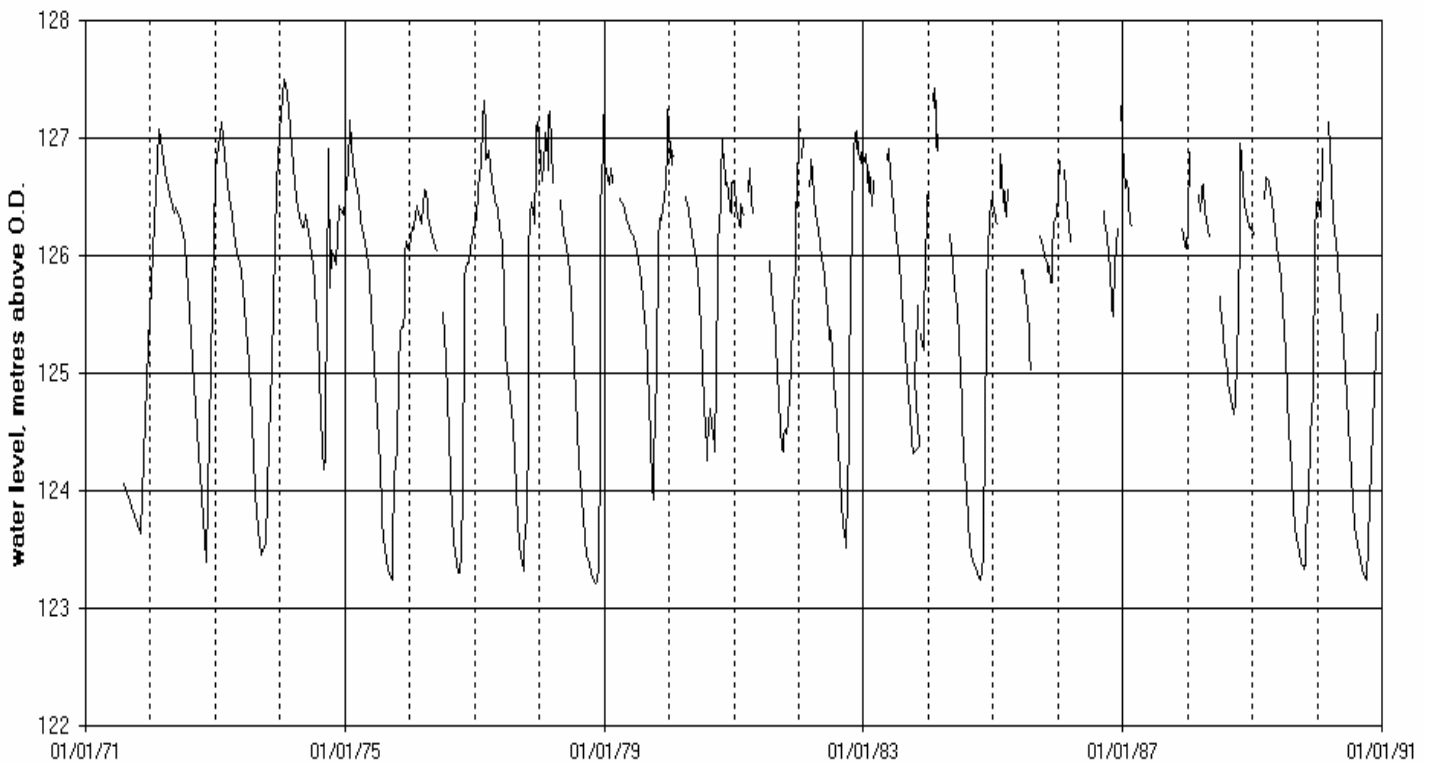
Well Hydrograph at EPA Station KIK108



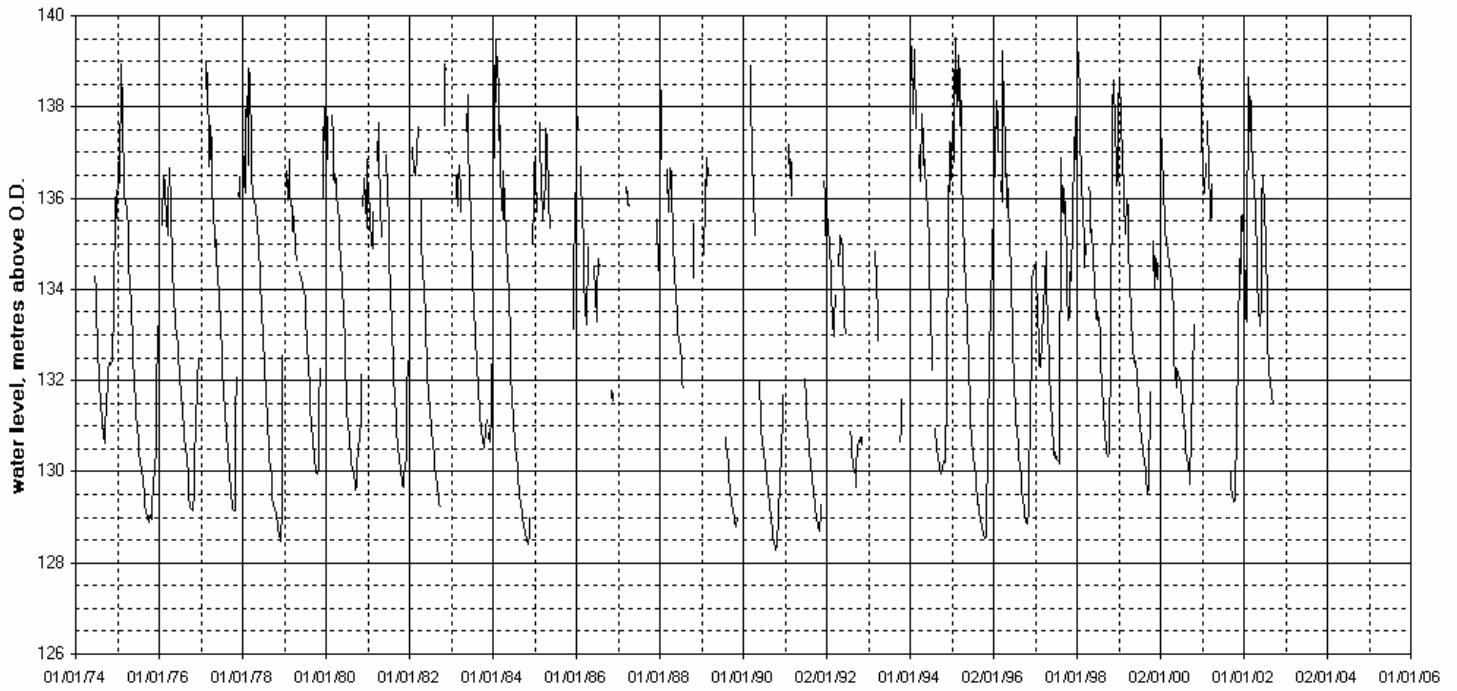
Well Hydrograph, LS 35/23



Well Hydrograph, Tubbrid,  
KNY 12/34, NGR S 342 620.  
12.65m deep borehole. 2315NWW056. Ballyadams-Nuenna



Well Hydrograph, Borrismore Creek Borehole,  
Woodsgift, Kilkenny 12/8, NGR S 330 615. Ballyadams Fm.



Well Hydrograph, Cloghmantagh Lower,  
KNY 13/42, NGR S 397 640,  
57m deep in Ballyadams Limestone. 2315NWW057

