REPORT

Maelor Foods Ltd

Pumping Test Report and Hydrogeological Impact Assessment

No. 2 Production Borehole 2025

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Executive Summary

Following an Appeal Maelor Foods Ltd have been granted Planning Permission to increase production at their Cross Lanes Site to 2 x 10^6 chickens/week. As a consequence, the water demand will increase to 2,700 m^3/day, 976Ml/year.

The present plant has a net water consumption of 9.1 ltr/bird. The future water demand will be 18,200 m^3/week, or 2,700 m^3/day, based on pumping 7 days/week.

The present water supply is from a borehole (No.1 Production Borehole) drilled into the Triassic Sandstones, and which produces 1350 m^3/day. Abstraction is authorised by Abstraction Licence No. WA/067/0007/015/v002. This licence permits abstraction of 1350 m^3/day, 400Ml/year.

To meet the increased demand a second borehole(No.2 Production Borehole), was drilled into the Triassic Sandstone, in 2025. It is located 147 m to the North West of the No.1 Production Borehole.

The new borehole is 175 m deep, and 250mm dia. It is lined with steel casing to 75 m. The Triassic sandstone was left open.

It was thought that the No.1 borehole was drilled into the Kinnerton Sandstone, which is the bottom unit of the Triassic Sandstones, however the strata penetrated in the No.2 borehole, and new geological information provided by seismic surveys, carried out during oil and gas exploration, suggest both boreholes are drilled into the Chester Pebble Beds, which is the sandstone unit above the Kinnerton Sandstone.

This is of no material consequence, as both sandstone units are important aquifers, and are in hydraulic continuity.

On completion of drilling the water levels in both production boreholes and three monitoring boreholes were measured for >28 days. During this period the No.1 Borehole was being used to full capacity of 1350 m^3/day. The monitoring demonstrated the aquifer was more than capable of supporting the existing abstraction, and there was potential for supporting increased abstraction.

A 14 day pumping test of the No.2 borehole was then carried out, at a pumping rate of 1349 m^3/day. During this test No.1 Borehole continued pumping at maximum capacity.

During this test equilibrium conditions were established after a maximum of 1.5 days, indicating that the additional abstraction was sustainable. At the end of the 14 days, the pump was switched off. Water levels were monitored and all borehole levels

recovered in under 1.5 days, again indicating that the additional abstraction is sustainable.

The possible impact of the additional abstraction on surface water features and other water supply boreholes, was examined. It was concluded that all surface water features were protected by the thick clay layers overlying the sandstone, and other known water supply boreholes were outside the area influenced by the additional abstraction.

It was concluded that abstraction of 2,700 m^3/day. 936,000 m^3/year is sustainable and will have no adverse impact on the aquifer, water features, or other abstractors. There is a beneficial effect to the River Dee, as 95% of all water abstracted is returned to it, after treatment.

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June 2026

Technical Summary

Following an Appeal Maelor Foods Ltd have been granted Planning Permission to increase production at their Cross Lanes Site to 2 x 10^6 chickens/week. As a consequence, the water demand has increased to 2,700 m^3/day, 976Ml/year.

The present plant has a net water consumption of 9.1 ltr/bird. The water demand is therefore 18,200 m^3/week, or 2,700 m^3/day, based on pumping 7 days/week.

The present water supply is from a borehole (No.1 Production Borehole) drilled into the Triassic Sandstones, and which produces 1350 m^3/day. Abstraction is authorised by Abstraction Licence No. WA/067/0007/015/v002. This licence permits abstraction of 1350 m^3/day, 400Ml/year.

To meet the increased demand a second borehole(No.2 Production Borehole). has now been drilled into the Triassic Sandstone, and which is located 147 m to the North West of the No.1 Production Borehole.

This borehole is 175 m deep, and 250mm dia. It is lined with steel casing to 75 m. The sandstone was left open.

The exposed strata below the casing is hard Pebbly sandstone to 152 m, at which point there was a marked change to soft fine grained sandstone, with no Pebbles. There was a zone between 116 and 124 mBD where there were significant drilling fluid losses. A similar zone was encountered at 121mBD when No.1 borehole was drilled. Pebbles were also recorded in the No.1 Borehole.

Descriptions of the Kinnerton Sandstone in the British Geological Survey Memoirs for the area[3], describe it as being pebble free. However, The Chester Pebble Beds, which is the unit immediately above the Kinnerton Sandstone, is described as "Pebbly red-brown sandstones, argillaceous sandstones and sandy mudstones". This description fits the sandstone encountered to full depth in No.1 Borehole and to 152 m in No.2 Borehole. It is possible that the site has been incorrectly mapped.

Seismic work undertaken in oil and gas exploration in the area by Triton Resources suggest that the mapped line and angle of dip are incorrect. This work suggests the line of dip is nearly due east, rather than south southeast, and the angle of dip is 22^o, not 10^o.
There is also the suggestion that there is significant unmapped faulting. Any, or all of these factors could account for incorrect mapping, particularly as the bedrock is confined over a wide area.

Hydrogeologically, if it is incorrectly mapped it is of little practical importance as all the units are connected by the high permeability weathered zone at the top.

During June and July 2025, tests were carried out to confirm the long term performance of No.1 borehole, and prove the sustainable capacity of No.1 borehole.

Initially No.1 borehole was run at full capacity, of 1350 m^3/day 5.5 days/week for 28 days. The effect on aquifer water levels were monitored in 3 other boreholes, all within 220 m of No.1 borehole. Water levels were also monitored in a borehole drilled into the overlying drift on the site, the river Dee, and at Blackrock Farm, which is approximately 1,200 m to the west.

This monitoring showed that, when No.1 borehole was switched on the water level dropped rapidly, by about 21 m, it then stabilised after about 1 day and remained steady for the remaining 4+ days. When the pump was switched off it recovered to very nearly the pre 2018 level, and was still rising, when the pump was switched back on. This shows that the aquifer is in equilibrium, and water levels stable. There has been no permanent lowering of the water table.

The cyclical pattern of pumping was evident in the 3 other aquifer monitoring boreholes, to varying degrees, dependant on the distance from No.1 borehole. The pumping cycle was not present in the level trace, of the drift borehole water level, or the river Dee. Both are protected from any effect by the overlying clay layers.

Normally water levels start to decline in May, and in fact the drift water level and the river Dee were declining, at a rate of c12 mm/day. Nos 1 &2 boreholes, and the closes observation borehole were still rising very slowly, indicating the recharge was exceeding abstraction. The data from an NRW observation borehole sited approximately 2km to the North West was examined, and the water level was declining throughout the end of May to the end of July, confirming the usual seasonal trend applied outside the site monitoring area..

Analysis of the data from the No.1 borehole showed that the drop in water level when the pump was running, had reduced from 29 to 21 m. The value of transmissivity had also doubled. This suggests development of flow paths in the bedrock.

Following the 28 day monitoring period, a 14 day constant rate test was conducted on No.2 borehole. The No. 1 Borehole was running throughout this period. It was intended to shut No. 1 down and run the factory on the water pumped from No.2, to test it independently. Unfortunately, preliminary quality tests suggested that there was a slight difference in quality, which the water treatment plant would struggle to handle. It was decided to proceed with the combined Test.

During the combined test the same monitoring points were used.

Following 14 days of constant pumping, the pump was switched off and the water level in all boreholes monitored until the levels had fully recovered. A summary of the results is given in Table TS1, below:

Table TS1

Summary of Test Results.

Pumping Rates –	**No.1 Borehole**	**1350 m^3/day**
	No.2 Borehole	**1349 m^3/day**
	Combined	**2699 m^3/day**
Duration		**14 days**
Equilibrium Established After		**1 day**
Full Recovery Achieved		**1 day**
Aquifer Parameters -	**Transmissivity (Ave)**	**2404 m^2/day**
	Storage Coefficient	**8.9×10^{-2}**
	Hydraulic Conductivity	**0.795 m/day**
	Specific Capacity	**34.26 m^3/day/m**
Radius of Effect	**- Distance – Drawdown**	**450 m**
	-Maximum Calculated	**857 m**

The results of the test indicate that the two abstraction boreholes are capable of supplying 2700 m^3/day, and abstraction at this level could be sustainable.

Following completion of the test, a hydrogeological impact assessment was undertaken.

Maelor Foods Ltd site is at the base of the western slope of the Dee Valley and adjoins the river, at the western side of the site the land rises to c27mAOD, falling down to the river bank, which is a c16 mAOD. The site is surrounded by pasture and arable land, with water courses draining down to the river.

The strata sequence below the site is:

Sand & Sand and gravel

Thick Boulder Clay (Upper Boulder Clay)

Thick sand, sand and gravel with clay layers
Thick Boulder Clay (Lower Boulder Clay)

Weathered Sandstone

Solid Sandstone.

In both Production Boreholes all the strata above the solid sandstone is cased out, so water is only abstracted from the sandstone. The weathered sandstone is in continuity with the bedrock, so water will be indirectly taken from it.

The solid sandstone is made up of a sequence of layers of porous sandstone and mudstone. Because the mudstone has low permeability, water movement across the beds is very limited and effectively water only moves up, or down the individual sandstone layers, to the weathered zone which is basically a layer of sand about 10m thick, covering all the sandstone beds, and in fact connecting the sandstone units. It is generally of high permeability, allowing water movement in all directions, distributing water to the individual sandstone Units and beds.

Rain falling in the area will soak into the surface sand and gravel. Most of the rain will run off down dikes etc to the river, but some will pass through the upper boulder clay layer through holes in it, or where it is absent, into the middle sand and gravel.

The middle sand and gravel acts as a reservoir, which feeds the river via dikes, and again some will pass through holes in the lower boulder clay, into the weathered zone, for distribution to the individual sandstone beds.

The main areas where there are holes in the Boulder Clays, or it is missing, are on the higher ground to the west, on the higher ground up the valley slope.

In the immediate are of the site, the two Boulder clay layers are intact, and as they are impervious water will not pass through them. They therefore serve a very useful service, as they protect surface water features, dikes, ponds, streams, etc, from the effects of abstraction from the two production boreholes.

To verify that this protection was in fact in place, the water level in the middle sands and gravels was monitored, through a borehole (drift borehole) drilled close to the river Dee. There was no evidence of any effect throughout the 3 stages of the testing.

A second borehole (Deep River) drilled within 20m of the drift borehole, and monitoring the water level in the top of the sandstone and weathered sandstone, clearly showed the pattern of pumping both Production Boreholes. If the middle sands and gravels had bee affected, it would have been evident in the Drift Borehole trace.

The level in the river Dee was monitored at a point close to the Drift and Deep River Boreholes. The river runs on the Upper Boulder Clay, which provides additional protection. As expected, there was no evidence of any effect.

As indicated in table TS1 above the maximum radius of effect, has been calculated to be 857 m. Within this radius, the geological evidence suggests the two boulder clay layers are intact. As a consequence, the river Dee and surface water features are protected and will not be affected.

A water features survey identified 3 other abstractors with boreholes, and within a 1.5 km radius of the site. These were:

Name of Abstractor	Grid Reference	Distance from Pumping well (m)
Calypso Drinks	SJ 38190 48940	2,135
Cross Lanes Activity Centre	SJ 37390 46980	1,234
Black Rock Farm Abs BH	SJ 37452 47358	1,272

It was intended to monitor the water levels at the cross lane Activity Centre and Blackrock Farm, electronically. This was not possible for technical reasons. The level at Blackrock Farm was checked by manual dips.

Calypso Drinks was monitored in the 2017 and 2018 testing and no effect was detected. It was agreed it would not be monitored, on this occasion.

All Three abstractors are a long way outside the calculated radius of effect, and therefore would not be affected.

The sustainability of abstracting 936 Ml/year, at the rate of 2,700 m^3/day, has been investigated.

The standing water level in the Sandstone is c16mAOD, therefore water recharging it must be coming from land with a surface level of at least this height. A crude estimate of the area of land above this height, within a 5 km radius, and which lies above the Triassic sandstones, lying to the west and south of the site has been made and is >40km^2.

Water entering the sandstone is usually between 10 and 30% of rainfall. Using a value of 20% and rainfall of 870 mm/year. The minimum applicable recharge will be 6960 Ml/year, which is 7 times greater than proposed abstraction. It is emphasised that this is recharge applicable to the Maelor site, and not the aquifer in total. Recharge to the aquifer will be many times greater than this estimate.

The following is further evidence of sustainability:

> **During the pretest stage of the test, although No.1 Production Borehole was Pumping at the maximum rate, equilibrium conditions were reached, and the overall level trend was rising.**
>
> **During the pumping phase, with both borehole pumping at maximum rate equilibrium was established in all abstraction and monitoring boreholes within 1.5 days.**
>
> **Once the No.2 Production Borehole was shut down, water level came back to pretest levels in all boreholes, within 1.5 days.**

It is concluded that abstraction of 936Ml/year, 2700 m^3/day is sustainable.

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June 2026

Maelor Foods Ltd

Report on Testing of The New No. 2 Borehole
Maelor Foods Ltd, Pickhill Lane, Cross Lanes, Wrexham LL13 0UE and
Hydrogeological Impact Assessment

1.0 Introduction

The company process poultry at their Cross Lanes Plant. Water is required for this purpose and in 2016 a borehole (No,1 Borehole|) was drilled into the Triassic Sandstone.

A 10 day constant rate test was carried out on this borehole in November 2016 The pumping rate was 1052 m^3/day, equilibrium was established in 1.38 days, and the drawdown was 22.75 m. Full details of the test and the Hydrogeological Impact Assessment are given in the GHSCE Report dated June 2017[1].

A second Test was carried out in January 2018. This permitted the daily rate to be increased to 1350 m^3/day. This test is covered in detail in the GHSCE Report dated June 2018[2]

Abstraction is permitted under licence no.WA//067/0007/015/V002.

The existing plant processes 400,000 chickens/week, and, after deducting recirculation, has a net water use is 9.1 l/bird. Following appeal, Planning permission has been granted which allows production to increase to 2 x 10^6 birds/week

To meet the increase in water demand, a second borehole has been drilled into the same aquifer, 147 m to the NW of the No. 1 Production borehole. This borehole was drilled and tested in accordance with consent no.WA/067/0007/0022.

The agreed plan for testing was in three parts:

1.1 Assessment of the effects of Pumping No.1 Borehole

1.2 Carry out a pumping test on No. 2 borehole in isolation

1.3 Carry out a pumping test with both Nos. 1 & 2 boreholes pumping.

The assessment of the effects of No,1 borehole pumping is given in section 12 of this report.

Although it was intended to carry out an independent test of no.2 borehole, by using the water discharged from it, to feed the factory, it was not possible, as initial samples suggested that there were slight differences in water quality, which the water treatment plant may not be able to handle.

It was therefore decided to proceed with the joint test as shutting the factory down was not an option, and it was thought the water quality might change with pumping.

Details of the borehole construction, and the results of the test, are given in section “A” of this report, and the Hydrogeological Assessment is given in Section “B”

SECTION "A"

Borehole Construction and Testing

2.0 Justification of Need.

As indicated above phase 1 of the process plant handles 400,000 chickens/week for 50 weeks in the year, with actual processing taking place 5.5 days/week. The net water consumption equates to 9.1ltr/bird.

With the construction of phase 2 of the processing plant, production will increase to 2 x10^6 chickens/week. The water consumption will therefore be 18.2Ml/week. With abstraction spread over 7 days, the average daily requirement is 2,600 m^3.

The annual volume based on processing 50 weeks in the year is 910 Ml. During the remaining 2 weeks of the year there will be significant water consumption for cleaning etc.

To allow for processing , cleaning and unforeseen purposes it is proposed to apply for a licence for the following quantities:

936,000 m^3/year
3,000 m^3/day
130 m^3/hr

3.0 No. 2 Borehole – Position and Construction

3.1 Position and Summary of construction

The borehole was drilled at SJ 38617 46848, which is 147 m to the north west of the No.1 Production borehole, and is close to the site boundary. The location of the site is shown on map 1, and the position of the two production boreholes on the site are shown on Map 2.

A basic summary of the details of N0. 2 Production Borehole is :

Location	SJ 38617 46848
Datum Level	25.76. mAOD (0.3 m AGL)
Depth	175 mbd
Finished Dia.	245 mm
Final Casing Dia	274 mm
Casing Depth	75 mbd.
Water Struck	3.0 mbd
Water Level on Completion	11.4 mbd

3.2 Detail of Construction Method and Strata Penetrated

Construction of the No. 2 Production Borehole started on 2/10/2024 and was completed on 9/12/2024

The top 1.5 m was hand dug, to ensure that no unrecorded services were intercepted. From 1.5 mbd to 25mbd a rotary auger rig was used. Attempts were made to advance the borehole from 25 mbd with the auger machine, but these were unsuccessful, and the machine and method were changed to direct circulation mud flush. This system was used until competent sandstone was reached at 75 mbd. The sandstone was drilled utilising rotary water flush.

Three strings of permanent casing were installed and grouted in through a float shoe. These were:

Casing Dia (mm)	Casing Material	Depth From (MBD)	Depth to (MBD)
610	Steel (Welded)	0	22.75
406	Steel (Welded)	0	41.89
274	Steel (Welded)	0	75.0

The casing complied with BS 879

The permanent casing strings installed, the drilling method used and a summary of the strata penetrated, is shown in Fig 1. A more detailed strata description is given in the borehole record and strata log in appendix 1(Figures and Maps), and shown graphically in Fig 1A..

The 610 mm casing sealed out the Surface sand and gravel (1.5 – 9.0 mbd) and the top clay layer (9.0 – 18.5 mbd). The surface sand and gravel was variable ranging from medium gravel to fine sand. The top clay layer was also variable, from pure clay to thin layers of sand within the clay.

The 406 mm casing sealed out the middle sands and gravels, (18.5 – 43.5 mbd). Although predominantly sand there were layers of pure gravel.

It is to be noted that the water level recorded in the top sand and gravel was 3.0 mbd, where as the water level recorded in the middle sand and gravel was variable, but about 9.4 mbd. Indicating the top clay layer is of low permeability, and effectively confines the middle sand and gravel in the immediate area.

The 274 mm casing sealed out the bottom clay layer (43.5 – 64 mbd), and the transition zone/weathered top of the sandstone (64-75 mbd). The bottom clay layer started as low permeability clay (7.7 m thick), but then appeared to have an increasing number of thin sand layers, merging into the weathered sandstone at 64 mbd.

The water level in the strata below the bottom clay, could not be measured accurately as this section of the borehole was drilled using bentonite mud. There were significant Mud losses indicating high permeability.

The top 77 m of the sandstone (75 to 152 mbd) was hard and contained pebbles,. However below 152 mbd the sandstone became appreciably softer, and pebble free..

Although there was no noticeable change in the nature of the drilling, which would suggerst fracturing, or change in the speed of drilling, there were significant fluid losses between 116 and 122 mbd. This feature was also recorded in the drilling of No.1 Borehole, at 121 m, and which was recorded as being Soft Red Sandstone with Pebble Beds. This is in contrast to the description in the No.2 borehole, as being hard red sandstone. The description of "hard Sandstone", when drilling the Triassic Sandstones, often indicates the presence of faulting. Some Pebbles were present in the cuttings down to 152 mBD

The water level measured at various times during the drilling of the sandstone, and after standing for 14 hrs were as follows:

Drilling Depth (mbd)	**Water Level (mbd)**
93.5	9.9 (c15.86mAOD)
110	10.7 (c15.05mAOD)
125	11.5 (c14.26mAOD)
171	11.25 (c14.51mAOD)

On completion of drilling at 175 mbd, airlifting clear, and standing for 48 hours, the level was stable at 11.22 mbd.

These water level readings suggest the presence of low permeability layers (marl) within the sandstone.

4.0 Pumping Test

4.1 Test Procedure – Monitoring Details

A constant rate pumping test was conducted between the 29/06/2025 and 11/07/2025 immediately prior to this test, water levels were monitored for 28 days, from 29/05/2025 to 29/06/2025.

The following Water levels were monitored, using electric loggers

Borehole	**Datum (AOD)**	**NGR**	**Distance from Pumping Well (m)**
No.2 Production B/H	25.76	SJ 38617 46848	0

No. 1 Production B/H	24.68	SJ 38678 46737	127
New Car Park	27.8	SJ 38584 46884	49
River Deep	16.14	SJ 38778 46574	318
Drift	16.18	SJ 38771 46570	318

It was intended to use an electric logger to monitor the river Dee, however:

4.1.1 The level was too low to use the measuring point used in previous tests.

4.1.2 It was not possible to anchor the sensor to the river bed

4.1.3 The point where the level was measured varied, so that the water surface was as flat as possible to get an accurate reading.

4.1. 4 The dip reading was transferred to the reference point by level.

As a result, the river level was measured manually at the following intervals :

Pretest	Every two days
Pumping Phase	Daily at c8.00 am
Recovery Phase	Daily at c8.00 am

Details of the reference point are:

Monitoring Point	Datum (AOD)	NGR	Distance from Pumping Well (m)
River Dee*	15.83	SJ 38781 46559	332

At Black Rock Farm the boreholes were in use and no dip tubes are fitted. It was not possible to use electric loggers as originally intended. Regular Manual dips were therefore taken. The details of the two boreholes are:

Abstraction Borehole	SJ 37452 47358	1,272
Recharge Borehole	SJ 37462 47476	1,315

Rainfall data was obtained from the Five Fords Weather station at SJ 36143 48044, which is 2738 m from the No.2 borehole.

The water abstracted from the No1 Production borehole throughout the period of the test, was measured by the permanent meter. The water abstracted from the number 2 borehole during the constant rate test was also measured by a dedicated turbine meter.

4.2 Pretest Water Levels

As indicated above, all the boreholes, the river, and rainfall were monitored for at least 28 days prior to the start of pumping. The monitoring points are considered individually.

4.2.1 No.1 Production Borehole Graph 3

This borehole was in use throughout the pretest, pumping and recovery phases of the test. The pump runs continuously for 5.5 days, and sometimes 6 days per week at an average pumping rate of C1,350 m^3/day.

As will be seen in Fig 3, the pumping level during the week is c5.1 mBOD), recovering to c15 mAOD at the weekends. This suggests a drawdown of c 20 m. The drawdown is c21m, allowing for recovery to 2018 standing water level.

The pumping level is stable and in fact the trend line shows the average level was rising at a rate of 9mm/ day.

4.2.2 No.2 Production Borehole Graph 4

The logger in this borehole failed, and as it was strapped to the rising main immediately above the pump, it was not possible to replace itimmediately. Also, due to the size of the rising main it was not possible to install another logger to monitor this phase of the test. It was replaced for the pumping and recovery phases.

10 dip readings were taken. It will be seen from Fig 4 that when No 1 BH pump is switched off at the weekend the recovery is picked up in No.2. The graph suggests there is an effect of between 0.2 and 0.4 m. This borehole is 127 m from No. 1 Borehole. Allowing for this effect, the SWL will be c15.5 mAOD, and about the same as No.1 Production Borehole

The level at the start of pumping was 14.81 mAOD.

It is to be noted that the trend line is rising at a rate of 4mm/day.

It is also to be noted that the high permeability weathered sandstone zone is sealed out in this borehole.

4.2.3 Car Park Borehole Graph 6

As the car park borehole is 49m from the No.2 Production Borehole. It is to be noted that

4.2.3.1 The trendline suggest that the average level is rising at 1.2 mm/day

4.2.3.2 The level at the start of pumping was 14.533m AOD

4.2.3.3 The effect of pumping No.1 Production Borehole can be seen and is in the range of 0.25 to 0.35 m. The distance from No. 1 is 174 m.

The effect of pumping No.1 is basically the same as in No.2 Production Borehole but shown in more detail due to the greater density of readings.

As will be seen from the construction drawing in Appendix 1 this borehole is monitoring the water level in the high permeability weathered zone as well as the very top of the solid sandstone.

4.2.4 River Dee Graph 7

The trace of water level shows 3 distinct spikes, which are centred at approximately -38,000, -26,000, and -15,000 mins. The amplitude of these spikes is variable, but the average is about 0.4 m. As expected, they do basically match the significant rainfall events, as shown in Fig 8.There appears to be a time lag of between 4000 and 6000 mins.

There is no evidence of any effect of pumping No.1 Borehole.

It is to be noted that the trendline suggests the average river level is declining at 5 mm/day, and towards the end of the pretest period the trace steepens to 10mm/day.

4.2.5 Rainfall Graph 8

It will be seen that there was significant rainfall in the early and middle part of the pretest period (-40,000 to -15,000 mins) It was then basically dry from -15,000 mins to the start of pumping.

4.2.6 Deep River Borehole Graph 5

This borehole is drilled into the very top of the sandstone, with slotted casing at the bottom. Again, it is believed to be monitoring the weathered zone level as well as the solid sandstone level. The weathered zone is likely to be dominant.

There is significant movement in the level, with an amplitude of 0.15/0.2 m. This borehole is a similar distance from the No.1 Production Borehole (191 m) as the Car Park, and mimics the movement exactly, as will be seen in Fig 15. The level is however c0.4 m higher.

It is to be noted that the trendline is declining at the rate of 1.27 mm/day. The other three sandstone boreholes (Car Park and No.1 an No.2 Production boreholes), show a rising trend.

4.2.7 River Drift Borehole Graph 2

This borehole is monitoring the sand and grave layer encountered below18.5 mBD during drilling (Middle Sands).

The trace of the drift level is different to all the other borehole traces as:

4.2.7.1 The trendline is declining at the rate of 12 mm/day

4.2.7.2 The major movement for rain or effect of No.1 pumping, are absent

4.2.7.3 The level in this borehole is above the River Dee.

The subdued movement that is present appears to coincide with rain events and in particular, In the period of -10,000 to o mins the movement dies off completely. This coincides with the absence of movement in the river Dee trace (Fig 7), and rainfall

The levels suggest the drift sand and gravels are confined, and the fall in level is the expected seasonal decline, due to run off and recharge of the bedrock weathered zone.

4.2.8 Black Rock Farm

No dip tubes are fitted. It was not possible to install loggers. Manual dips were taken.

4.2.9 Water Levels Graph 1

The average water levels in the various boreholes tend to confirm the conceptual flow. The levels are

Borehole	**Strata**	**Level (mAOD)**
Deep River	Weathered Sandstone	14.87
Car Park	Weathered Sandstone	14.62
Drift	Middle S & G	13.46
River Dee	River Level	11.50
No. 2 Borehole	Bedrock	14.9
No. 1 Borehole*	Bedrock	15.4

- The recovery is incomplete before pumping restarts. The Based on 2018 testing the fully recovered level is likely to be nearer 16 mAOD.

The relationship between the various levels is shown in Graph1.

The levels suggest the water table is sloping to East or south east.

The drift level, and the Deep River level confirm that the clay layers effectively confine and separate the Middle sand and gravel, and the weathered/bedrock sandstones. The absence of any effect of pumping No.1 borehole in the drift borehole also supports the confining effect of the lower clay layer.

4.3 Pumping Phase

4.3.1 No.1 Production Borehole– Graphs 9A, 9B & 9C

As will be seen in Fig 9A there is very little evidence of any additional movement as a result of pumping No.2 Borehole.

Graph 9B shows a log-normal graph of the pumping phase. This suggests there is a small effect, as it gives credible values of T and S. It also suggests that Equilibrium was established after 1200 mins (0.83 days)

Graph 9C gives the log – log plot. There is a good match to the type curve and the values of T and S match those determined from the log normal plot. The parameter values determined from this borehole are probably the only true bedrock values. All the others are influenced by the high permeability weathered zone.

4.3.2 No.2 Production Borehole (Pumping Well) Graphs 10A & 10B

It will be seen from Graph 10A that the effect of pumping was 39 m, and the value of transmissivity calculated from the graph (Graph 10B), is 90 m^2/day, which is low, suggesting high well losses. The drawdown was approximately 35% higher than in the No.1 Borehole at about the same abstraction rate. The Transmissivity reflects this.

A comparison of the parameters of the two Boreholes is as follows:

	No. 1 BH (2018)	**No.2 BH (2025)**
Pumping Rate(m^3/day)	1350	1349
Drawdown(m)	29.2	39
Specific Capacity (m^3/day/m)	46.2	34.6
Transmissivity (m^2/day)	159	90
Equilibrium Established (mins)	1800	270

It is to be noted that throughout the No.2 Borehole test, No.1 borehole was pumping at a constant rate, this will have influenced the time taken to reach equilibrium, and could have an effect on the other parameters.

4.3.3 Car Park – Graph 11A, 11B & 11C

It is emphasised that this borehole is connected to the weathered sandstone.

In Graph 11A the drawdown resulting from pumping No. 2 borehole can clearly be seen between 0 – 1,500 mins. The recovery from switching off No.1 Borehole is also obvious between 6,000 and 8,000, 11,000 and 13,000 and 17,000 and 19,000 mins.

There is no immediate explanation for the dip in level at 16,000 mins

The log – normal plot of time – drawdown and the log – log plot, are shown in Graphs 11B and 11C respectively. They give very similar values of T and S, and are also in line with the values determined from the testing of the No.1 Production Borehole in 2017 and 2018.

4.3.4 Deep River Borehole – Graphs 12A, 12B & 12C

As will be seen from Graph 12A, there is a dominant cyclical movement, which fits the pumping cycle of No. 1 Production borehole. This would be expected as No.1 Borehole is much closer.

There is no obvious movement from the pumping of No.2 Borehole, apart from a small dip of c0.055 m, at the very start of pumping.

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As will be seen from Graph 12B, that the small fall in the level at the very start of the pumping period is in 2 parts. The Values of S & T have been calculated for the 2 sections of the curve. Calculation A is for the initial part of the graph (determination "A"). The values of T & S are high, and might be expected in the high permeability zone, and the effect starts after about 200 mins of pumping, which is about the expected time. The value of u is on the limit for accuracy, being 0.068

About 900 mins the curve steepens. Analysis of this section of the curve gives plausible values of T & S, (determination "B") but the start of the effect is a long time after the start of pumping. The effects of pumping No.1 Borehole which is only 191 m away, are far greater and mask the effects of No.2.

The Theis Plot, shown in Graph 12C. A match point was chosen and this gave Values of T and S. The value of T at 4830 m^2/day is about 3 times higher than was determined from the 2018 test, but the value of S at 1.5×10^{-1} is comparable. The high value of Transmissivity is closer to determination "A" from the log – normal graph. Because the No.2 Production Borehole is much farther away, a higher proportion of the development of the cone of depression will be in the high permeability weathered zone, higher values of T would be expected than were determined from the testing of No.1 Production Borehole.

It is concluded that the effect of pumping No.2 Borehole is in section "A" of Graph 12B. The effect of pumping No.2 Borehole, is to Depress the level by c0.28 m.

Graph 12A suggests the level trend is rising at 1.44 mm/day. This could be the delayed response to rain in the pretest period.

4.3.5 Drift Borehole Graph 13

The level trace appears to be a continuation of the pretest trace. There does appear to be a response to the rain events which occurred at c16,000 and 21,000 mins, with a delay of about 2days.

There is no evidence of any effect of pumping either No.1, or No.2 Borehole.

The trend line is declining at 16.56 mm/day, which is of the same order as in the pretest phase.

4.3.6 River Dee Graph 14

The river trace shows two peaks. These coincide with the rain events at 7500 and 17,500 mins.

There is no evidence of any effect of pumping.

4.3.7 Rainfall Graph 15

There were only three rain events during the pumping period. These were at 2,500, 16,000 and 18,000 mins. The only significant one was at 16,000 mins, and was 16 mm.

4.3.8 Distance – Drawdown Graph 16

A distance drawdown graph has been constructed, using the values of drawdown from the Car Park and the Deep River. The predicted radius of effect is 450 m. The value of T calculated from this graph, is 1411 m^2/day.

4.4 Recovery Phase

4.4.1 N0.1 Production Borehole Graphs 17A, 17B & 17C

As will be seen from Graph 17A, the recovery is clearly visible at the start of the trace, between 0 and 1,500 mins.

The t/t' – residual drawdown plot is shown in Graph 17B. The transmissivity determined from this graph is 449 m^2/day.

Graph 17C shows the calculated recovery as a log – log plot. The value of T determined from this was 351 m^2/day, and the value of S was 2.4×10^{-3}. There was a good match with the type curve.

Although complicated by the effects of No. 1 Borehole pumping, recovery appears to be complete after 1,500 mins

The Transmissivity and Storage Coefficient values, determined from this borehole are true bedrock values as the weathered zone was properly cased out in both boreholes.

4.4.2 No.2 Production Borehole Graphs 18A, & 18B

Graph18A shows the high well loss. It also suggests that there was full recovery in about 2,000 mins.

The value of T determined from the t/t'-residual drawdown curve of 69 m^2/day, shown in Graph 18B is in basic agreement with the value determined from the pumping curve of 90 m^2/day.

The recovery from pumping No.1 borehole can still be seen at weekly intervals.

4.4.3 Car Park Borehole Graphs 19A, 19B & 19C

As will be seen from Graph 19A there are external effects that are of the same magnitude as the effects of pumping No. 2 borehole. There does appear to be a recovery in Graph 19, and is complete in 1,000 mins.

The t/t' graph (Graph 19B) gives plausible value of T, which is 1,015 m^2/day.

Fig 19C shows the calculated recovery, with the match point for the Theis type curve shown on it. The values of T and S determined from this are T = 966 m^2/day and S = 3.35×10^{-3}.

There were rain events through out the recovery period and it is possible the rises in level are a combined response to the recovery of No. 1, and No.2 boreholes and rain.

It is to be noted that the trend line is now falling at 7.2 mm/day.

4.4.4 Deep River Borehole Graphs 20A, 20B & 20D

As will be seen from Graph 20A, the effects of pumping No,2 Borehole are masked by external effects, which are chiefly:

4.4.4.1 The effects of pumping No.1 Borehole, which is much closer.

4.4.4.2 The seasonal decline of the water table.

There is a section of the graph between 500 and 1,000 mins, where there is a small recovery, this has been taken as the effects of No.2 borehole ceasing pumping.

This small section has been analysed. Graph 20B shows residual drawdown plotted against t/t' and Graph 20D shows the log-log pLot of calculated recovery. The Parameters Determined from these graphs are:

t/t' plot T = 3292 m^2/day

Calc Recovery T = 3614 m^2/day
S = 1.3×10^{-1}

It is emphasised that there are external effects which make identification of the effect difficult.

It is to be noted that the trend line is now declining at 13 mm/day.

4.4.5 Drift Borehole Graph 21

As will be seen from Graph 21 There is no evidence of any recovery and as expected, no evidence of any effects of pumping No. 1 Borehole. There is however evidence of a response to the rainfall shown in Graph 23.

It will also be seen that the trend line is now declining at 16 mm/day

4.4.6 River Dee Graph 22

As will be seen in Graph 22 The river Flow is gradually reducing. Although there is evidence of the effect of the rainfall at the start of the period, The effect of subsequent rain events is very muted. This suggests there is little run off and the rain is being absorbed by the ground, which must have a soil moisture deficit.

The trendline suggests that the level is falling at the rate of is 20 mm/day. This is influenced by the rain event at the start of the period, however the decline in the later part of the period is 3 mm/day. This is presumably the decline in the ground water sourced base flow.

4.4.7 Rainfall Graph 23

It will be seen in Fig 23 that there was showery weather throughout the recovery period, with two significant events at the end of the period.

5.0 Findings of Test.

The drilling and testing of the No.2 borehole has produced additional information on a number of issues. These are as follows:

5.1 Geology

The site is shown on BGS1:50,000 series maps 121 and 122 as being on the Lower Mottled Sandstone (Kinnerton Sandstone). It is thought that this could be incorrect, and it is in fact on the Pebble Beds. For the following reasons

5.1.1 In the drilling of No.2 Production borehole a high permeability zone was encountered between 116 and 125 mbd (See fig 1A) This feature was also encountered in the drilling of No.1 Production Borehole, at a slightly lower level[5].

5.1.2 Approximately 25 m below this feature the sandstone changed to much softer material. This is more in line with descriptions of the Kinnerton Sandstone..

5.1.3 In the geological memoirs[3], a bed described as "Dark red-brown, coarse grained bands of pebbles, lies approximately 25 m above the base of the pebble beds. This could be a high permeability band.

5.1.4 Seismic Surveys, suggest significant additional faulting, and dips of >20^{o}. Both of which could move the outcrop of the Pebble Beds westward[4].

5.2 Water Levels

The test monitored the water level in effectively 3 separate aquifers. These were:

The middle sands and gravels (drift), monitored by the drift borehole

The top of the sandstone and it's overlying weathered zone, monitored by the Car park and deep river boreholes.

The solid bedrock monitored by no.1 & 2 Production Boreholes

5.2.1 The middle Sands and gravels

As will be seen from Graphs 2, 13, and 21A the level was falling throughout the Pretest, Pumping, and Recovery phases. The rate of fall remained constant at about 16 mm/day.

The level did respond to rain.

There was no evidence of any effect of pumping No.s 1 or 2 boreholes.

5.2.2 Top of Sandstone and Weathered Zone

As will be seen from Graphs 5 & 6, during the pretest period the Carpark borehole level was rising at 1.2 mm/day, whereas the Deep River was declining at 1.27 mm/day.

During the pumping phase, and as will be seen from Graph 11A, the car park declined at 25 mm/day, where as the Deep River rose at 1.44 mm/day (Graph 12A).

The recovery Period is shown in Graphs 19A and 20A, it will be seen that both levels are now declining, the car park at 7.2 and the Deep River at 13 mm/day.

The dominant feature in both boreholes is the effect of pumping No. 1 Production Borehole.

5.2.3 Bedrock boreholes.

As indicated above the two boreholes representing this category are the two production boreholes.

As will be seen from Graphs 3 and 4 the levels in both boreholes were rising, No. 2 borehole at 4 mm/day and No.1 borehole at 9mm/day, during the pretest phase.

Once pumping started, and after the initial drop, No. 1 borehole declined at 20 mm/day (Graph8A), and the level in No.2 borehole declined at 23 mm/day.

After the initial recovery Both boreholes were receding, No.1 Borehole was receding at 6.4 mm/day (Graph 17A), and No.2 at 4.8 mm/day (Graph 18A)

5.2.4 Level Relationship

The relationship between the various levels is shown in Graph 1. These are the pretest levels. It is to be noted that:

5.2.4.1 The deep River level is higher than the Car Park Level. In 2018[6] the converse was true. This is attributed to pumping No. 1 Borehole.

5.2.4.2 The No.1 borehole, when it is switched off, recovers to very nearly it's 2018 level[6], of higher than 15.5 mAOD.

5.2.4.3 The level in No. 2 Production borehole is slightly lower than No.1 Production borehole level, when No.1 Borehole pumping stops.

5.3 Aquifer Parameters

Both the pumping and recovery phases of the test provided data from which aquifer parameters could be determined. The fact that No.1 borehole was in use throughout the test did affect the water level readings

The data collected during the test has been analysed using the Cooper and Jacob (1946) Modified non equilibrium formula (CJ) and the Theis Non Equilibrium Formula (T). The values of T and S calculated for the individual boreholes are given below. The values obtained from the 2018 test[6], are included.

TABLE 5.3 Aquifer Parameters

Borehole	Analysis Method	Year of Test	T (m^2/day)	S
Bedrock Boreholes				
No. 1 Production(pmp)	CJ	2025	562**	7.05×10^{-4}
" " "	T	2025	1073**	1.1×10^{-3}

TABLE 5.3 Aquifer Parameters (Con't)

Borehole	Analysis Method	Year of Test	T (m^2/day)	S
" " "	CJ	2018	159**	-
No.1 Production(rcy)	CJ	2025	449**	-
" " "	T	2025	351**	2.4 x 10^{-3}
" " "	CJ	2018	127**	
No.2 Production (pmp)	CJ	2025	90**	-
No.2 Production (rcy)	CJ	2025	69**	
Bedrock + Weathered Zone				
Car Park (pmp)	CJ	2025	1543*	1 x10^{-2}
" "	T	2025	1590*	9.27 x 10^{-3}
+ "	CJ	2018	1458*	1.0 x 10^{-2-}
" "	T	2018	1487*	2 x 10^{-2}
Car Park (rcy)	CJ	2025	1015*	-
" "	T	2025	966*	3.35 x 10^{-3}
" "	CJ	2018	915*	-
" "	T	2018	716*	1.4 x 10^{-2}
Deep River	CJ	2025	8170*	2.5 x 10^{-2}
" "	T	2025	4830*	1.5 x 10-1
" " "	CJ	2018	2059*	7.7 x 10^{-2}
" " "	T	2018	1244*	1.1 x 10^{-1}
Deep River (rcy "B")	CJ	2025	3292*	_
" " "	T	2025	3614	1.3 x 10^{-1}
Deep River (rcy)	Cj	2018	561	-

" " "	T	2018	1172*	4.4×10^{-1}
Distance Drawdown	CJ	2025	1411*	1×10^{-2}

The above table demonstrates a number of important facts

5.3.1 It will be seen from the above table, that when the water flow is through the solid bedrock the values of T and S are significantly lower. The averages, calculated from the data collected from No.1 Production Borehole, when used as an observation borehole during the 2025 test of No. 2 Production borehole, were:

$T = 609\ m^2/day$
$S = 1.4 \times 10^{-3}$

The values used to calculate the average values are marked *

5.3.2 The increased well loss in No. 2 borehole, compared to number 1 is demonstrated by the difference in the values of T. The thickness of exposed sandstone and the average values of Transmissivity have been used to calculate the hydraulic conductivity.
The values are given below:

	No.1 Borehole	No.2 Borehole
Average value of T (m^2/day)	143	79.5
Exposed Sandstone (m)	95	100
Hydraulic Conductivity K (m/day)	1.5	0.795

The data used in calculating the average values of T are marked*. In calculating the value of K the exposed thickness of sandstone has been used rather than the total thickness of the aquifer. This is because the confining beds in the sandstone restrict flow from unexposed beds.

5.3.3 The average values of T and S for boreholes where the weathered zone is exposed, is very much higher than for the true bedrock boreholes and are as follows.

$T = 2404\ m^2/day$
$S = 8.9 \times 10^{-2}$

The values used to calculate the averages are marked*.

5.4 Radius of Effect.

The distance drawdown graph suggests the radius of effect when equilibrium was reached was 450 m. (Graph 16). Equilibrium was achieved in about 1.5 days.

As a check the radius of effect can be calculated for different times, from the equation $r_o = \sqrt{(2.25.T.t/S)}$. The radius of effect has been calculated for times up to 42 days and is shown in Graph 25 The value of T used for this calculation is 2404 m^2/day, and the Value of $S = 8.9 \times 10^{-2}$.

The highest value of T was the Cooper Jacob determination, for the pumping phase of the Deep River borehole, which gave values of T = 8170 m^2/day and S = 2.25. Using these values, the maximum radius of effect is 857 m.

5.5 Black Rosk Farm.

Neither of the boreholes is fitted with a dip tube. It was not therefore possible to install a data logger. The following dips were taken from the abstraction borehole. As the recharge borehole was in use, on every visit it could not be dipped.

Date Time		Elapsed Time	Part of Test	Water level (mBD)
20.05.2025	15.30	-52950	Pretest	31.34
23/05/2025	10.45	-48945	Pretest	31.42
11.06.2025	14.30	-21330	Pretest	31.61
02.07.2025	10.30	10050	Pumping	31.63
11.07.2025	12.15	23175	Recovery	31.65
22.07.2025	16.30	41010	Recovery	31.71

These levels are shown in Graph 24. It will be seen that the level is falling during the first half of the pretest period, but then levels off, before starting to fall at the end of the pumping period and continuing to fall throughout the recovery period.

The trend line shows an average fall throughout the monitoring period of 5 mm/day. This basically in line with the average fall in the Maelor Observation boreholes.

There is no evidence of any effect of pumping the No. 2 Maelor borehole. The total fall in level during the monitoring period was 0.37 m, of which 0.27 m occurred during the pretest period, leaving only 0.1 m for the pumping and recovery periods, and the fall between the midway through the pumping period (10050 min) and the very start of the recovery (23175 mins) was only 0.02 m.

The drawdown – distance graph, graph 16 suggests the radius of effect is 480 m. This radius is supported by the fact that the drawdown in the deep river borehole, which is 318 m from the pumping well was < 0.05 m. The Black Rock Farm boreholes are >1200 m away.

As a further check, and using graph 25, the theoretical radius of effect would only reach 1200 m after 36 days continuous pumping. As the pump was only running for 14 days, and the level, in the pumping well, stabilised after 300 min (0.21 days), no effect would be expected.

Under operational conditions, there would be a 1.5 day recovery every 6 days. This would significantly delay the spread of the cone of depression.

It is concluded that there will be no measurable effect at Black Rock Farm

6.0 Results of Test

The results of the test are as follows:

6.1 The No.2 Production borehole is capable of supporting abstraction of 1350 m^3/day, and a combination of boreholes Nos 1 and 2 are capable of supporting 2700 m^3/day.

6.2 There is no measurable effect on the drift water table, of the combined abstraction of c2,700m^3/day, or the individual abstraction from either borehole, confirming the protection provided by the lower clay layer.

6.3 The development of the cone of depression as a result of abstraction, is in two phases, the initial development is along the individual sandstone beds, actually penetrated by the borehole. The second phase occurs, when the cone reaches the subcrop of the individual beds, and then develops in the high permeability, weathered sandstone layer.

6.4 The strata encountered in the drilling of No. 2 Borehole, suggests that the top section of the sandstone is more typical of the Pebble Beds, than the Lower Mottled Sandstone. In support of this there was a marked change at 159 mBD. Below this level, the sandstone was much softer and more typical of the Lower Mottled Sandstone (Kinnerton Sandstone). This suggests the outcrop of the Pebble Beds extends farther west, than is mapped.

6.5 There is no evidence of any adverse effect of the additional abstraction on the Operation of the Black Rock Farm Abstraction System.

6.6 The average values of Transmissivity and storage coefficient in the bedrock are T = 609 m^2/day S = 1.4 x 10^{-2} and for the bedrock/weathered zone T = 1925 m^2/day S = 8.4 x 10^{-2}

6.7 Equilibrium was achieved in all the monitoring boreholes in < 2 days.

6.8 Full recovery was achieved in all boreholes in < 3 days.

6.9 There is no measurable effect on the drift (Middle Sands), or the River Dee.

Table 6.10

Summary of Test Results

Function	**No.1 PB**	**No.2 PB**	**Car Park**	**Deep River**	**Drift**	**River Dee**
Pping Rate (m^3/d)	**1350**	**1349**	**-**	**-**	**-**	**-**
Pretest Level (mAOD)	**-5.08**	**14.81**	**14.273**	**14.84**	**13.468**	**11.42**
Pumping Level	**-5.9**	**-24.56**	**13.91**	**14.81**	**13.212***	**11.39***
Drawdown (m)	**0.8**	**39.37**	**0.36**	**0.03**	**-**	**-**
Recovered To (mAOD)	**-5.11**	**14.86**	**14.595**	**14.97**	**13.063***	**11.363***
Time to Equilibrium (mins)	**1440**	**285**	**1385**	**1020**	**-**	**-**
Time to Full Recovery (mins)	**1845**	**1890**	**3645**	**3495**	**-**	**-**
Average Aquifer Parameters						

T – Pumping	**818**	**90**	**1567**	**6500**	**-**	**-**
T – Recovery	**405**	**69**	**990**	**3453**		
S – Pumping	**1.1×10^{-3}**	**-**	**9.64×10^{-3}**	**1.75×10^{-1}**		
S - Recovery	**2.4×10^{-3}**	**-**	**3.35×10^{-3}**	**1.3×10^{-1}**		
Bulk Hydraulic Conductivity (m/day)	**3.94****	**0.795**				
Specific Capacity (m^3/day/m)	**64.28****	**34.26**				
Radius of Effect (m)***		**857**				

***There was no evidence of an effect of pumping and this is seasonal depression of the water table**

****These values are calculated from the pretest data analysis of No.1 Production Borehole, when it was the only borehole pumping (Graph 28)**

*****This is the maximum calculated value, determined by using the Cooper Jacob analysis of the Deep River B/H pumping phase.**

SECTION "B"

Hydrogeological Impact Assessment

7.0 Introduction

As stated in section 1 of this report, Maelor Foods Ltd are increasing the capacity of their chicken processing factory at Cross Lanes, and hence require additional water.

The present water supply is from a borehole, which was drilled into the Kinnerton Sandstone Formation in 2016, and was tested at 1072 m^3/day. The impact of this new abstraction was assessed and reported in the GHSCE report dated June 2017[1].

The borehole was retested in 2018, to permit the daily yield to be increased to 1350 m^3/day. The impact of the increased abstraction was assessed and reported in the GHSCE report dated June 2018[2].

Abstraction is presently covered by Licence No. WA//067/0007/015/V002. This permits abstraction of:

56.25 m^3/hr
1350 m^3/day
400.000 m^3/year

To cover the increased production capacity the company now require a licence for:

936,000 m^3/year
2,700 m^3/day
130 m^3/hr

The justification for these quantities is given in Section 2, in part "A" of this report.

To meet the demand, a second borehole has been drilled into the same aquifer, 127 m to the NW of the No. 1 Production borehole. This borehole was drilled and tested in accordance with consent no.WA/067/0007/0022. Details of the construction of the borehole and the details of the test are covered in section "A" of this report. The Environmental impact is now considered.

8.0 Setting

The site is located south of the village of Cross Lanes and close to Bangor on Dee. It is in the valley of the River Dee, which meanders to the south east of the site, but is basically flowing in a northerly direction, passing to the east of the site. At its nearest point, the river is 217 mtr to the south east of the existing (No.1 Production Borehole), and 318 m from the new borehole (Production Borehole 2).

The site is bounded by agricultural land, which is sloping in a southeasterly direction towards the river.

The locations of the boreholes, including the observation boreholes, are shown generally on Map 1 and in detail on Map 2.

9.0 Geology

9.1 Published Geology

The new No. 2 Production Borehole is sited at NGR SJ 38617 46848. It is close to the boundary of two, BGS 1:50,000 series geological maps, Map 121 Wrexham[7] and 122 Nantwich[8].

Both maps suggest the site is on the River Gravels, underlain by Boulder Clay. The bedrock is shown as the Kinnerton Sandstone Formation (Lower Mottled Sandstone).

The Memoirs for the Nantwich map[9], amplify the total sequence and suggest it could be:

2nd Terrace River Gravels

1st Terrace River Gravels

Upper (Glacial) Sands

Upper Boulder Clay

Middle (Glacial) Sands

Lower Boulder Clay

Kinnerton (Lower Mottled) Sandstone

Coal Measures

The second Terrace gravels in the immediate area[10] are described as being composed of silt and gravel, normally <1.5mtr thick, however between Pickhill Old Hall and the Maelor site 3.6 mtr of gravel are recorded. There is a small outcrop of 1st Terrace gravels just to the east of Pickhill Old Hall. It is possible that these could also be present in some of the boreholes.

The Upper Glacial Sands are described as a thin layer of silty sand with stones.

The Upper Boulder Clay, to the west of the Dee[11]is described as being a thick, continuous till-sheet composed of stiff, brown-weathering clay with abundant Irish Sea Erratics. It can reach substantial thicknesses >30 mtr, but is generally about 6 mtr thick. In the area south west of Pickhill Old Hall it is recorded as being 3.65 mtr.

The Middle Glacial Sands[12] vary in thickness, from >20 mtr to < 2 mtr. There is little detail, as, in most areas, they are confined by the Upper Boulder Clay. In general, they seem to consist of well sorted layers of sand and gravel. The lateral extent of the individual layers is not recorded.

In the few places that the Lower Boulder Clay[13] can be examined, it is described as being stiff, red-brown sandy clay, which in places is described as stony. The thickness is variable from 1 mtr to >18 mtr.

The Lower Mottled Sandstone[14] (Kinnerton Sandstone) is described as soft red sandstone with thin beds of red sandy mudstone. In one borehole alternations of millet-seed sandstone and marl were recorded. The maximum thickness could be approaching 300 mtr. but thins in an easterly direction.

More recent work[15] suggests that the siltstones and very fine grained sandstones occur in the upper part of the formation and the coarser millet-seed sandstones occur at lower levels.

The Permo-Triassic sequence lies unconformably on the Coal Measures. The top beds of the Upper Coal Measures are the Erbistock Beds. They are described as being chiefly red sandstone and mudstone, with a few carbonaceous layers and seat earths. The Erbistock Beds outcrop to the north and west of the site, but are at a depth of > 200 mtr under the site. At its nearest point, the outcrop is 1,600 mtr to the North West.

The Permo-Triassic Series are shown on Map 122[8] as dipping in a 25^{o} South of East direction, and at a dip angle of approximately 6^{o}, however the dip in the part of the section closest to the site, is shown at about 10^{o} Based on the relative position of the site to the mapped position of the western edge of the Kinnerton Sandstone Outcrop, and the western edge of the Outcrop of the Pebble Beds, the thickness of the Kinnerton Sandstone at the site will be approximately 330 mtr.

The site is within a fault block bounded by East-West trending faults along approximate Northings 444 & 515. The Eastern Boundary Fault runs between the two East – West Faults, trending slightly eastwards as it moves South. It lies between Eastings 453 & 475.
The Western Boundary Fault intersects the Northern Boundary Fault at Eastings 390 and then trends South Westwards, in the Coal Measures.

All four faults have lateral displacements measured in kilometres and vertical displacements of >100 mtr. There will be considerable disturbance in the vicinity of the faults. Because of the large lateral displacement, the faulting is tear-faulting of post Jurassic age[16]. Geophysical Surveys on the Permo-Triassic Series, in other parts of the country, have demonstrated that there is likely to be significant, unmapped faulting[17,18].

The geological Information given in the interpretation of Triton Resources 1991 Seismic survey[4] has been examined. Although the western edge of the survey is approximately 2km to the east of the site, The survey does indicate the dips and faulting which is present. The location of the Shot lines, that are relevant are shown on Map 3, with the Triton Interpretation.

Line P 87-01 runs W -E and suggests dips of 22^{o} to the East, reducing to 5-8^{o}, to the east.

Line P87 – 07 runs 10^{o} east of south and is located about 2km to the east of the Maelor site. This section suggests the southerly dip is about 8^{o}.

This information suggests the line of dip in the immediate area could be much closer to east, than south as suggested by the published BGS maps.

Detailed examination of the data, does suggest that minor faulting could be present, in addition to the major faults, that are shown on the sections.

9.2 Site Geology

There are now 5 boreholes on the site. These are:

TABLE 9.2
Site Borehole Details

Borehole	Datum (AOD)	NGR	Distance from Pumping Well (m)	Depth (m)
No.2 Production B/H	25.76	SJ 38617 46848	0	175
No. 1 Production B/H	24.68	SJ 38678 46737	127	171
New Car Park	27.8	SJ 38584 46884	49	90
River Deep	16.14	SJ 38778 46574	318	90
Drift	16.18	SJ 38771 46570	318	20

With the exception of the drift borehole, all the boreholes penetrated the full thickness of the superficial deposits. The main points are:

9.2.1 As will be seen from the borehole logs in appendix 1 (Figures and Maps), the strata sequence matches what would be expected from the published geology.

9.2.2 The Lower Boulder Clay, Middle Glacial Sands, and the Upper Boulder Clay, are present in all four deep boreholes.

9.2.3 Above the Upper Boulder Clay the strata, varies. It is suggested that in the Deep River and Drift boreholes, this top section is of fluvial origin, or has been reworked.

9.2.4. In the two production boreholes, a layer of gravel was encountered, in No.1 between 116 and 135 mBD, and in No. 2 Between 116 and 125 mBD. A small amount of gravel was present in both boreholes above this horizon, and in No.1 it was noted below it. The sandstone was noted as hard in this zone. This is not typical of the Lower Mottled (Kinnerton) Sandstone. It is normally reported as being pebble free and soft.

9.2.5 In No.2 Production Borehole there was a significant change at 159 mBD. The sandstone was much softer, and no gravel was noted, between 159 and the base of the borehole at 175mBD.

The sandstone encountered in No.1 borehole, and above 159 mBD in No. 2 borehole is more typical of the description of Pebble Beds, than the Lower Mottled Sandstone

The Kinnerton Sandstone is described as poorly cemented soft, fine grained sandstone, with coarse grained material (millet seed) beds towards the base[19,20]. The Pebble beds are described as well cemented medium – coarse grained pebbly sandstone with interbedded mudstone[21]. A typical section is given in the memoirs[22].

It is suggested that the Maelor Site is on the subcrop of the Pebble Beds and that No. 2 Production Borehole enters the Lower Mottled Sandstone (Kinnerton Sandstone) at 159 mbd.

The seismic information[4], suggests the dip is about 22°, in a virtually due east direction.

The eastings of the two boreholes are

Production Borehole No.2	38617
Production Borehole No. 1	38678
Difference	-61 mtr

No 1 borehole is therefore 61 m down dip of No.2 Borehole, and at a dip of 22^{o} there would be an extra 24.5 m of Pebble Beds. The base of the Pebble Beds in No.2 borehole was at 159 mBD. This would mean that the base of the Pebble Beds in No.1 borehole, allowing for the difference in datum height, is at 182 mBD. The borehole was terminated at 171mbd, and therefore was still in the Pebble Beds.

The strata logs of the two boreholes, are shown in Figs 1A and 1B. It is to be noted that there is significantly more references to pebbles in No. 1 borehole than in No. 2. This is consistent with the section of Pebble Beds penetrated being higher up the unit, and above the transition zone.

The incorrect positioning of the site on the Kinnerton Sandstone could be due to the under estimate of the dip. The Kinnerton Sandstone is recorded as being about 300 m thick[20], and a change in dip angle could reduce the width of the outcrop by about 2km. Alternatively, the high loss zone encountered at c120 mBD, could be a fault plane.

10.0 Hydrogeology.

10.1 Published Hydrogeology.

The two previous assessments have assumed that the aquifer under the site is the Kinnerton Sandstone. It thought that this is incorrect and it is in fact on the edge of the Pebble Beds. This assessment assumes it is on the subcrop of the Pebble Beds.

The site is close to the boundary of two Hydrogeological Study areas, The Shropshire and Cheshire and south Lancashire areas. The. Information on the Pebble beds is similar for both areas, but average values for some of the parameters are slightly different.

10.1.1 As discussed above the Pebble Beds consist mainly of reddish brown, cross – stratified, coarse grained pebbly sandstone or conglomerate of fluvial origin. Sporadic beds and lenses of mudstone also occur[21]. It is also stated that the basal beds are gradational and difficult to define[21].

10.1.2 Where it has been examined, fractures were predominantly bedding plane joints, with few vertical fractures[23]. The pebbly horizons are reported as being more cemented[23]. Because of the increased strength, due to better cementing, jointing is less random and more widespread[24]. Again, because of the increased competence, most fractures stay open[25].

10.1.3 As is common with nearly all the Triassic sandstones the horizontal permeability exceeds the vertical permeability by an average of 7:1, and that values of 50:1 were recorded. As expected, permeability increases with grain size[26].

10.1.4 The range of Bulk hydraulic conductivity values, for the Pebble Beds is quoted as being 0.33 to 16 m/day, resulting from a combination of variable cementation and lithology. The median value is 3.86 m/day, and the geometric mean 3.28 m/day[27]

10.1.5 There is no guidance on the storage coefficient in the Pebble Beds, but the average porosity is similar to the Kinnerton Sandstone, and is 23.2%[28].

10.1.6 The transmissivity of the weathered zone and the drift are likely to be high, and could be >4,000 m^2/day[29].

10.2 Conceptual Flow and Cone of Depression

10.2.1 Conceptual Flow

The test results, given in section A of this report, are in agreement with the conceptual flow proposed in the 2017 study[1]. The conceptual flow proposed was :

10.2.1.1 Rain falls on the exposed drift sand and gravel in the area to the north and west of the site, outside the area protected by the upper clay layer, recharging the drift deposits.

10.2.1.2 The sands and gravels are of high permeability allowing easy movement of water. Surplus water drains over the top of the clay layer into the river.

10.2.1.3 Water from the drift sand and gravel migrates through holes in the Boulder Clay and recharges the weathered zone of the Pebble Beds.

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10.2.1.4 The weathered zone is of high permeability, and acts as a distributor layer, for the underlying Pebble Beds

10.2.1.5 Water moves down the individual Pebble beds into the abstraction well.

10.2.2 Cone of Depression

The published geology and hydrogeology, suggests that the cone of depression will be constrained by the presence of low permeability mudstone and siltstone beds, variation in cementation, and fissuring being along bedding planes. There is little evidence of cross bed (vertical fissuring).

The conceptual flow also proposes that the cone development is in 2 stages:

Stage 1 Along the solid beds of relatively low permeability, confined vertically, by partial barriers of mudstone, cementing etc, to the weathered zone. Development in a N – S direction is effectively unconstrained, as there are no know faults within 1 km.

The East – West development is effectively confined to the beds exposed in the borehole. The cone will develop up the beds at the angle of dip, effectively meaning that the centre point at which the cone develops in the weathered zone is displaced to the west.

Stage 2 Unconfined development in the high permeability weathered zone. There are no known constraints in the weathered zone, so the cone should develop equally around the perimeter of what will be an ellipse at the subcrop of the solid beds. The long axis of the ellipse will be N-S.

The concept is shown in Figs 2A,B,&C

10.3. Maelor Borehole Relationship.

As stated in section 9.2 of this assessment there are 5 boreholes on the site. The relative position of these boreholes on the aquifer is important when considering the effects of pumping.

Due to mudstone layers, cementing, and bedding plane fissuring, effects of pumping are considered to be confined to the beds exposed in the borehole, hence, the East – west position is very important, when considering the effect of pumping. The E – W (down dip) position of the 5 boreholes is shown in Fig 3.

The fifth borehole, which is not shown in Fig 3, is close to the Deep River borehole, but was only drilled into the drift deposits.

Fig 3 clearly shows the following:

10.3.1 The Car Park borehole should be monitoring the effect of pumping both Production Boreholes through the solid bedrock, but as the bottom 10 m of the casing was a well screen with gravel pack, and the screen extended up to the weathered zone, the effects could also be coming indirectly through the weathered zone.

10.3.2 No.2 borehole will be receiving the effects of pumping No.1 through the bedrock, and vice versa. This means that parameter values calculated from these two boreholes are true bedrock values.

10.3.3 The Deep River borehole does not penetrate the pumping zones of either borehole and the effects monitored in this borehole must be coming indirectly through the weathered zone.

10.3.4 The high permeability layers, encountered in both boreholes 1 and 2, and shown in blue, are not directly down dip of each other, and appear to be separate pebbly areas. To account for the fluid loss during drilling, they are likely to be connected to the weathered layer.

10.3.5 The water table is sloping very gently towards the river as would be expected.

10.4 Aquifer Parameters

The aquifer parameters determined from the 2025 test results and the 2018 testing[2] are given in table 5.3, in section "A" of this report.

The parameters were calculated using the Theis nonequilibrium equation[30] and the Cooper Jacob modified nonequilibrium equation[31].

The significant features are:

10.4.1 Although No.1 borehole was pumping throughout the 2025 test, the effects of pumping No. 2 can be seen. As the weathered zone was sealed out in both boreholes, and both boreholes penetrate the same section of the aquifer, the parameter values obtained from this data represent bedrock values. The average values obtained were:

Transmissivity	609 m^2/day
Storage Coefficient	1.4 x 10^{-3}
Hydraulic Conductivity	6.41 m/day

The hydraulic conductivity is at the higher range of recorded values.

10.4.2 The proportion of the development of the cone of depression, that the Weathered zone contributes is reflected in the values of Transmissivity and Storage coefficient. The farther up, or down dip the monitoring borehole is, the greater the contribution of the weathered zone appears to be.

In the 2025 test of No. 2 Borehole and the 2018 test of No.1 Borehole, the average values of T and S and the distance up, or down dip are as follows:

TABLE 10.4

Parameter Values in Relation to Distance of Monitoring Borehole- up or down dip

Test	Point	Distance (m)	T (m^2/day)	S
2025	Car Park	49	1278	7.54 x 10^{-3}
2025	Deep River	305	4981	1,08 x 10^{-1}

2018	Car Park	174	1143	1.46×10^{-2}
2018	Deep River	191	1259	2.0×10^{-1}

10.5 Recharge and Sustainability of Abstraction.

Recharge to this area is difficult to quantify. As postulated in section 10.2.1 of this report, the Pebble Beds are charged through the weathered zone. This weathered zone will extend over the outcrop of all the Triassic Sandstones, i.e.

Wilmslow Sandstone

Chester Pebble Beds

Kinnerton Sandstone

Over much of the area the sandstones are confined by drift deposits, and in the immediate area, by Boulder Clay.

As stated previously recharge of the weathered zone must be from permeable unconfined drift deposits, through holes in the Boulder Clay. There is no accurate information on where these holes are.

The minimum potential area of recharge can be refined to

10.5.1 Areas where the ground level is above c 16 mAOD, and over lying the Triassic sandstones, as all the boreholes penetrating the aquifer have Standing water levels of between 15 and 16 mAOD, (see Graph 1A).

10.5.2 The outcrop/subcrop of all the units of the Triassic sandstones as the weathered zone will extend across all units and be continuous. It could even extend across the Erbistock beds, but this is problematical and dependent on the clay content.

Map 3 shows the ground height with the basic geology super imposed on it within a 5 km radius of the site.

It is estimated that the area to the north, west, and south, which is above 16 mAOD, extends to >40km^2.

Recharge values vary between 10 and 30% of rainfall. The average rainfall in the Wrexham area is 870 mm/year.

On the basis of 20% the recharge could be >6960 Ml/year.

It is emphasised that this estimate does not include the high ground on the eastern side of the valley. Or land to the north and south beyond the 5km radius.

It does not include areas below 16 mAOD, which will contribute recharge to the drift deposits. The water level in the Drift borehole was <13mAOD at the end of the recovery period.

If all this land were included the area could well be at least double.

It is emphasised, that this is recharge applicable to the Maelor site and not the total aquifer.

This crude estimate does suggest that potential recharge is significantly greater than potential abstraction

Sustainability has been assessed on the basis of the evidence collected from the 2017 tests[1], the 2018 tests[2] and the 2025 tests, covered in this report.

The No.2 Production Borehole, on which this test was conducted, is to be used at the same time as the No. 1 Production Borehole. As a consequence, the total abstraction from the site will be a maximum of 2,700 m^3/day.

To check that this level of abstraction is sustainable No. 1 borehole was in maximum use (1350 m^3/day – 5.5 days/week) throughout all three phases of the test. The baseline conditions for the 2025 test of No.2 Borehole are therefore set in the pretest period.

The detailed performance of No.1 Borehole after 8 years of pumping, is analysed in section 12 of this assessment, but the findings are:

*Equilibrium conditions have been established

*On cessation of pumping, recovery to the 2018 pretest levels is achieved.

*Recharge is exceeding abstraction.

*Pumping No.1 Borehole at 1350 m^3/day is sustainable

The phases of the 2025 test are considered separately.

10.5.1 Pretest Period. (Baseline Condition)

A comparison of the combined pretest level graph (Graph 1), with the combined pretest level graph for the 2018 test(Graph 1A), indicates the long term pumping effects of No.1 Production Boreholes. The main points are:

10.5.1.1 When the No.1 pump switches off the level appears to be recovering towards the 2018 pretest level of close to 16mAOD.

10.5.1.2 During pumping No.1 Borehole the Carpark level has dropped about 0.7 m to 14.7mAOD since 2018.

10.5.1.3 The Deep River Borehole level is virtually unchanged at 14.9 mAOD. Suggesting no long term effect on the level.

10.5.1.4 The River Drift Borehole and the River Dee are approximately 0.75 m lower than in 2018. This is attributed to seasonal decline. The 2018 test was conducted in January, and the 2025 test conducted in June. There was considerably less rainfall during the 2025 test.

This comparison confirms that the long term effects, of pumping No.1 borehole, are limited and are probably, confined to a radius of less than 300m.

Throughout the pretest period No.1 borehole was in full use. Despite this, with the exception of the deep river borehole, the levels in the Car Park (graph 6), No 2 Production borehole (graph 4) and No. 1 Production borehole (graph 3) all show a rising trend, confirming that recharge is exceeding abstraction.

In the period -35000 to -15,000 there were significant rain events and this rise in the three boreholes connected to the target aquifer, could be a delayed reaction to this rain.

Although. the drift borehole (graph 2) does show subdued reaction to the individual rain events, the overall trend of the Drift Borehole and the River (Graph7), is a steady fall of 11/12 mm/day.

As conformation that this fall was typical of the level trend in the Triassic Sandstones, Graph 26 shows the water level movement in the Barton Observation Borehole (NGR SJ 44840 54528). This shows that, although there was a response to rain, in the pretest period, overall, the level fell 30 mm, i.e. 1.125 mm/day, during the period. Graph 29 shows the water level movement in the Stretton Mill Observation Borehole (NGR SJ 45490 53030). The level is falling at 5 mm/day, over the period of testing.

The delayed response to rain in the deeper boreholes, suggests that the bottom boulder clay layer, in the site area is intact and that recharge is having to travel some distance.

The pretest data demonstrates that, despite satisfying maximum demand of No.1 borehole, recharge permits aquifer levels to rise at a time of year when levels would be expected to level off, or start falling. Additional abstraction could be sustainable.

10.5.2 Pumping Phase

The pumping phase started on 25th June 2025. It would be expected that in general the water tables would have been receding, This is confirmed by the Barton Borehole Level (Graph26) in which the level fell 70 mm (c

3.9mm/day. The additional abstraction would have been expected to exacerbate the rate of decline.

The monitoring showed surprisingly little effect, despite the fact that there was only about 5 mm of rain during the period (graph 15), and less than 1 mm in the last 10 days of the pretest period (graph 8). The results were as follows:

Borehole	**Initial fall (mtr)**	**End of Initial Fall (mins)**	**Level movement After Initial Fall (mm/day)**
No.1 Production	0.75	1500	-20
No.2 Production	40	700	-22
Car Park	0.35	1200*	-25
Deep River	0.05	1300*	+1.44
Drift	No effect-	-	-15.8

- The development of the drawdown in the observation boreholes was influenced by the effects of No.1 Production Borehole starting up.

The pumping phase data shows:

10.5.2.1 As will be seen from the Deep River data, outside the area of immediate effect, the water table was still rising. This indicates that recharge is exceeding abstraction.

10.5.2.2 The drawdown in the Deep River borehole is only 50 mm. It must therefore be close to the practical limit of effects.

10.5.3 Recovery Phase.

All four boreholes connected to the aquifer showed a sharp recovery, but then levelled off.

A comparison of the pretest level and the recovered level us given in table 10.5.3 below.

Table 10.5.3

Comparison of pretest and recovered levels

Borehole	**Pretest Level (mAOD)**	**Recovered Level (mAOD)**	**Status**

No. 1 Borehole	-5.08 .	-5.02	Recovered
No.2 Production	12.81	12.86	Recovered
Car Park	14.273	14.54	Recovered
Deep River	14.84	14.9	Recovered

The effects of pumping No.1 Production Borehole do complicate interpretation of the data, and determining the exact rate of water table decline difficult, However, the evidence suggests that full recovery was achieved in all four boreholes in under 2.5 days.

The above analysis shows that recharge is exceeding the demands of No.1 and 2 Boreholes, and that pumping both boreholes at a daily rate of 2,700 m^3, is sustainable.

11.0 Effect on Water Features and Other Abstractors.

11.1 A water Features Survey was carried out and a number of Surface Water Features were identified within the prescribed 1.5 Km Radius. It was agreed that, following the 2017[1] and 2018[2] work on No.1 Production borehole, and the presence of the Lower and Middle Boulder Clay being established, these features were protected from the effects of pumping Nos.1 & 2 Production Boreholes. It was further agreed, that, with the exception of the River Dee, no surface features were to be monitored.

11.2 The drift and Deep River Boreholes are within 10 mtr of the river and the strata logs, given in Fig 1B give accurate guidance as to the strata under the river. The logs show that the river runs over clay and Clay bound sand and gravel. In the borehole logs this is about 10 m thick. However, the revised datum for the drift borehole is 16.18 mAOD, and the river bed is at about 9.5 mAOD. The thickness of the clay layer is about 3.3m. Below this is approximately 14 m of sand, sand and gravel, and some small bands of clay, extending down to about 24m bgl.

Between this pervious material and the weathered zone of the aquifer is approximately 24 m of clay and clay bound sand. This includes the lower boulder clay.

The upper clay unit on which the river runs and the lower Boulder Clay immediately above the aquifer, provide protection from the effects of abstraction from the aquifer. This is demonstrated by the water levels in the middle sand and gravel, as monitored by the drift borehole and the aquifer monitored by the Deep River borehole, which monitors the aquifer water level . The relative levels are given in table 11.2 below

Table 11.2
Pretest Levels at River (Graph 1

Monitoring Point	**Pretest Level (mAOD)**
River Dee	11.5

Drift Borehole	13.5
Deep River	14.9

There is no sign of pumping No1 Production Borehole in any of the three river level graphs (Graphs 7, 14, and 22). No. 1 Borehole is much closer, was pumping at the same rate as No.2, and had a regular cyclical pumping pattern, that would have been easy to identify on the trace, if present.

There was no evidence of pumping either No.1, or No.2 Boreholes on the drift level graphs (graphs 2, 12, or 21A).

95% of the water abstracted from the boreholes will be returned to the river. There is therefore a net gain of 2565 m^3/day, (0.03 m^3/sec)

.It is concluded that there is no effect of pumping No.1, or No.2 Boreholes, on River Levels or flows..

The following boreholes were picked up by the survey

Name of Feature	Grid Reference	Distance from Pumping well (m)
Calypso Drinks	SJ 38190 48940	2,135
Cross Lanes Activity Centre	SJ 37390 46980	1,234
Black Rock Farm Abs BH	SJ 37452 47358	1,272
Black Rock Farm Rechge BH	SJ 37462 47476	1,315

11.3 The Calypso Drinks Borehole was monitored in the earlier testing, and reported on in the 2017 and 2018 reports[32]**.** It was concluded that there will be no effect.

11.4 Cross Lane Activity Centre has a 113 mm dia borehole. Unfortunately, there is no access for manual dipping, or for installing a level logger. The predicted radius of effect is 450 m (Graph 16). The Activity Centre is > 1200 m away and therefore outside the radius of effect. The time – Radius of Effect Graph (Graph 25) suggests it would take c27 days for any effect to reach this borehole. During that time the pump would have shut down, allowing partial recovery, on at least 4 occasions. All the evidence suggests there would be no measurable effect on this borehole.

11.5 The Black Rock Farm boreholes are c 1,300 m away. Level dips of the abstraction borehole did not suggest any measurable effect. The Distance – Drawdown Graph (Graph 16, and the radius of effect – time graph (Graph 25) would support this evidence of no effect. It is to be noted that the form of the curve in Graph 24 is very similar to the Barton Borehole graph (Graph 26).

Table 11

Summary of Effects

Feature	Effect	Comment
Overall Water Resources	Minor Adverse	95% of abstraction returned To River
Ground water Resources	Major Adverse	increase of 536Ml/year
Surface water Features	no effect	Protected by Boulder Clay
Drift Water level	no effect	Protected by Boulder Clay
Drift Water Resources	minor adverse	loss due to additional recharge to aquifer
River Dee	Minor Positive	95% returned to river
Black Rock Farm	No Effect	Outside radius of effect
Cross Lane Activity Centre	No Effect	Outside radius of effect
Calypso Drinks	No Effect	Outside radius of effect.

12.0 Assessment of the Long Term Effects of Pumping No.1 Borehole.

Since 2018 No.1 borehole has been used to feed the factory. The pumping rate has been 1350 m^3/day for about 5.5 days/week, shutting down on Saturday and restarting on Monday of each week. This pattern was adhered to during the pretest period, allowing an assessment to be made.

As will be seen in Graph 3, on each cycle the level drops rapidly, and then stabilises, in about 1 day. It then remains steady for the remainder of the cycle, indicating equilibrium conditions have been established.

It is also to be noted that the water table in trending upwards at 9mm/day, indicating that recharge is exceeding abstraction.

12.1 Long Term Effects in the No.1 Production, Car Park and Deep River Boreholes

A comparison of Graphs 1, the 2025 pretest levels, and 1A , the 2018 pretest levels, shows the overall effect on the water table in the immediate area. The comparison is shown in table 12.1A below :

Table 12.1A

Change in Water Level 2018 – 2025

Borehole	Change in Level (m)	Distance (m)
Car Park	-0.8	171
Deep River	-0.1	194

It is emphasised that no attempt has been made to correct these figures for seasonal variation in levels

A detailed comparison of the phase graphs for 2018[33], with the 2025 Graphs 3,5,& 6. Shows that at the same pumping rate the drawdown at the equilibrium point has reduced. A comparison is given in table 12.1B below

Table 12.1B

Comparison of drawdown in 2018 and 2025
At pumping Rate of 1350 m^3/day In No.1 Production Borehole

Borehole	Drawdown (m) 2018	2025
No. 1 Production B/H	29.5	21
Car Park B/H	0.29	0.28
Deep River	0.14	0.15

These figures suggest that there has been significant flow path development in the bedrock

They also demonstrate the mitigating effects of the weathered zone, partially in the Car Park Borehole, and totally in the Deep River Borehole.

12.2 Immediate Effect of Pumping

Graph 1 shows the immediate effect of pumping cycles in No.2, Car Park, and Deep River Boreholes, during the pretest period. This can be quantified by examination of the individual graphs. The amplitude of the movement in the three boreholes is given in Table12.2 below

Table 12.2
Amplitude of Movement in Monitoring Boreholes
(No.1 Borehole Pumping)

Borehole	Amplitude of movement (m)

No.2 Production Borehole	0.4
Car Park	0.27
Deep River	0.155

A depression of 0.4 m in No.2 borehole will not affect its performance.

The drift borehole has not been included as there was no evidence of any effect in the 2025 monitoring

12.3 Aquifer Parameters

The effects of No.1 Borehole Pumping during the pretest period can clearly be seen on in the pretest Car Park Graph – Graph 6. The start of pumping can be identified very accurately. The Pumping phase starting at. -13,185 mins has been analysed to determine the aquifer parameters. The analysis is shown in Graphs 27 and 27A. A similar exercise on the No.1 borehole data allows the Transmissivity to be determined (Graph 28)

The values obtained are given in Table 12.3 below.

Table 12.3
Aquifer Parameters for Car Park and No.1 Borehole
(No.1 Borehole Pumping)

Analysis Method	Borehole	Transmissivity (m^2/day)	Storage Coeff
Cooper Jacob	Car Park	2129	1.9×10^{-2}
Theis	Car Park	1933	$1.7 \times 10^{=2}$
Cooper Jacob	No.1 B/H	375	-

The value of Transmissivity is nearly double the values obtained in the 2018 test. This would be expected if flow paths have developed in the bedrock. There could be development in the weathered zone as well, but the identification of the exact timing of the effect in the Deep River Borehole is uncertain because of other effects.

The value of storage coefficient is of the same order as in the 2018 test.

12.4 Conclusion on the Operation of No.1 Borehole

No.1 Borehole has been operating for 8 years and on the evidence provided during the pretest monitoring period in 2025, it is concluded that:

12.4.1 No. 1 Borehole is capable of being pumped at 1350 m^3/day on a long term basis.

12.4.2 Water levels stabilise after c1 days pumping, when equilibrium conditions are achieved.

12.4.3 Flow paths have developed in the bedrock and as a result there has been a significant reduction in the drawdown.

12.4.4 The radius of practical effect is c300m.

12.4.5 Recharge is exceeding abstraction.

13.0 CONCLUSIONS OF HIA

It is concluded that

13.1 The site is on the west bank of the River Dee, and above the Triassic Sandstone group, which is confined by thick drift deposits.

13.2 The geological mapping suggests the site is above the Kinnerton Sandstone Unit, but there is substantial evidence to suggest the site is above the Chester Pebble Beds.

13.3 Seismic evidence suggests that the dip is nearly due east and the angle of dip is c22^o.

13.4 The anisotropic nature of the aquifer causes an elliptical cone of depression with the long axis in a north – south direction.

13.5 The cone of depression develops in two stages, initially up the beds exposed in the pumping well, to the weathered zone, and then spreading out in the high permeability weathered zone.

13.6 Recharge is indirect, coming from the drift granular layers, through holes in the lower Boulder clay and into the high permeability weathered zone, from where it is transferred to the active bedrock zone.

13.7 No.1 Production Borehole has been operating for 8 years and levels have stabilised. The drawdown has reduced, indicating the development of flow paths in the Bedrock. The water levels were rising indicating recharge exceeds abstraction.

13.8 Basic estimates suggest recharge is many times greater than proposed abstraction.

13.9 Abstraction of 2,700 m^3/day, 976 Ml/year is sustainable.

13.10 There will be no measurable effects on any water features or other abstractors

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June 2026

INDEX OF FIGURES and MAPS

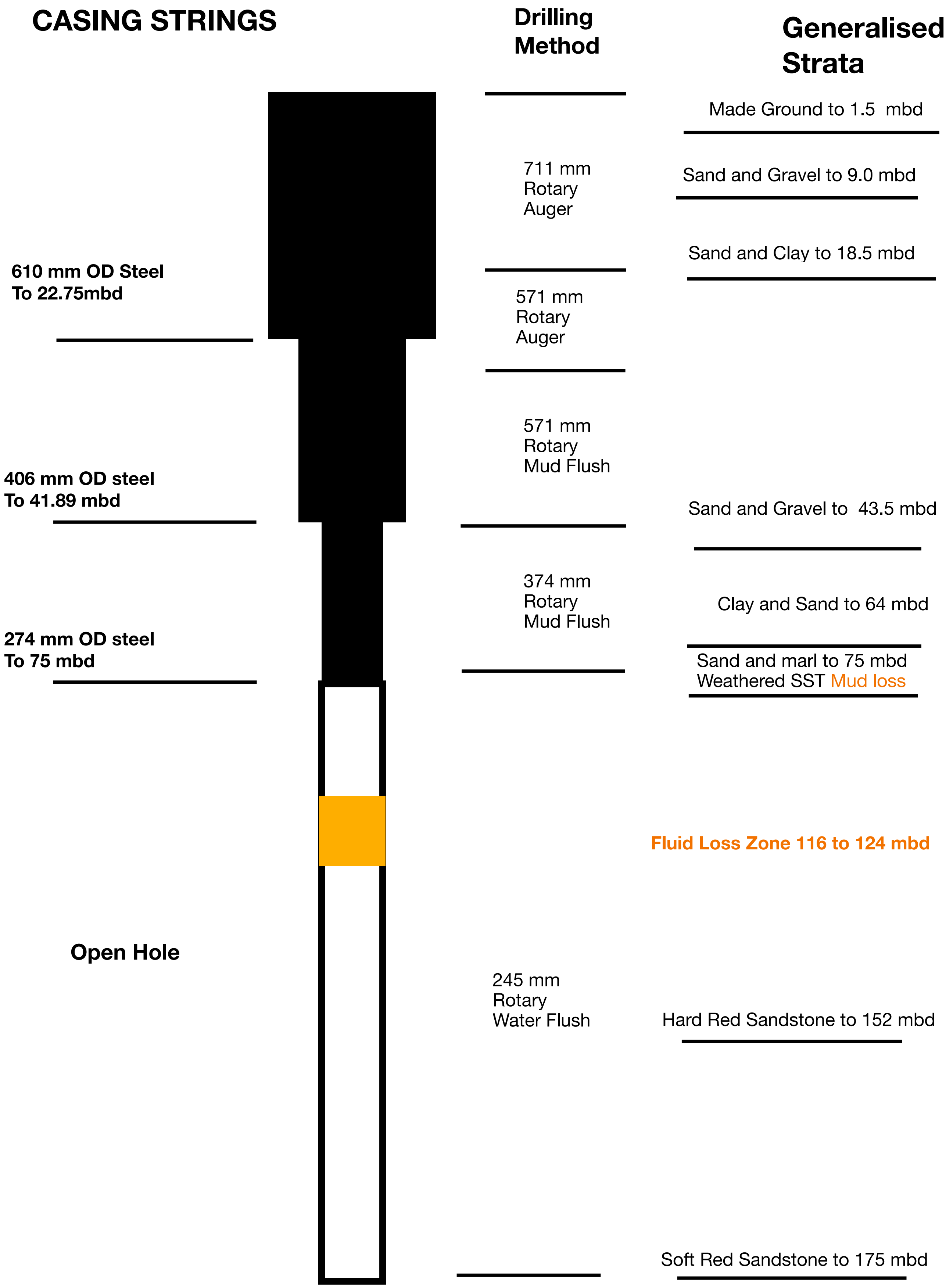
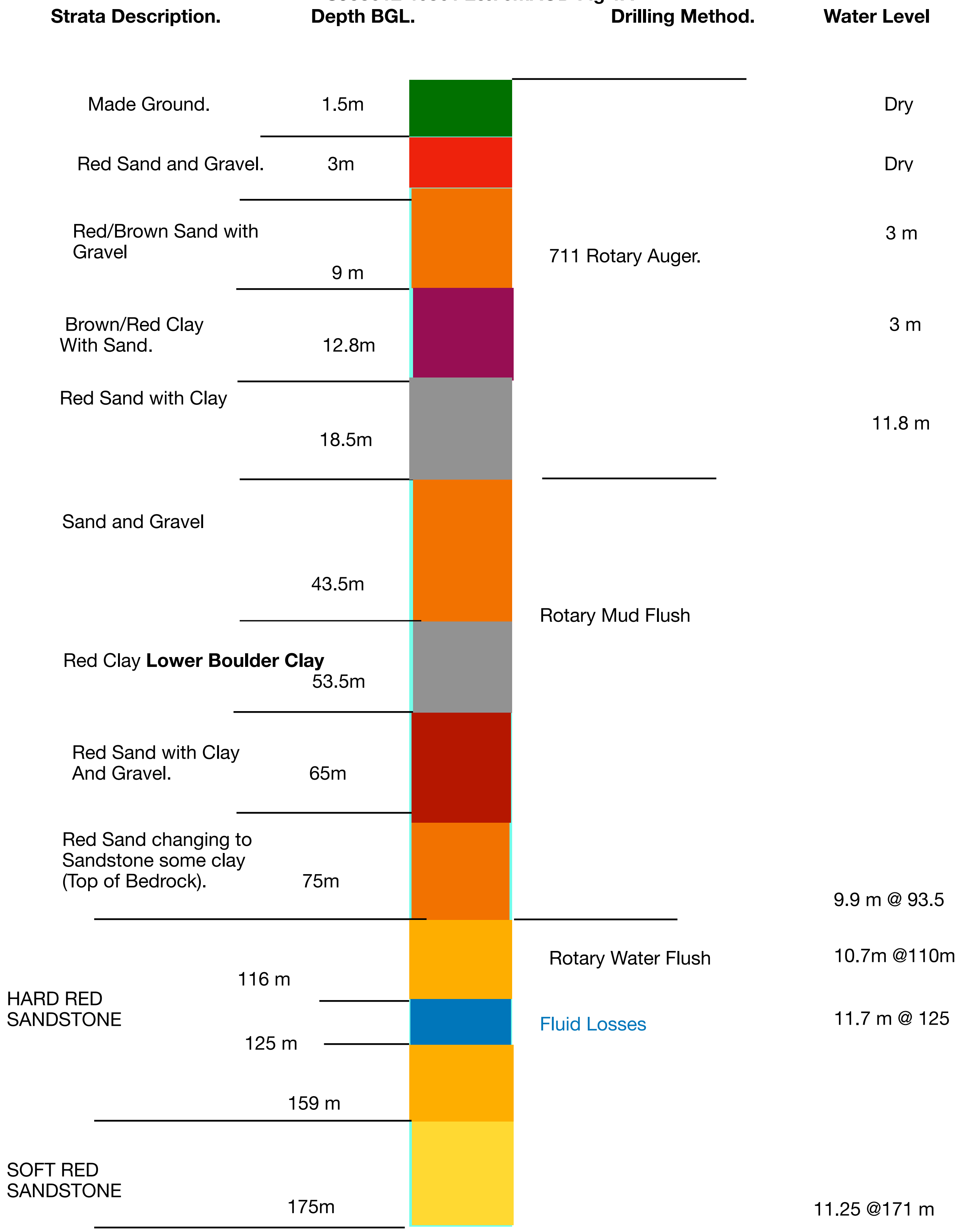
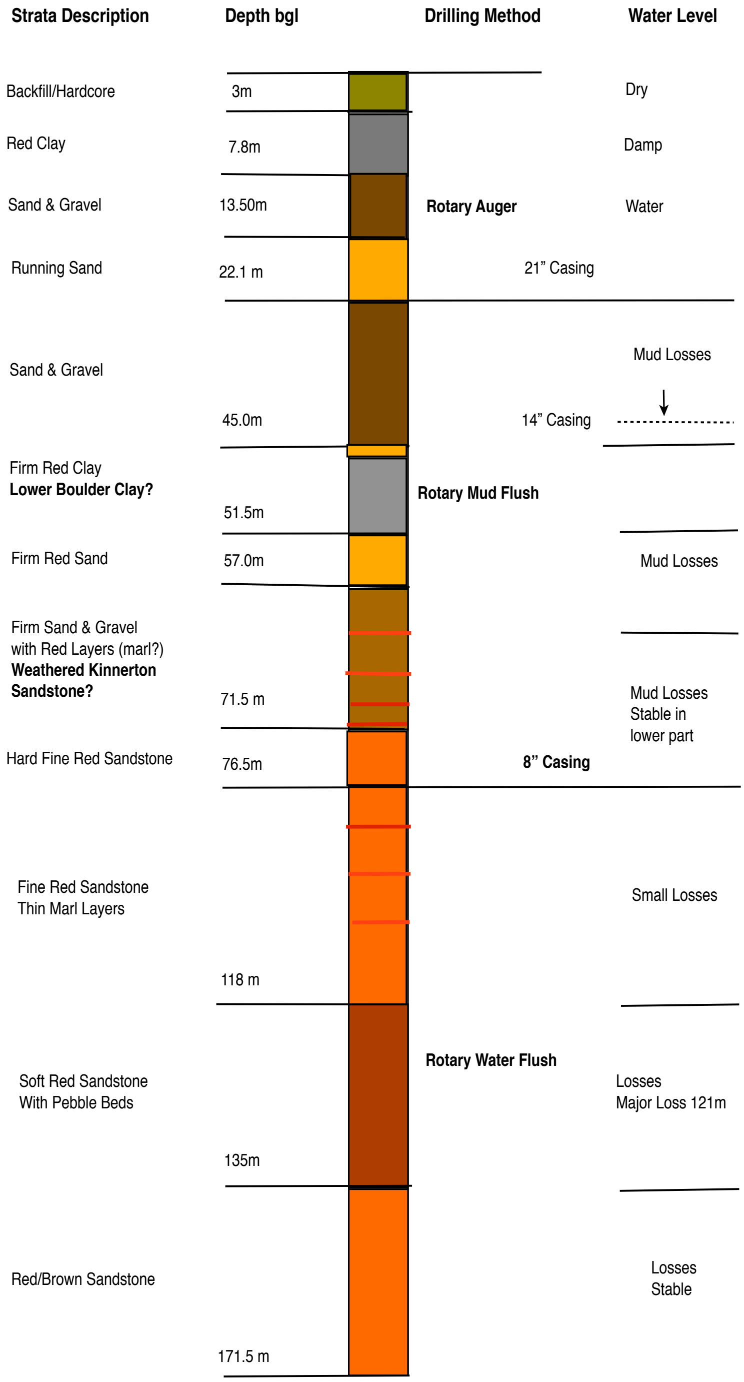


Fig 1 SUMMARY OF CONSTRUCTION

Maelor Foods Ltd No.2 Production Borehole Drillers Log Interpretation
SJ38612 46861 25.76mAOD Fig 1A

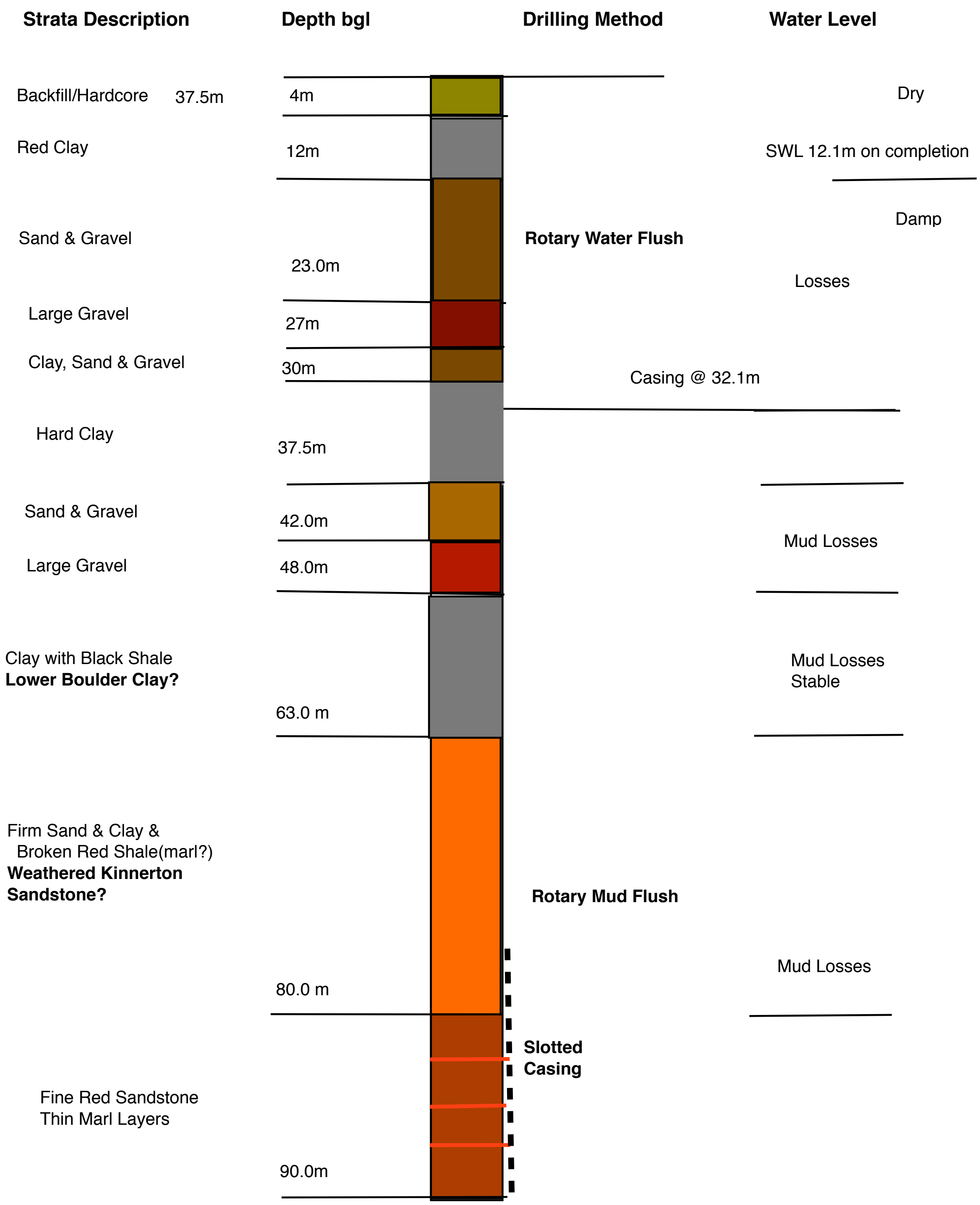


Maelor Foods Ltd - Production Borehole Drillers Log Interpretation
SJ 38673 46737 24.8 mAOD

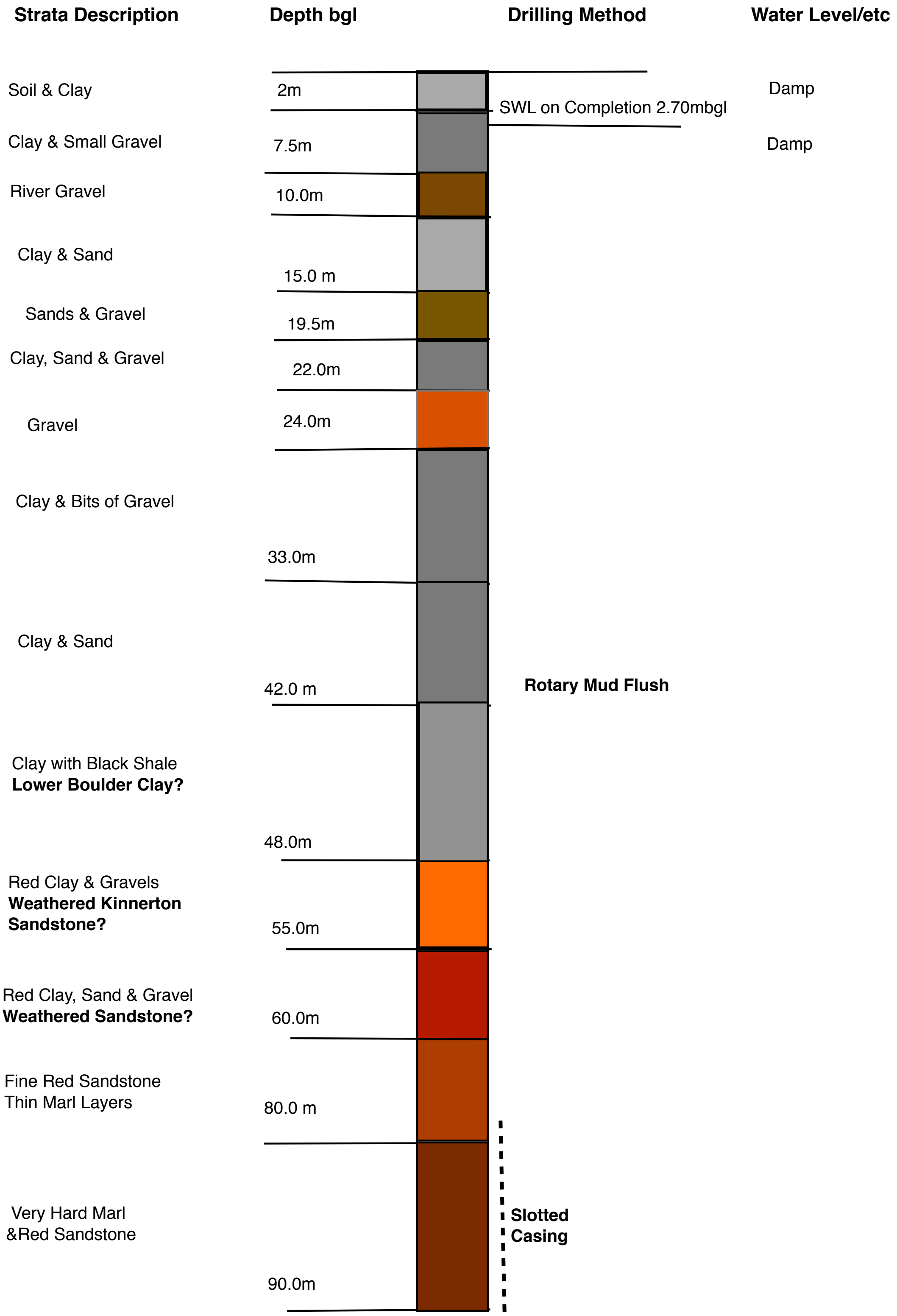


ß

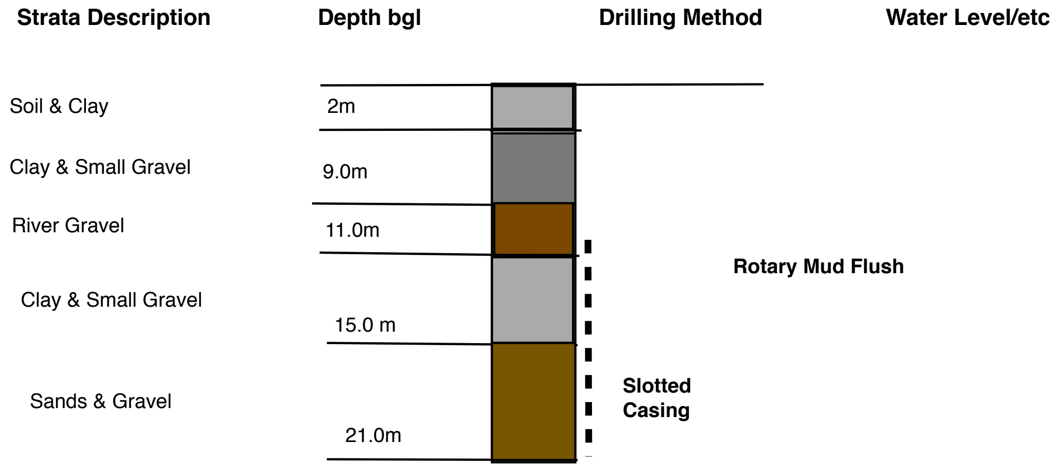
Maelor Foods Ltd - Car Park Observation Borehole (1) Drillers Log Interpretation
SJ 38582 46884 27.0 mAOD



Maelor Foods Ltd - Deep River Dee Observation Borehole (2) Drillers Log Interpretation
SJ 38778 46574 17.6 mAOD



Maelor Foods Ltd - Drift River Dee Observation Borehole Drillers Log Interpretation
SJ 38770 46572 17.6 mAOD



Borehole record form

British Geological Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Environment Agency

Water Resources Act 1991 (as amended by the Water Act 2003)

A Site details

Borehole drilled for: Maelor Poultry Ltd

Location: Pickhill Lane, Cross Lanes, Wrexham, LL13 0UE

NGR (ten digits): SJ 38615 46828 — Please attach site plan

Ground level (if known): ______ metres Above Ordnance Datum

Drilling company: P.R.Marriott Drilling Ltd

Date drilling commenced: 03/10/2024 (DD/MM/YYYY) Completed: 10/12/2024 (DD/MM/YYYY)

B Construction details

Borehole datum (if not ground level): 0.3 metres (m). Please tick if this is above ☑ or below ☐ ground level.
(point from which all measurements of depth are taken, for example, flange, edge of chamber)

Borehole drilled diameter:

mm	from	to (m/depth)
711	GL	27.5
571	27.5	43.5
374	43.5	75
246	75	175

Casing material and type (for example, if plain steel, plastic slotted). Please record permanent casing details, not temporary casing.

Casing material	diameter (mm)	from	to (m/depth)
Plain Steel	274	+0.3	75
Steel	610	GL	22.75
Steel	406	GL	41.69

Grouting details: All strings pressure grouted through float shoe. using straight cement grout

Water struck at 1. 3.0 m (depth below datum – mbd) 2. 19.0 m (mbd)
3. 64 m (mbd) 4. ______ m (mbd)

C Test pumping summary (Please supply full details on form WR39)

Test pumping datum (if different from borehole datum): ______ m. Please tick if this is above ☐ or below ☐ ground level.

Pump suction depth: 70 mbd

Water level (start of test): 12.95 mbd

Water level (end of test): 50.54 mbd

Type of test (for example, bailer, step, constant rate): ______

Pumping rate: 56.21 m³/hour ☑ or litres/second ☐. Please tick as appropriate.
for 16 days, 0 hours, 0 mins

Recovery to 12.840 mbd in 1 days, 5 hours, 30 mins
(from end of pumping)

Date(s) of measurements: Pump started 25/06/2025 (DD/MM/YYYY)
Pump stopped 11/07/2025 (DD/MM/YYYY)

Please supply chemical analysis if available. If you have included this please tick this box ☐

D Strata log

Geological classification (BGS only)	Description of strata	Thickness m	Depth (to base of strata) m
	Made Ground	1.5	1.5
	Red Sand and Gravel	1.5	3.0
	Red/Brown Sand and Gravel	6.0	9.0
	Brown/Red Clay with sand	3.8	12.8
	Red sand and clay	5.7	18.5
	Small Gravel	0.5	19.0
	Red Sand	8.5	27.5
	Green sand with small gravel	0.8	28.3
	Red sand and small gravel	15.2	43.5
	Red Clay and sand	2.3	45.8
	Red Clay	7.7	53.5
	Red sand with clay	2.0	55.5
	Red sand with clay and some gravel	6.5	62.0
	Red sand with clay and lot of gravel	2.0	64.0
	Red sand with occassional gravel	6.0	70.0
	Red sand with clay and small gravel	5.0	75.0
	Hard red sandstone	77.0	152.0
	Soft Red sandstone	23.0	175.0
	Water losses between 116 and 122 mbd		
	(continue on separate page if necessary)		
	Other comments (for example, gas encountered, saline water intercepted)		

E Completing this form

How long did it take you to fill in this form?

For Official use only

Date received (DD/MM/YYYY)

File

Consent number

BGS reference number

Accession number

Wellmaster number

SOBI number

NGR

LIC NO

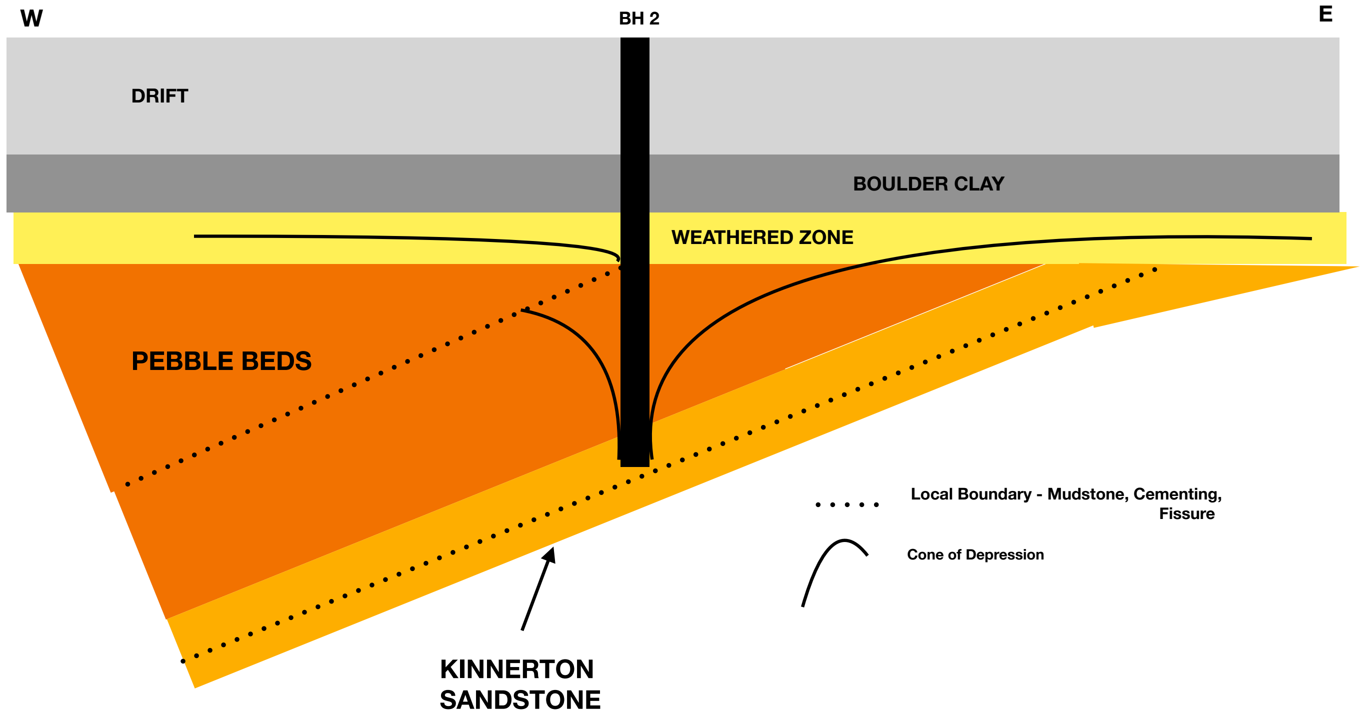
Purpose

EA reference number

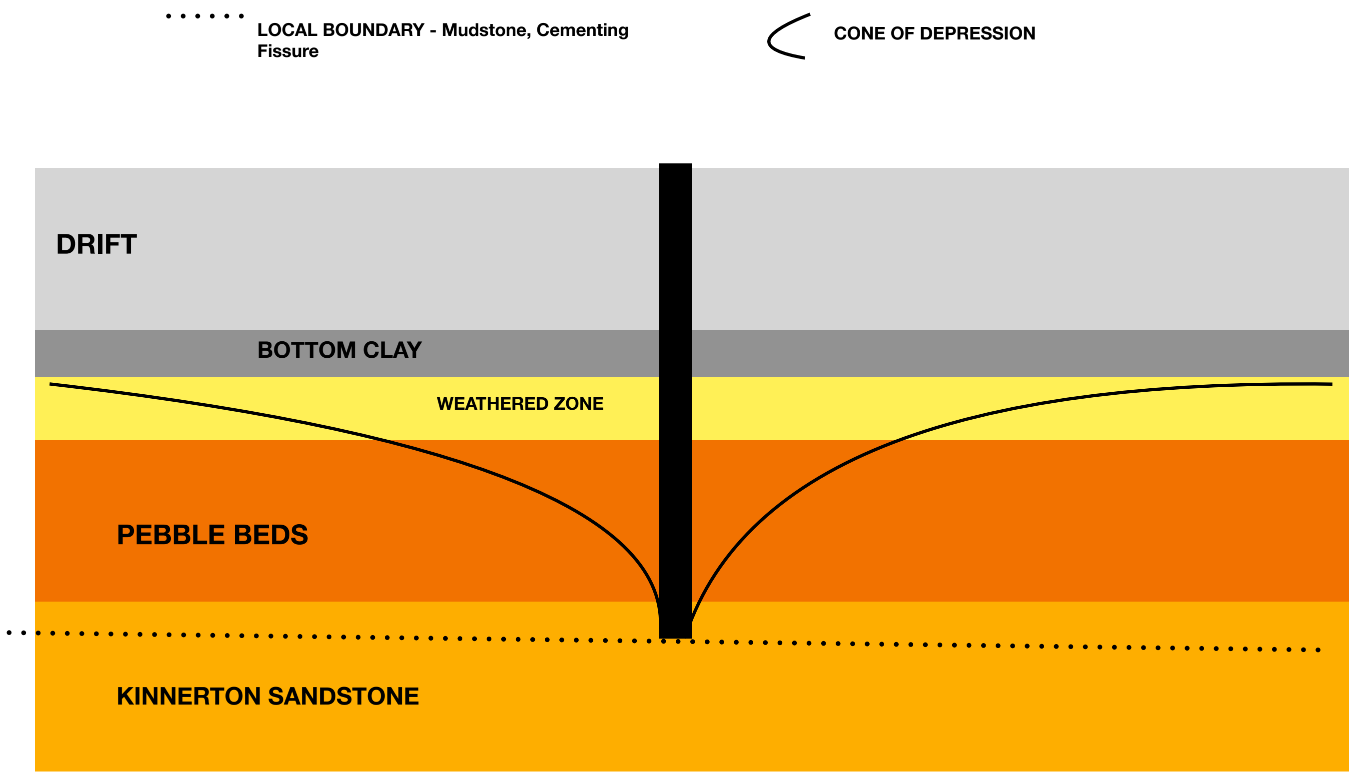
Copy number

Entered by

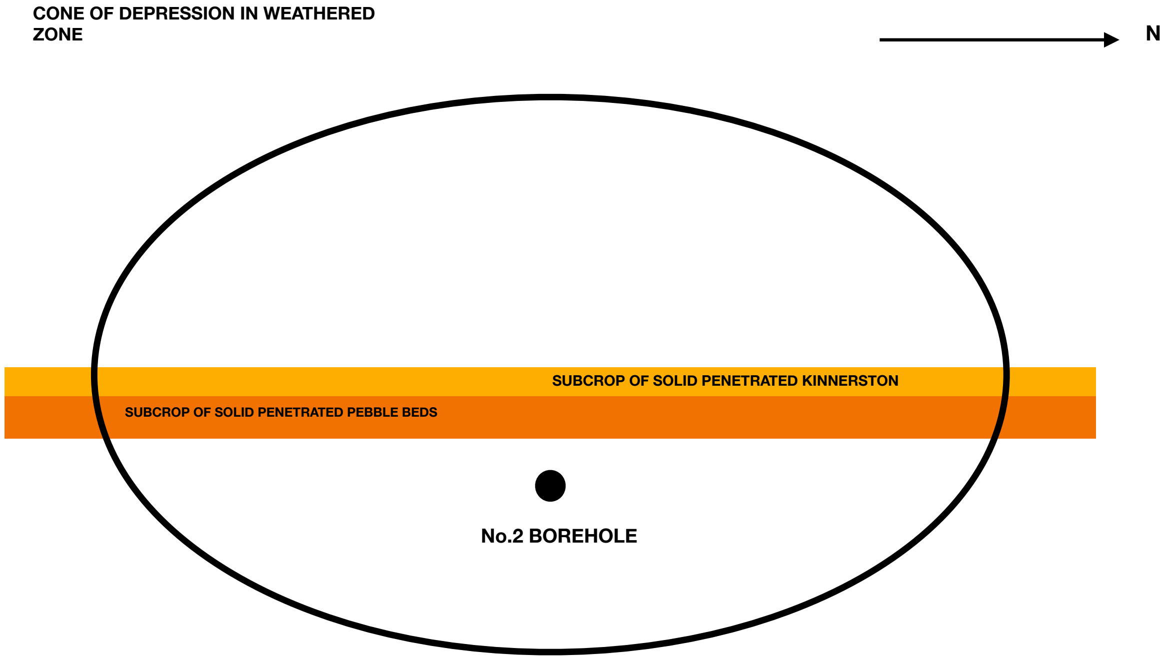
Cone of Depression E - W Section
Fig 2 A



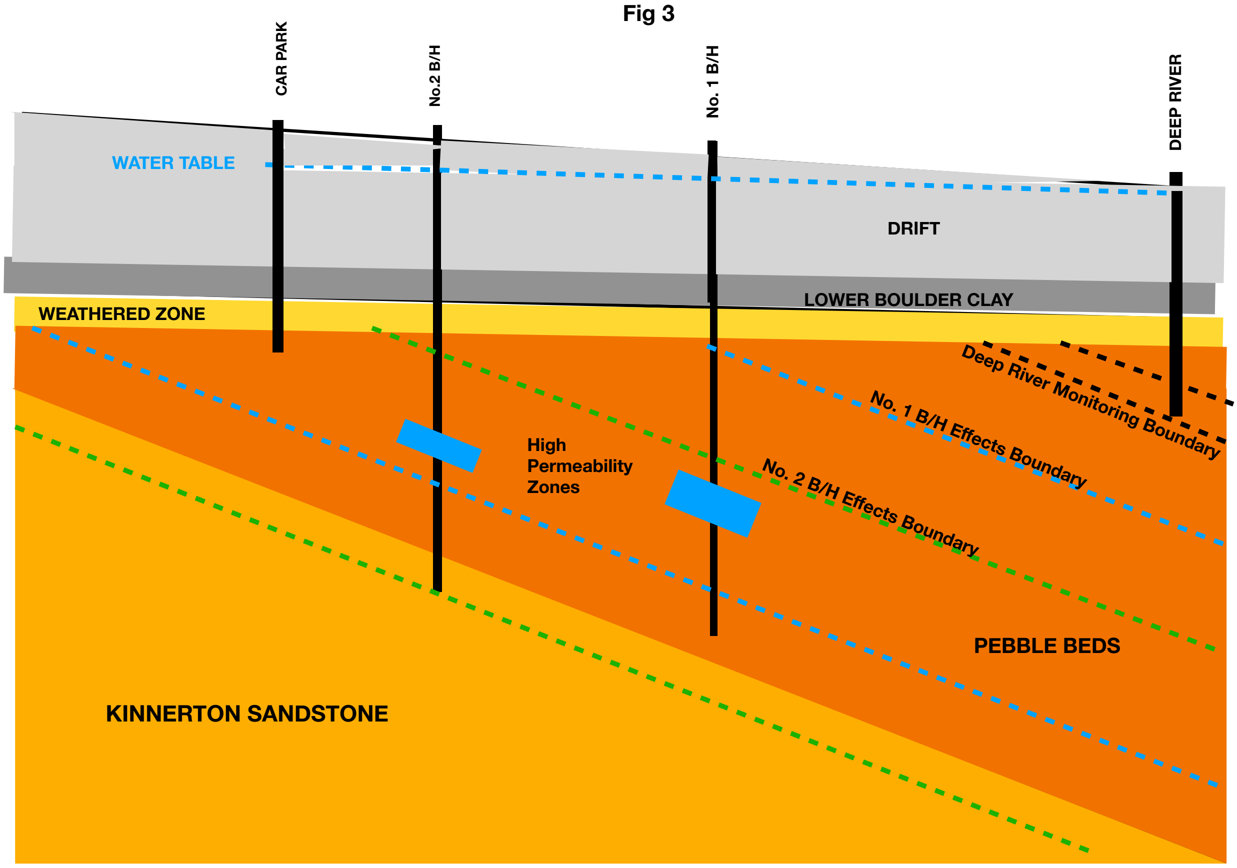
CONE OF DEPRESSION N - S SECTION
Fig 2B

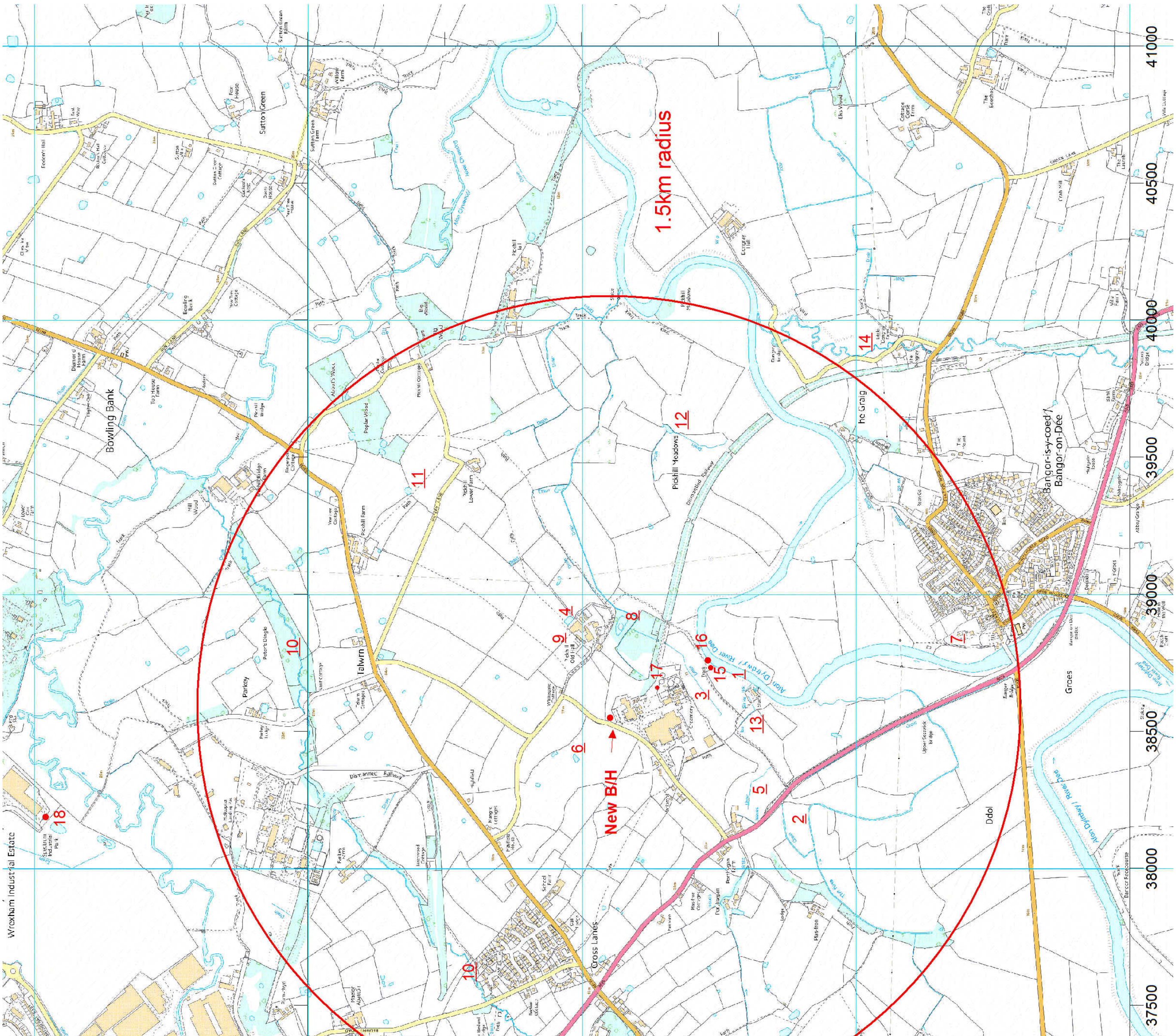


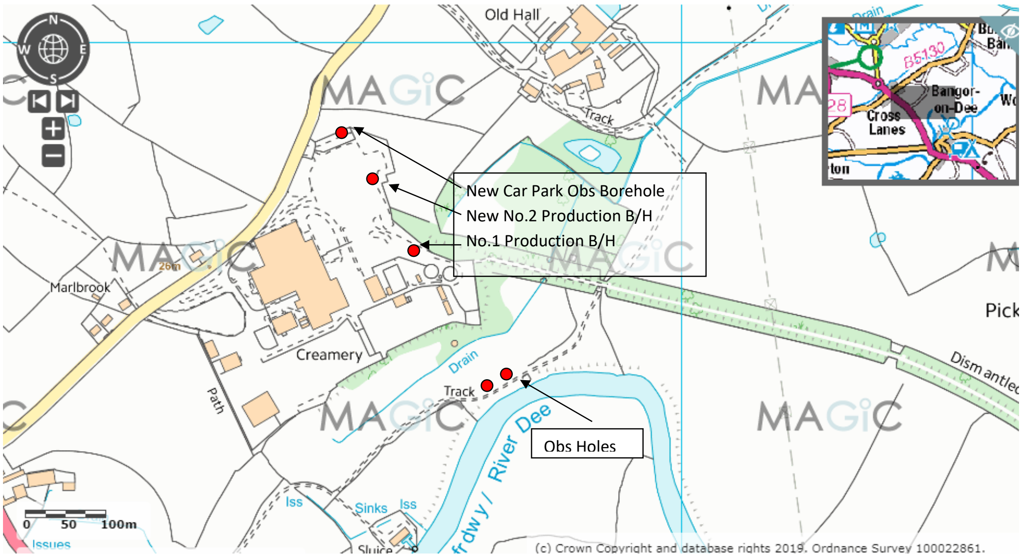
CONCEPTUAL CONE OF DEPRESSION
Fig 2C



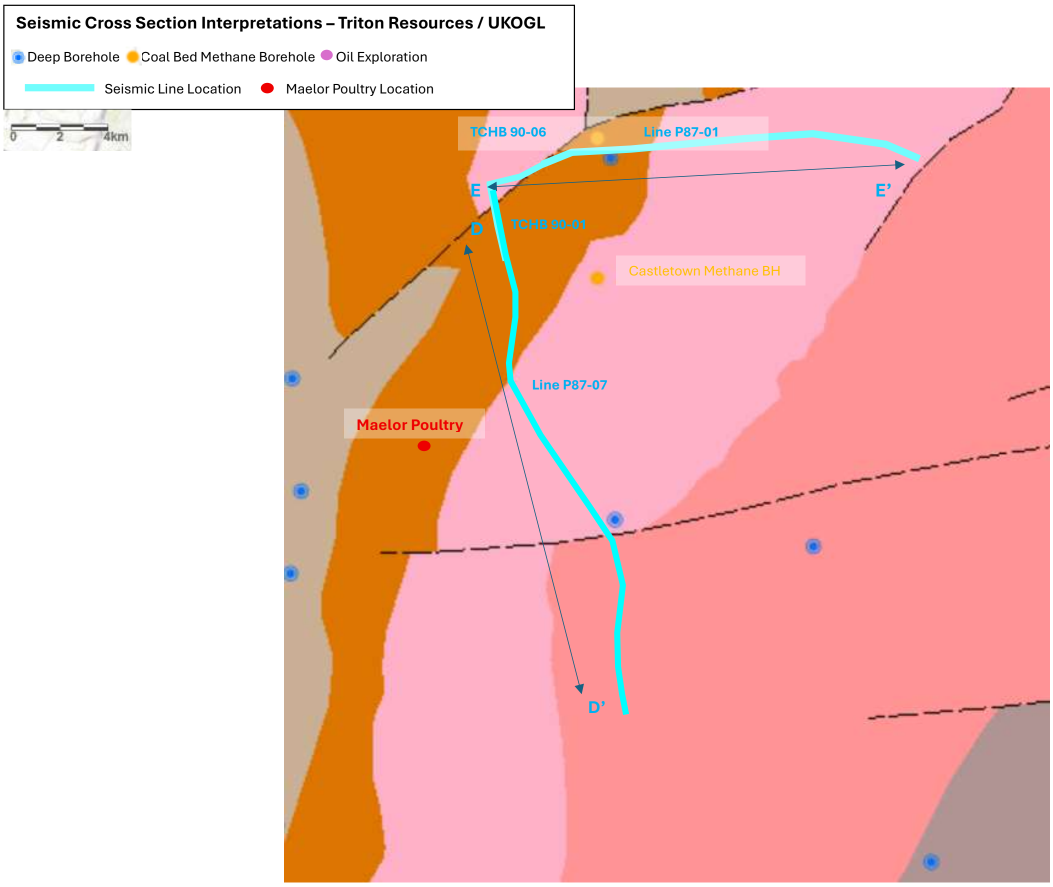
ZONES OF EFFECTS AND MONITORING
Fig 3



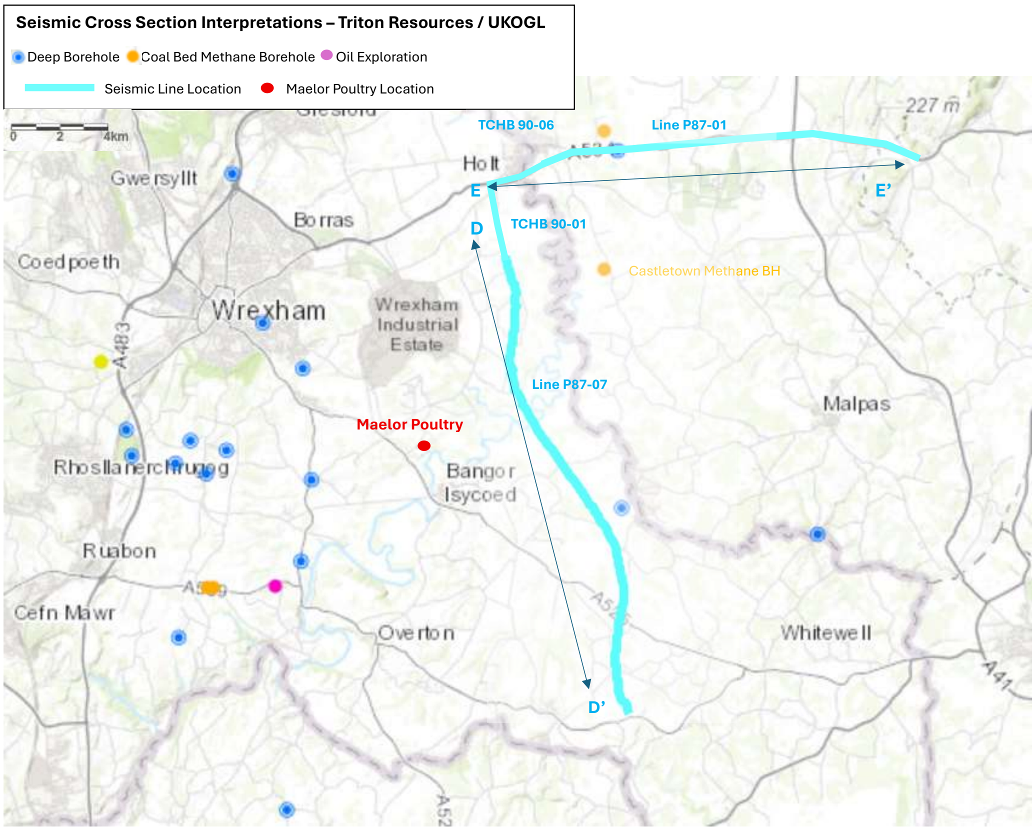

1.5km radius
New B/H
Wrexham Industrial Estate
Bowling Bank
Sutton Green
Talwrn
Cross Lanes
Pickhill Meadows
The Graig
Bangor-is-y-coed / Bangor-on-Dee
Ddol
Groes
41000
40500
40000
39500
39000
38500
38000
37500
37000
48000
47500
47000
46500
46000
45500
45000
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19



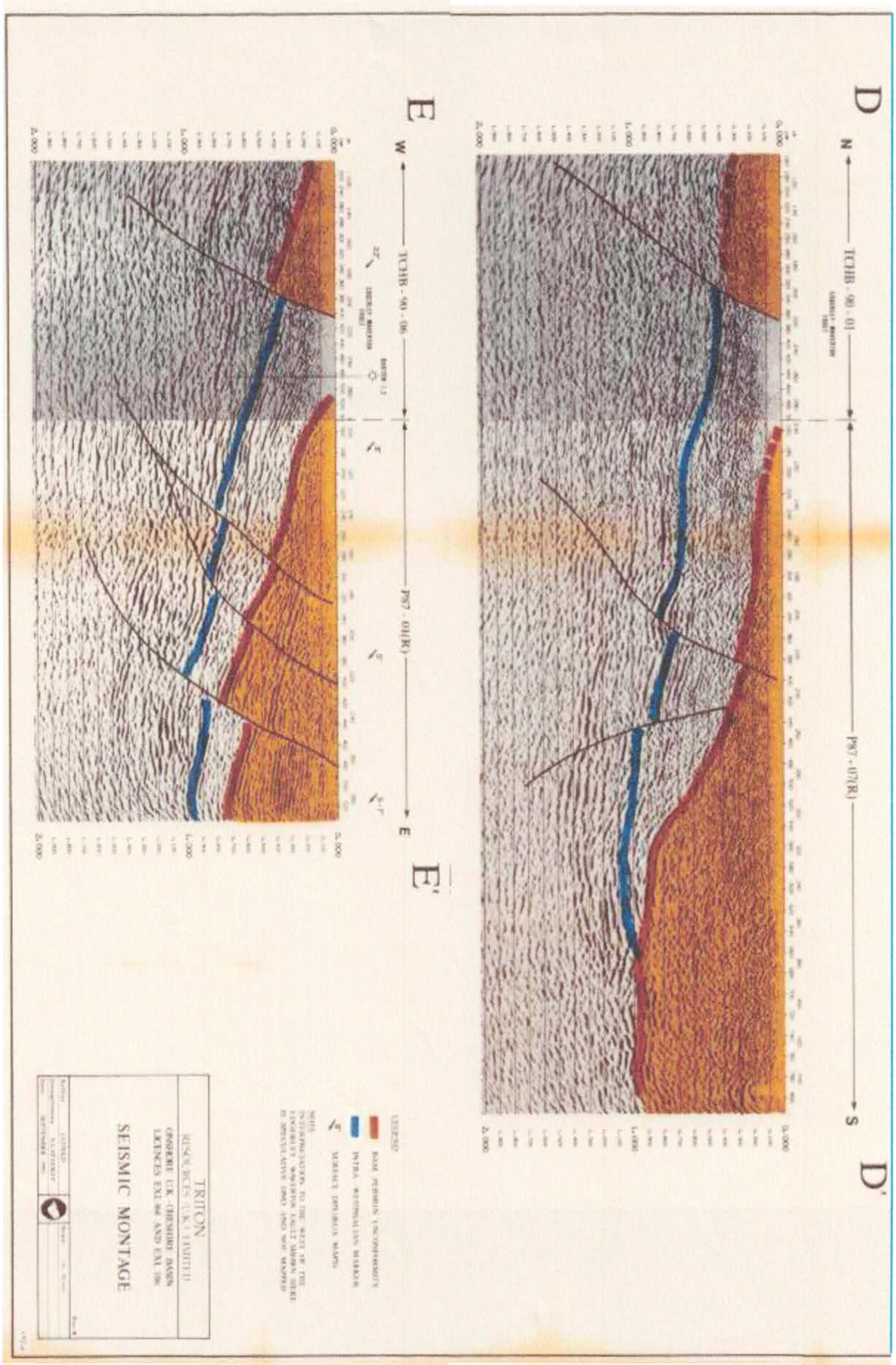
New Car Park Obs Borehole
New No.2 Production B/H
No.1 Production B/H
Obs Holes
Old Hall
Marlbrook
Creamery
River Dee
(c) Crown Copyright and database rights 2019. Ordnance Survey 100022861.

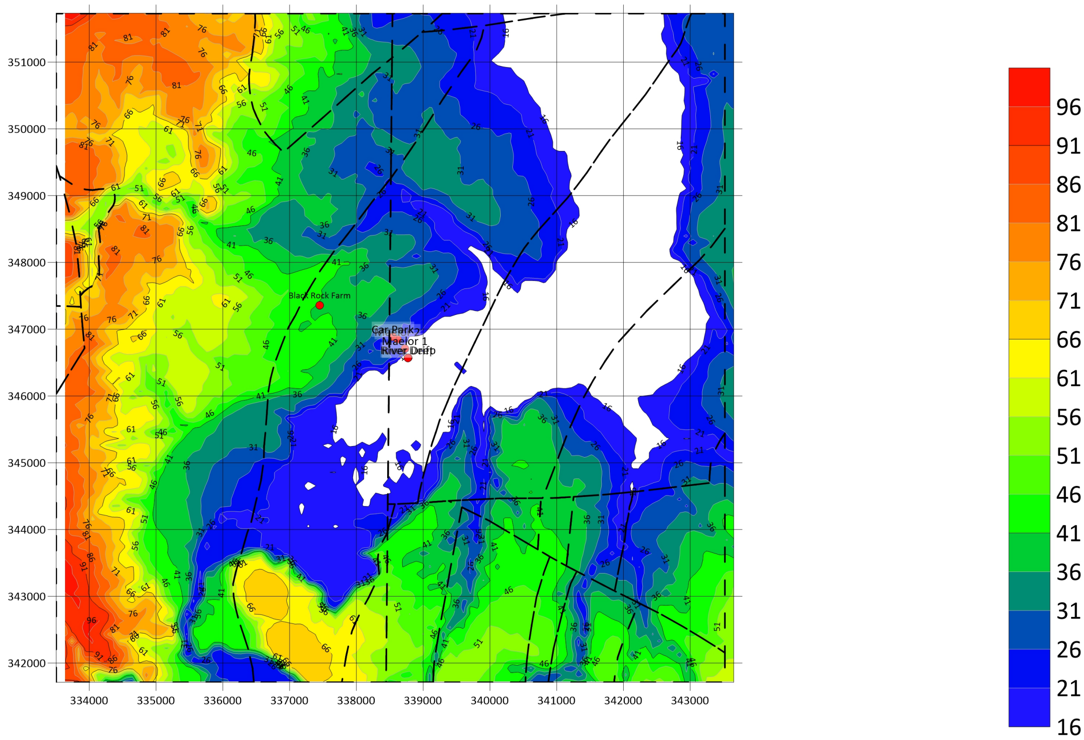


Seismic Cross Section Interpretations – Triton Resources / UKOGL
Deep Borehole
Coal Bed Methane Borehole
Oil Exploration
Seismic Line Location
Maelor Poultry Location
TCHB 90-06
Line P87-01
E
E'
D
TCHB 90-01
Castletown Methane BH
Line P87-07
Maelor Poultry
D'



Seismic Cross Section Interpretations – Triton Resources / UKOGL
Deep Borehole
Coal Bed Methane Borehole
Oil Exploration
Seismic Line Location
Maelor Poultry Location
0 2 4km
TCHB 90-06
Line P87-01
E
E'
D
TCHB 90-01
Castletown Methane BH
Line P87-07
D'
Maelor Poultry
Holt
Gwersyllt
Borras
Coedpoeth
Wrexham
Wrexham Industrial Estate
A483
Rhosllanerchrugog
Bangor Isycoed
Ruabon
Cefn Mawr
Overton
Malpas
Whitewell
227 m


D
N
TCHB - 90 - 01
P87 - 07(R)
S
D'
E
W
TCHB - 90 - 06
P87 - 01(R)
E
E'
TRITON
SEISMIC MONTAGE

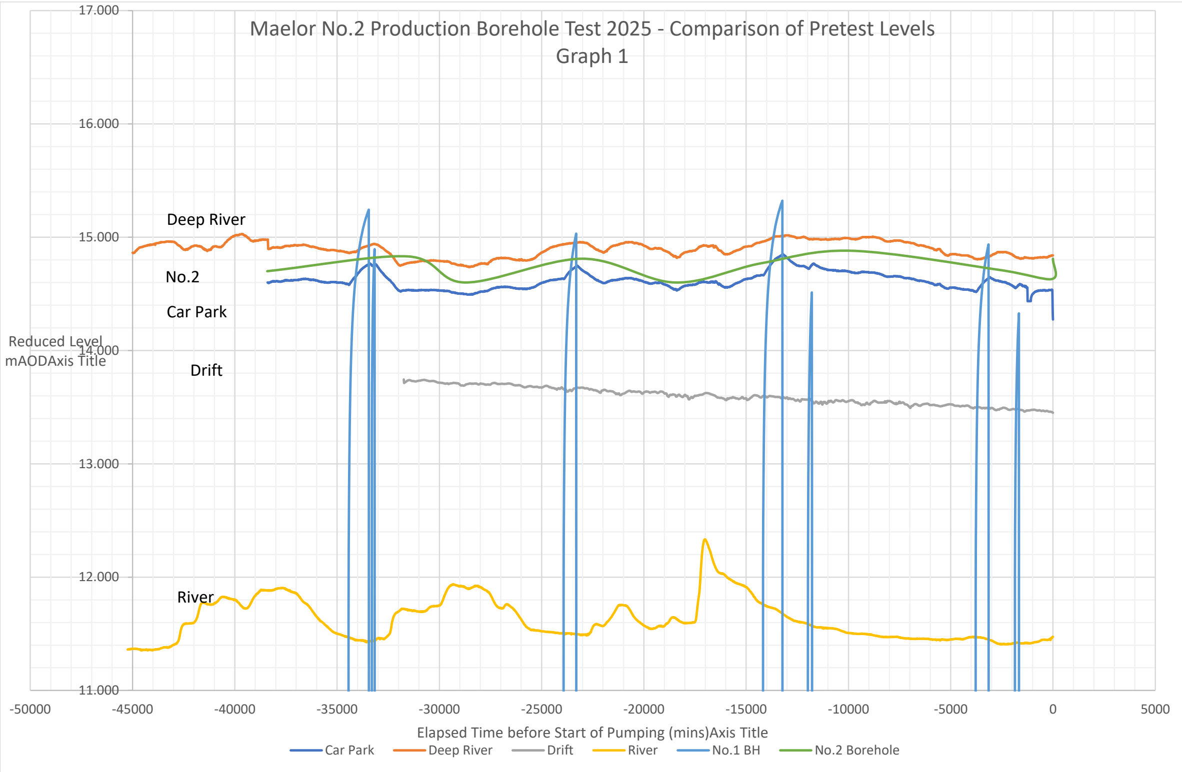


Land Above 16 mAOD

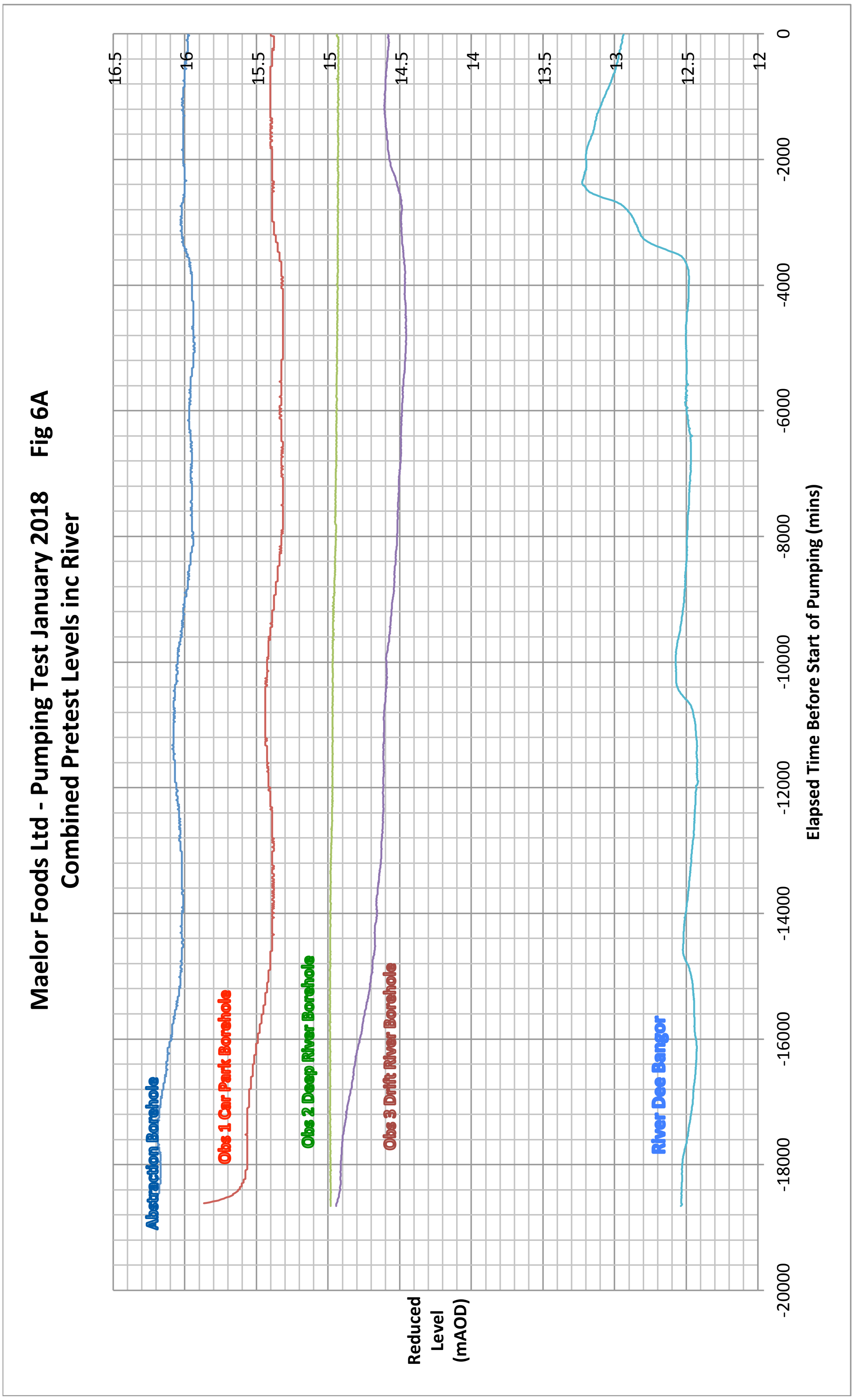
0 2000 4000 6000 8000

INDEX OF GRAPHS

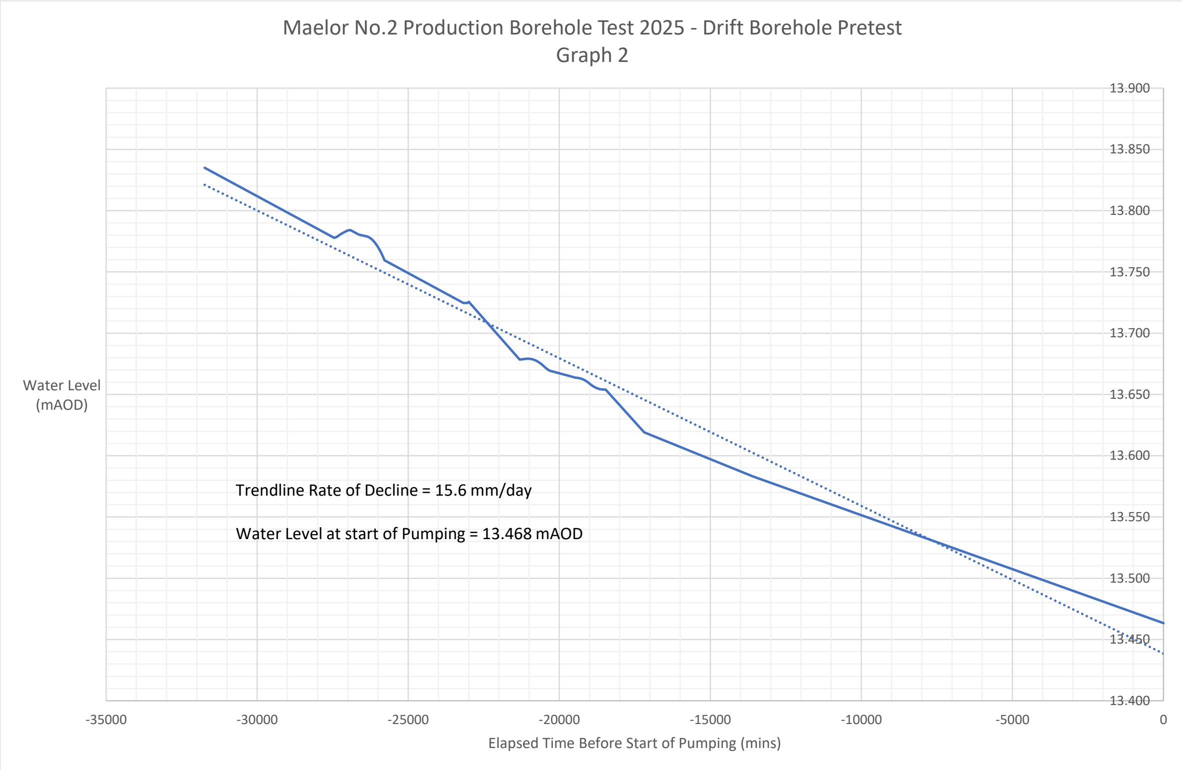
INDEX OF GRAPHS (con't)



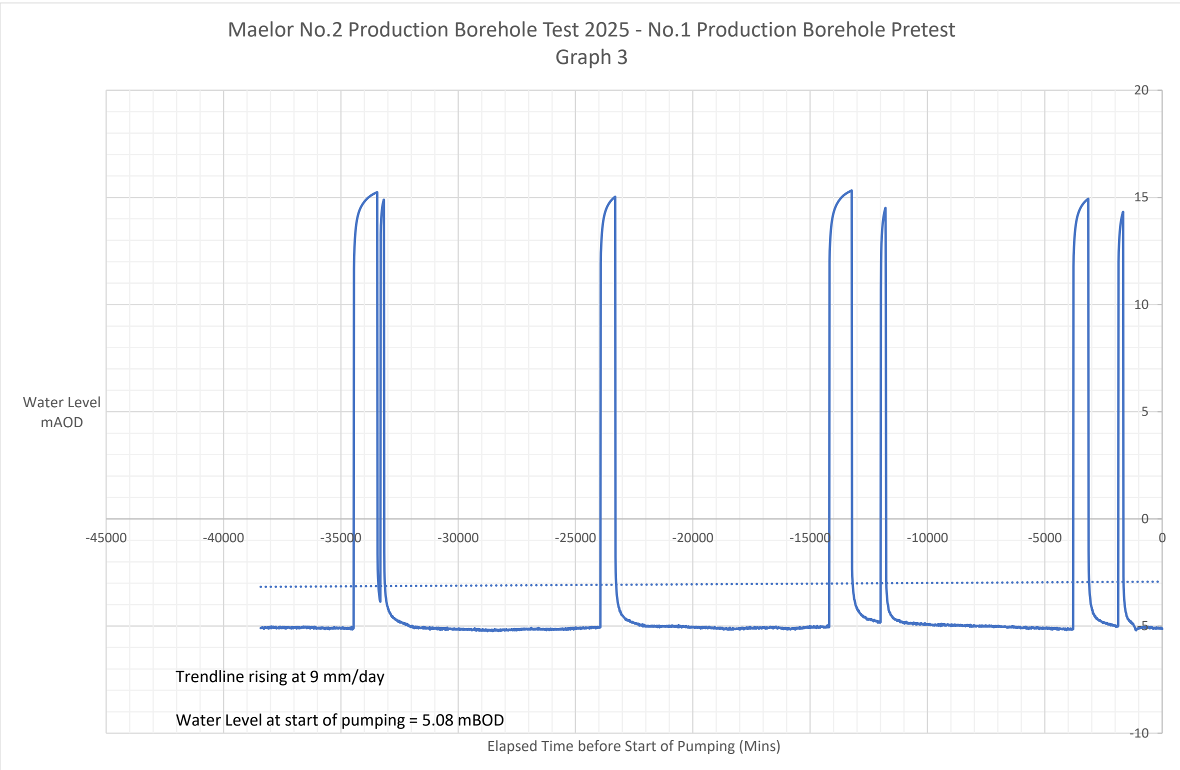
Maelor No.2 Production Borehole Test 2025 - Comparison of Pretest Levels
Graph 1
Reduced Level mAODAxis Title
17.000
16.000
15.000
14.000
13.000
12.000
11.000
Deep River
No.2
Car Park
Drift
River
-50000
-45000
-40000
-35000
-30000
-25000
-20000
-15000
-10000
-5000
0
5000
Elapsed Time before Start of Pumping (mins)Axis Title
Car Park
Deep River
Drift
River
No.1 BH
No.2 Borehole



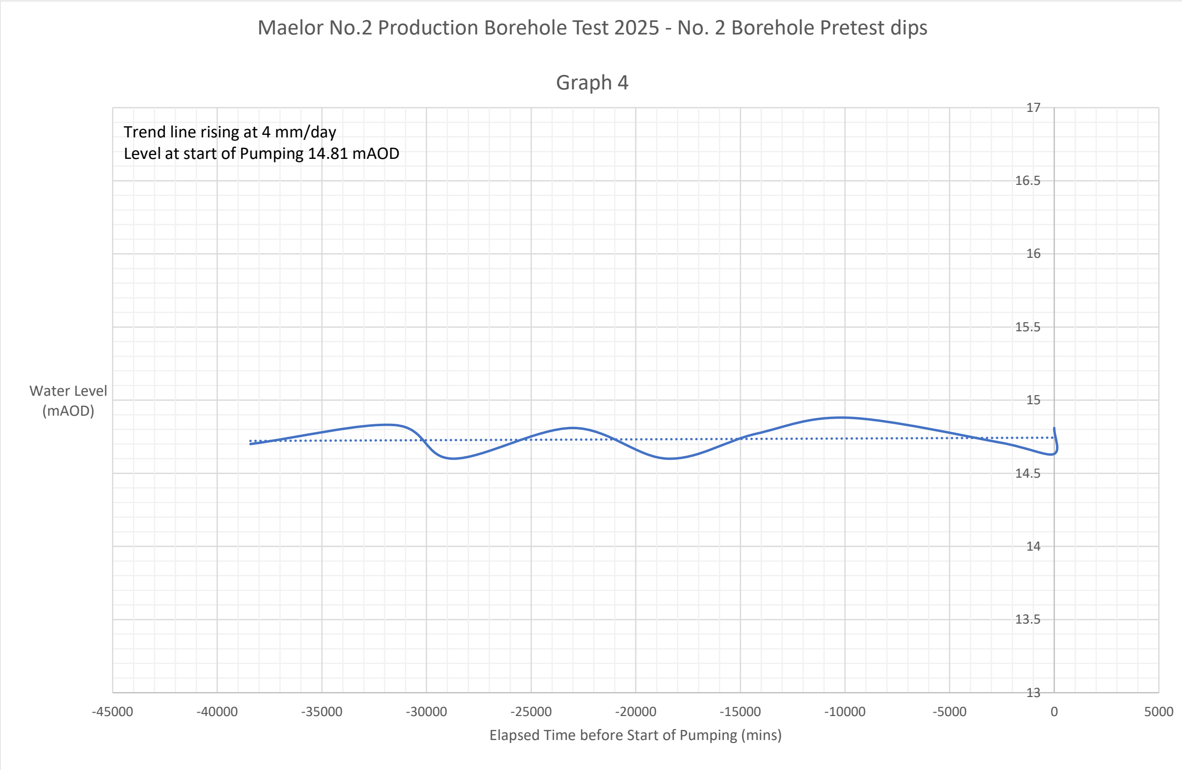
Maelor Foods Ltd - Pumping Test January 2018 Fig 6A
Combined Pretest Levels inc River
Abstraction Borehole
Obs 1 Car Park Borehole
Obs 2 Deep River Borehole
Obs 3 Drift River Borehole
River Dee Bangor
Reduced Level (mAOD)
Elapsed Time Before Start of Pumping (mins)
16.5
16
15.5
15
14.5
14
13.5
13
12.5
12
-20000
-18000
-16000
-14000
-12000
-10000
-8000
-6000
-4000
-2000
0

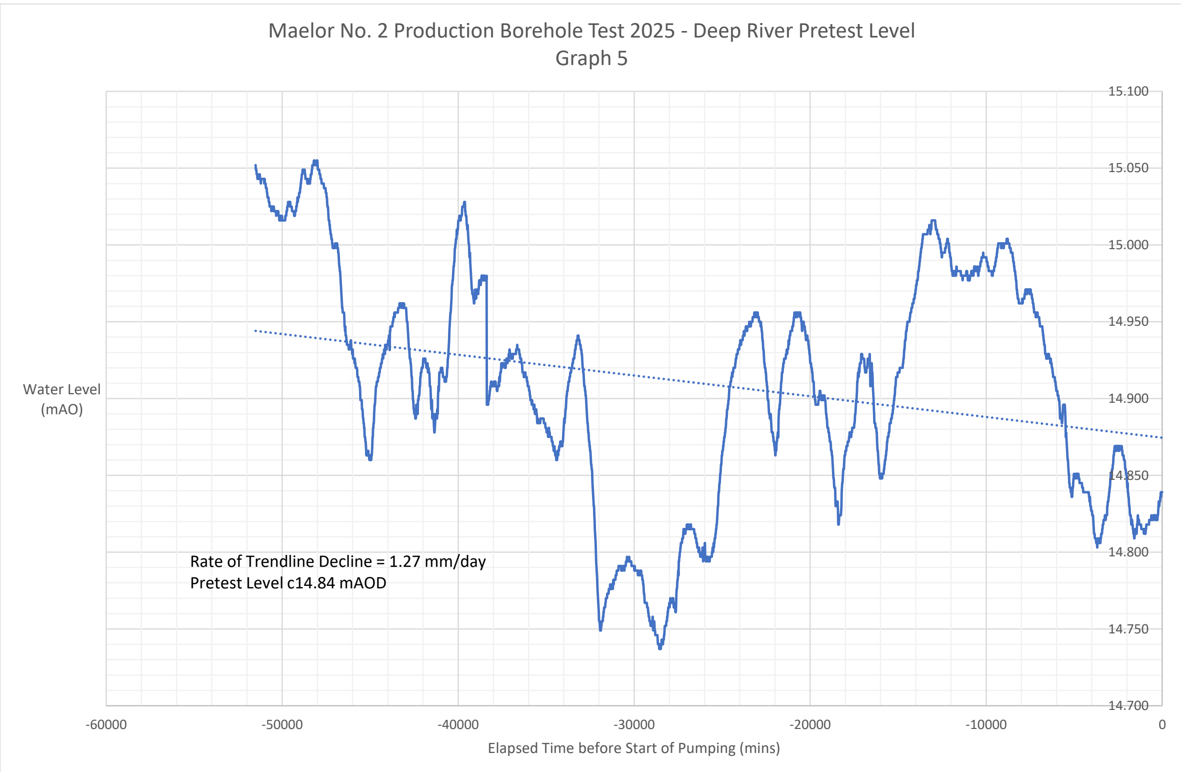


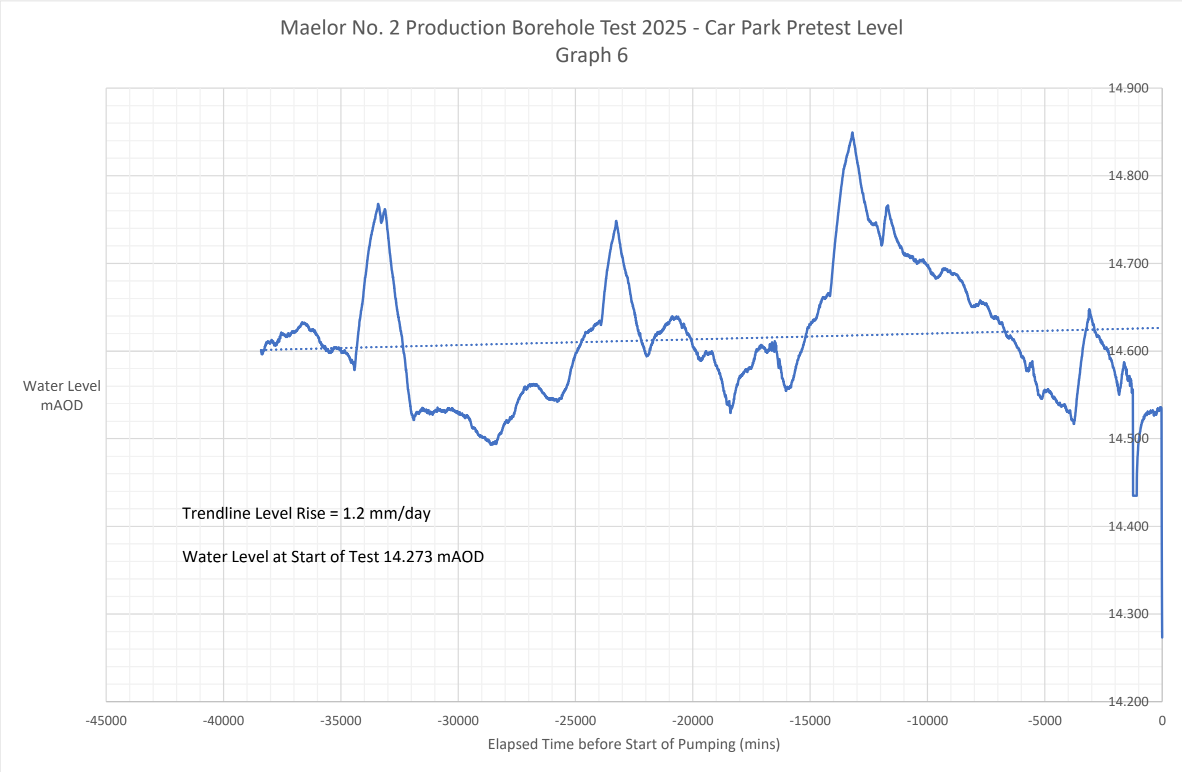
Maelor No.2 Production Borehole Test 2025 - Drift Borehole Pretest
Graph 2
Water Level (mAOD)
13.900
13.850
13.800
13.750
13.700
13.650
13.600
13.550
13.500
13.450
13.400
-35000
-30000
-25000
-20000
-15000
-10000
-5000
0
Elapsed Time Before Start of Pumping (mins)
Trendline Rate of Decline = 15.6 mm/day
Water Level at start of Pumping = 13.468 mAOD



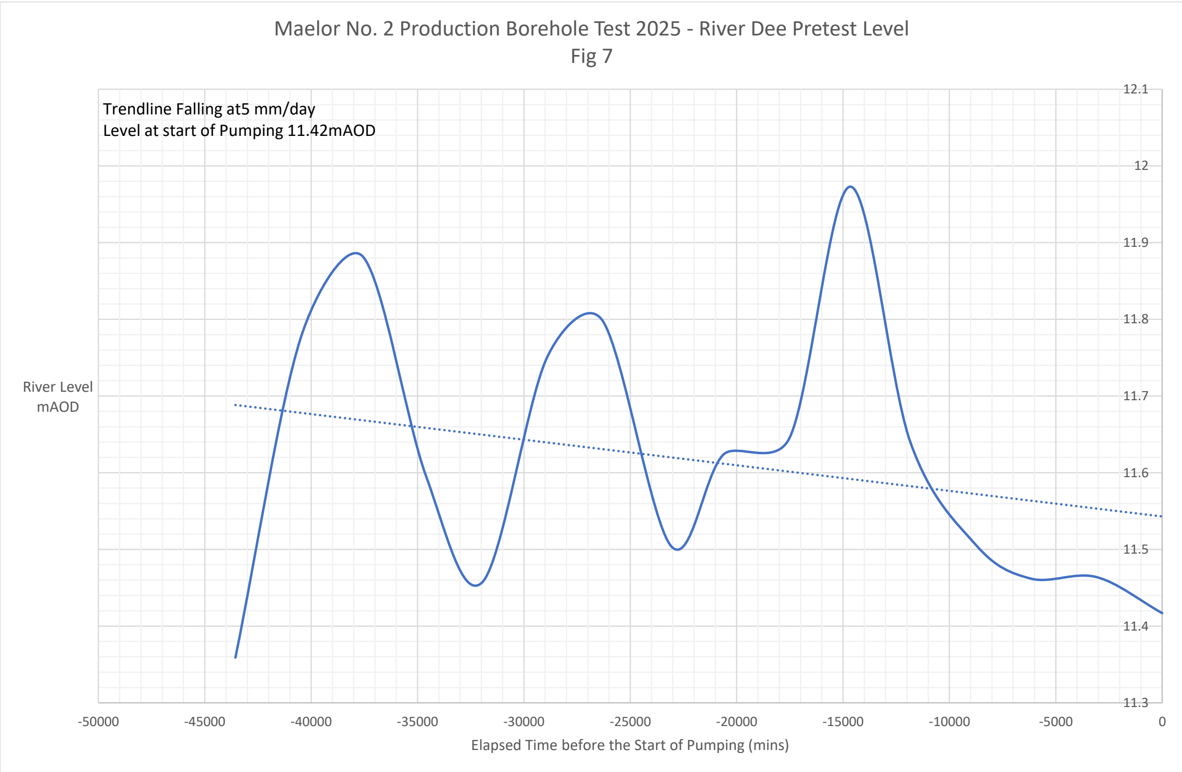
Maelor No.2 Production Borehole Test 2025 - No.1 Production Borehole Pretest
Graph 3
Water Level mAOD
20
15
10
5
0
-5
-10
-45000
-40000
-35000
-30000
-25000
-20000
-15000
-10000
-5000
0
Elapsed Time before Start of Pumping (Mins)
Trendline rising at 9 mm/day
Water Level at start of pumping = 5.08 mBOD


Maelor No.2 Production Borehole Test 2025 - No. 2 Borehole Pretest dips
Graph 4
Trend line rising at 4 mm/day
Level at start of Pumping 14.81 mAOD
Water Level (mAOD)
17
16.5
16
15.5
15
14.5
14
13.5
13
-45000
-40000
-35000
-30000
-25000
-20000
-15000
-10000
-5000
0
5000
Elapsed Time before Start of Pumping (mins)

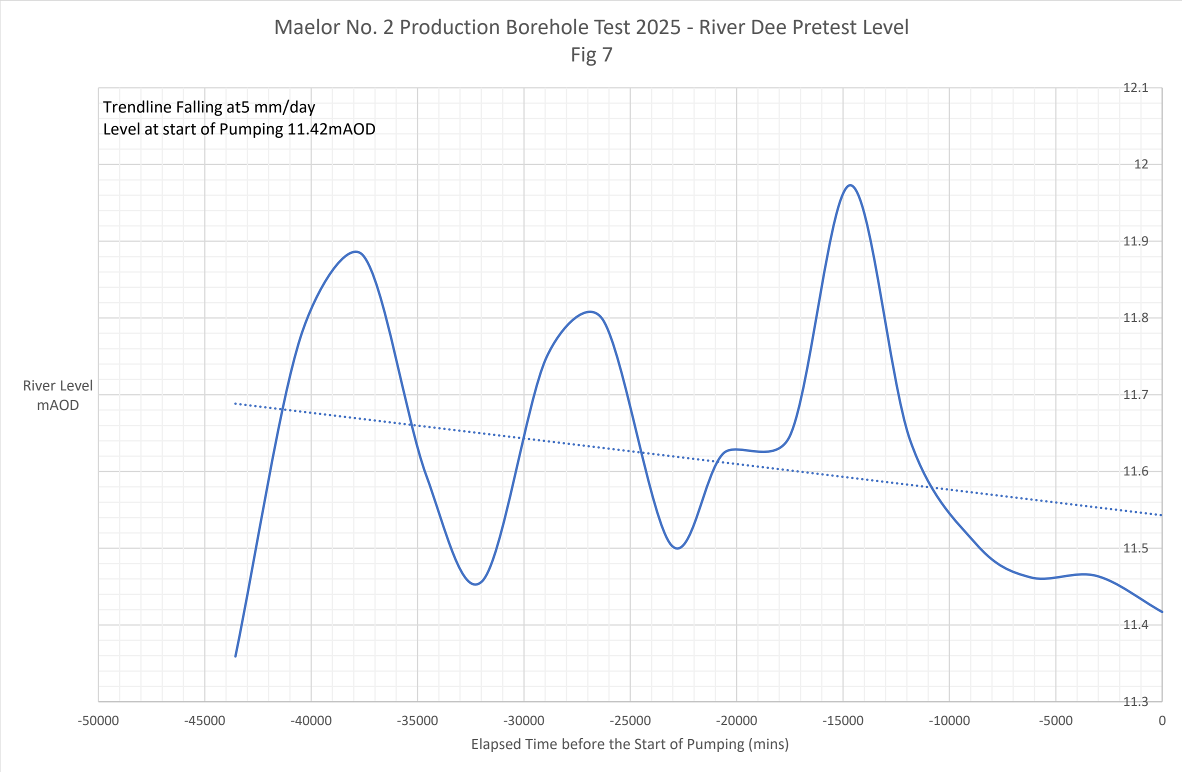

Maelor No. 2 Production Borehole Test 2025 - Deep River Pretest Level
Graph 5
Water Level (mAO)
Rate of Trendline Decline = 1.27 mm/day
Pretest Level c14.84 mAOD
15.100
15.050
15.000
14.950
14.900
14.850
14.800
14.750
14.700
-60000
-50000
-40000
-30000
-20000
-10000
0
Elapsed Time before Start of Pumping (mins)

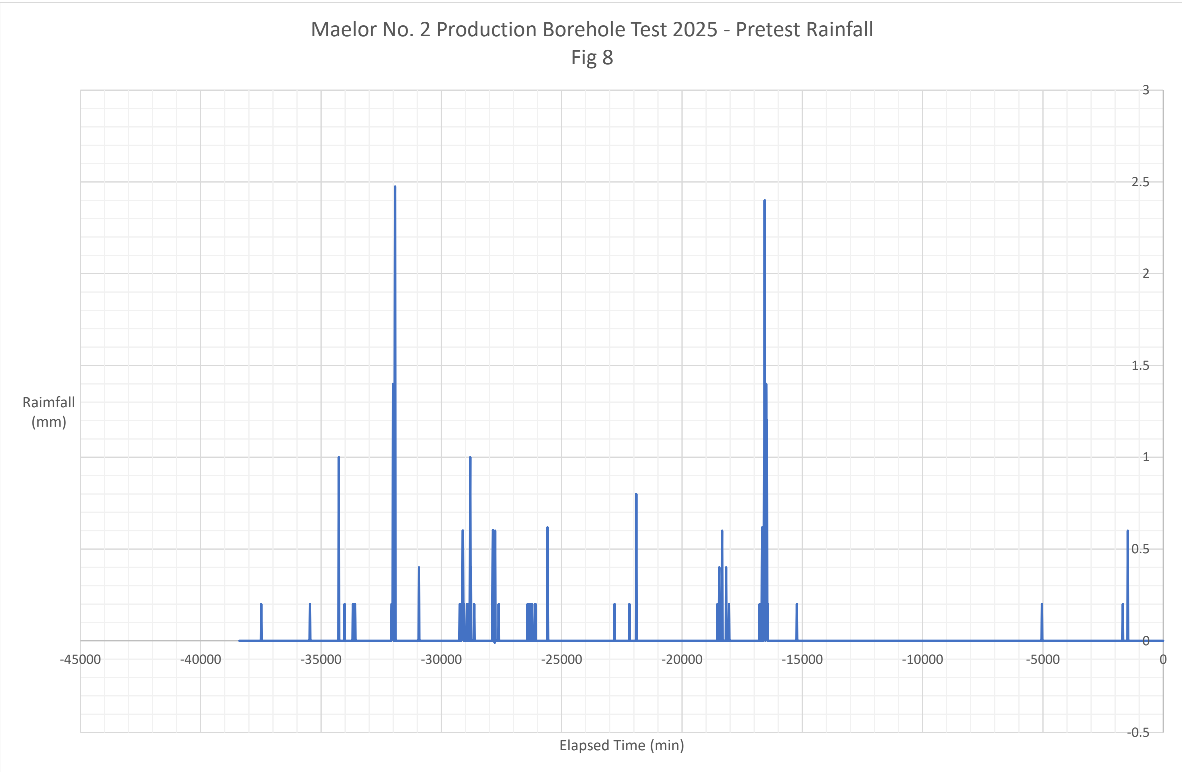


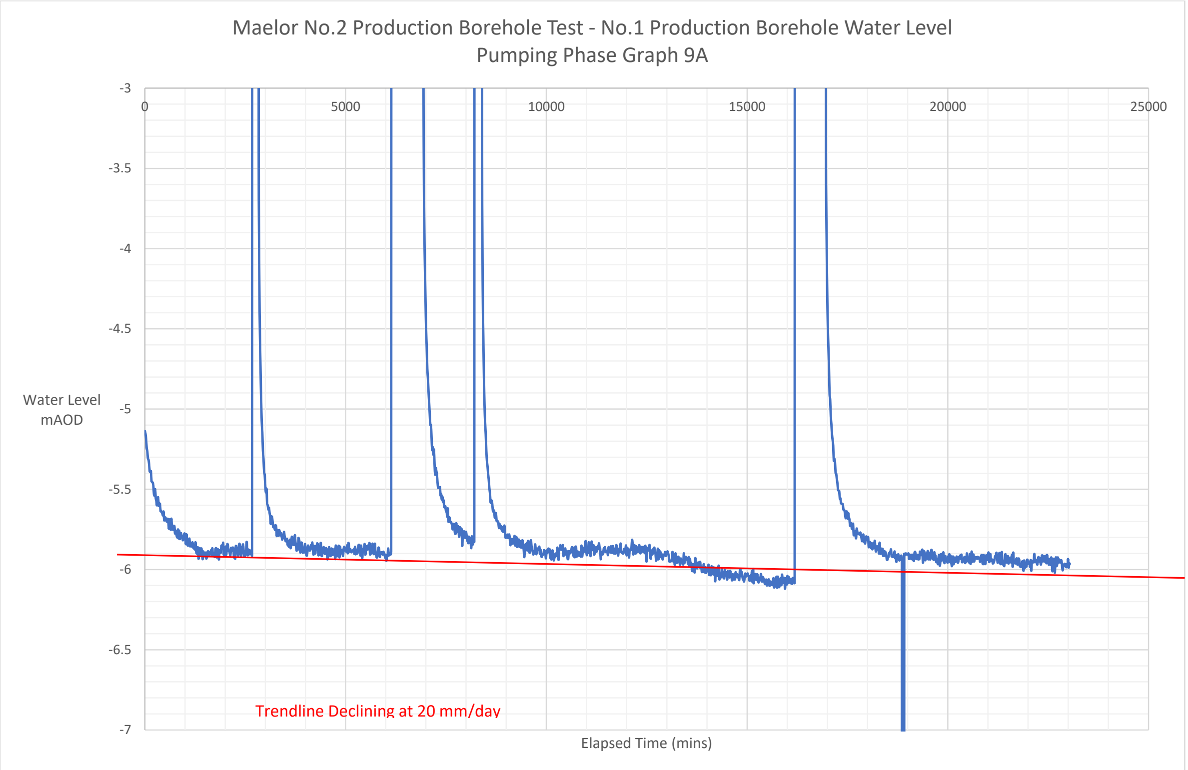
Maelor No. 2 Production Borehole Test 2025 - Car Park Pretest Level
Graph 6
Water Level
mAOD
Trendline Level Rise = 1.2 mm/day
Water Level at Start of Test 14.273 mAOD
14.900
14.800
14.700
14.600
14.500
14.400
14.300
14.200
-45000
-40000
-35000
-30000
-25000
-20000
-15000
-10000
-5000
0
Elapsed Time before Start of Pumping (mins)

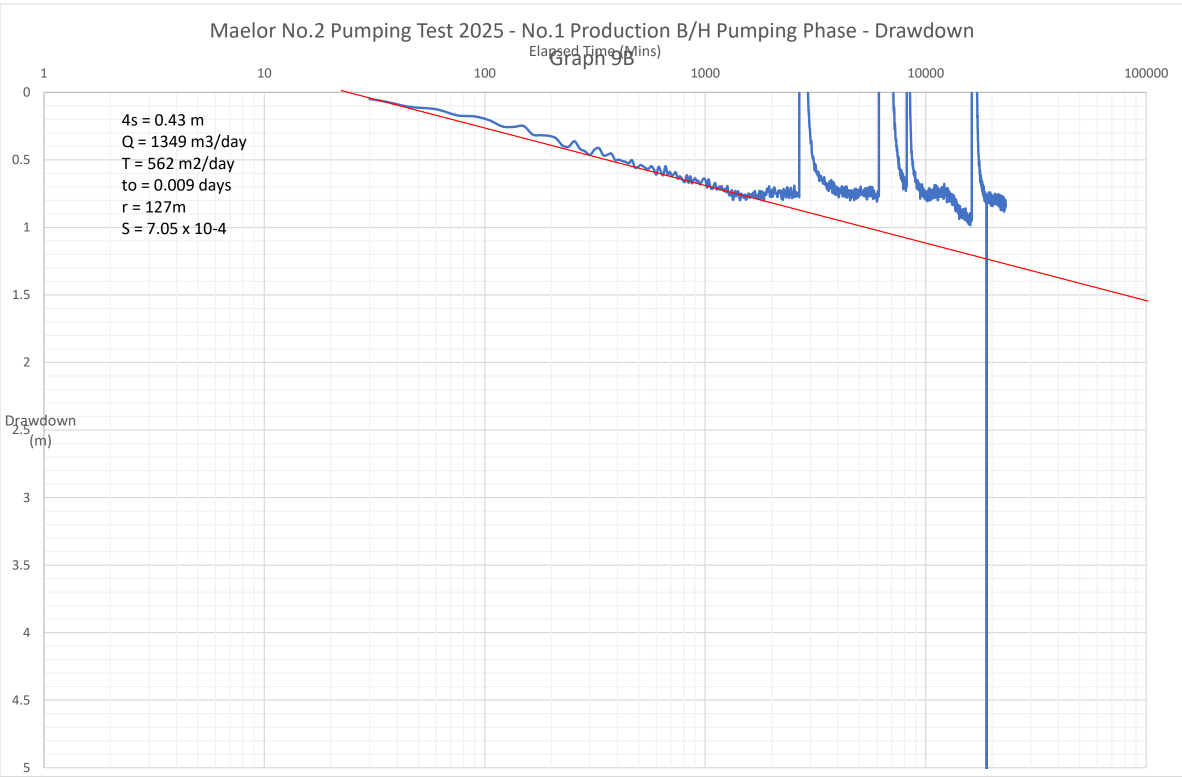


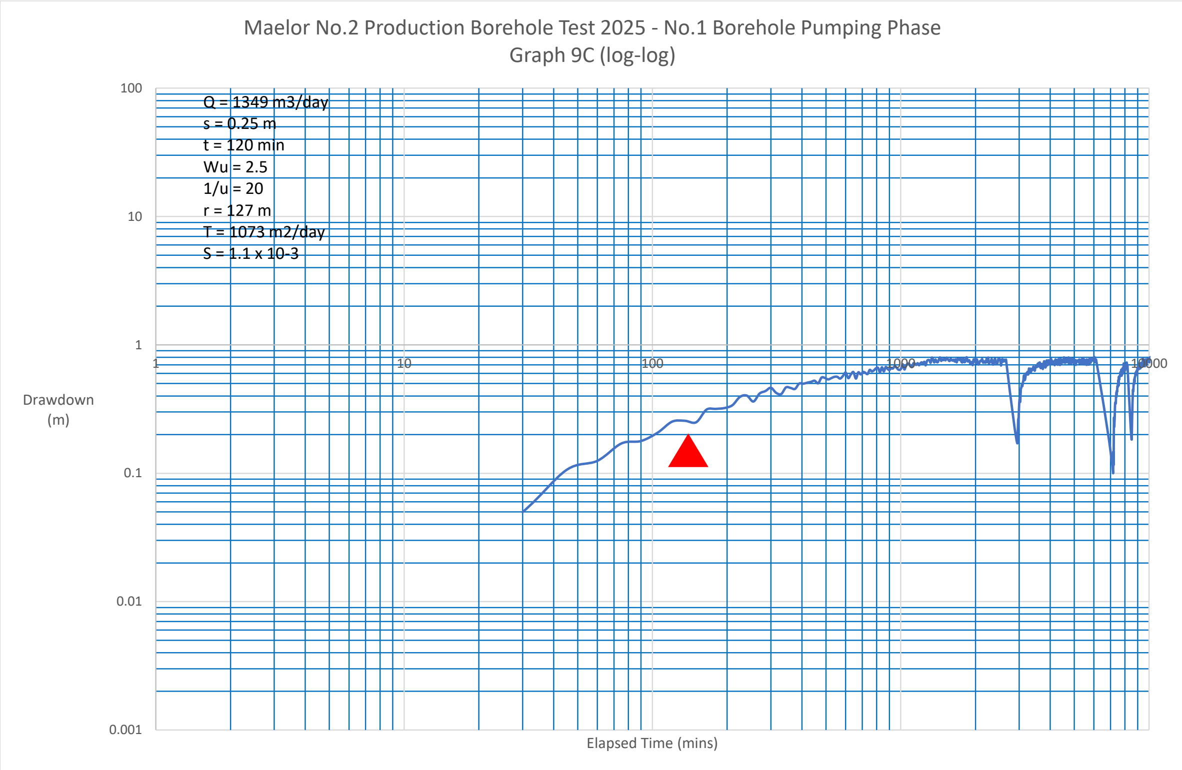
Maelor No. 2 Production Borehole Test 2025 - River Dee Pretest Level
Fig 7
Trendline Falling at5 mm/day
Level at start of Pumping 11.42mAOD
River Level
mAOD
12.1
12
11.9
11.8
11.7
11.6
11.5
11.4
11.3
-50000
-45000
-40000
-35000
-30000
-25000
-20000
-15000
-10000
-5000
0
Elapsed Time before the Start of Pumping (mins)


Maelor No. 2 Production Borehole Test 2025 - River Dee Pretest Level
Fig 7
Trendline Falling at5 mm/day
Level at start of Pumping 11.42mAOD
River Level mAOD
12.1
12
11.9
11.8
11.7
11.6
11.5
11.4
11.3
-50000
-45000
-40000
-35000
-30000
-25000
-20000
-15000
-10000
-5000
0
Elapsed Time before the Start of Pumping (mins)

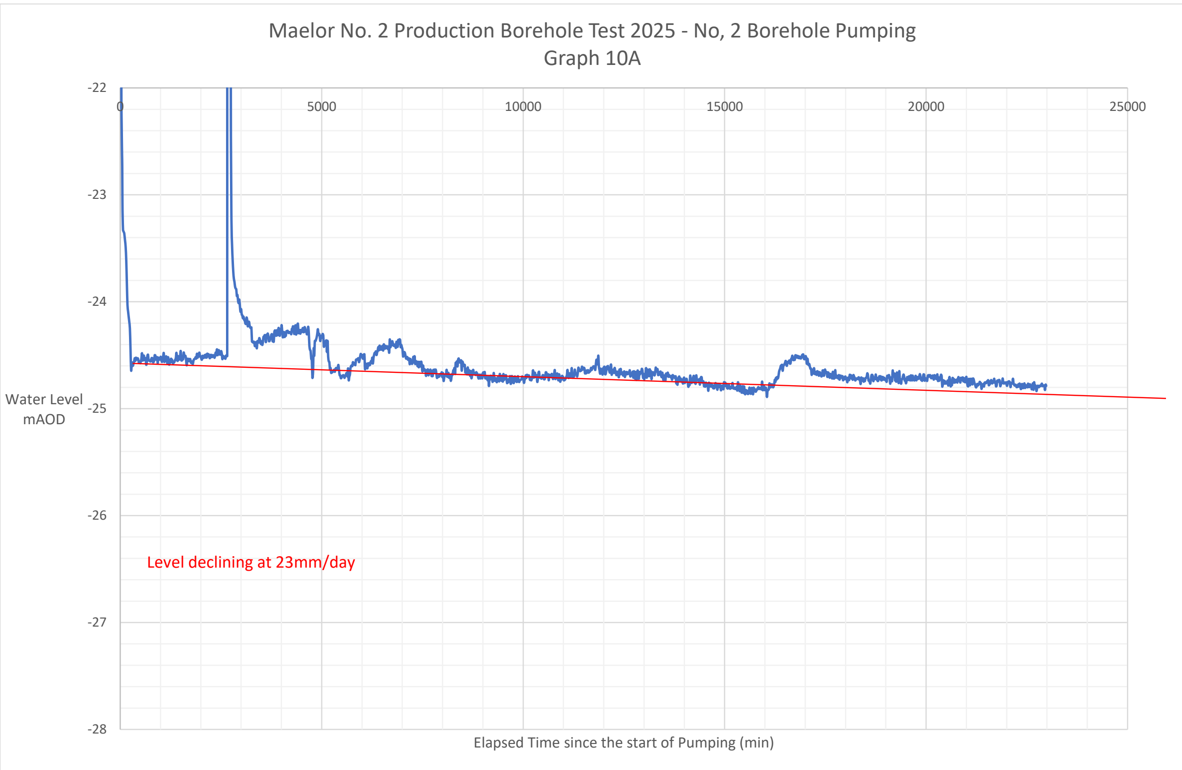

Maelor No. 2 Production Borehole Test 2025 - Pretest Rainfall
Fig 8
Raimfall (mm)
3
2.5
2
1.5
1
0.5
0
-0.5
-45000
-40000
-35000
-30000
-25000
-20000
-15000
-10000
-5000
0
Elapsed Time (min)


Maelor No.2 Production Borehole Test - No.1 Production Borehole Water Level
Pumping Phase Graph 9A
Water Level mAOD
Elapsed Time (mins)
Trendline Declining at 20 mm/day
-3
-3.5
-4
-4.5
-5
-5.5
-6
-6.5
-7
0
5000
10000
15000
20000
25000

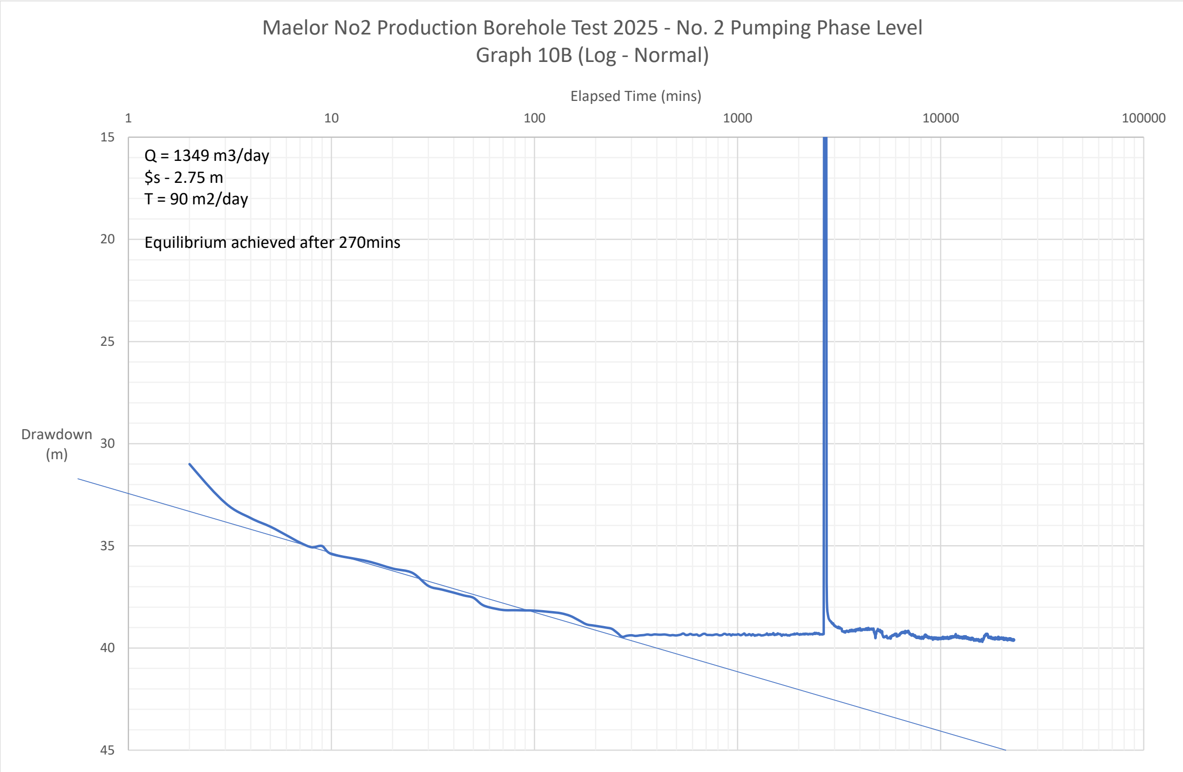

Maelor No.2 Pumping Test 2025 - No.1 Production B/H Pumping Phase - Drawdown
Graph 9B
Elapsed Time (Mins)
Drawdown (m)
4s = 0.43 m
Q = 1349 m3/day
T = 562 m2/day
to = 0.009 days
r = 127m
S = 7.05 x 10-4
1
10
100
1000
10000
100000
0
0.5
1
1.5
2
2.5
3
3.5
4
4.5
5



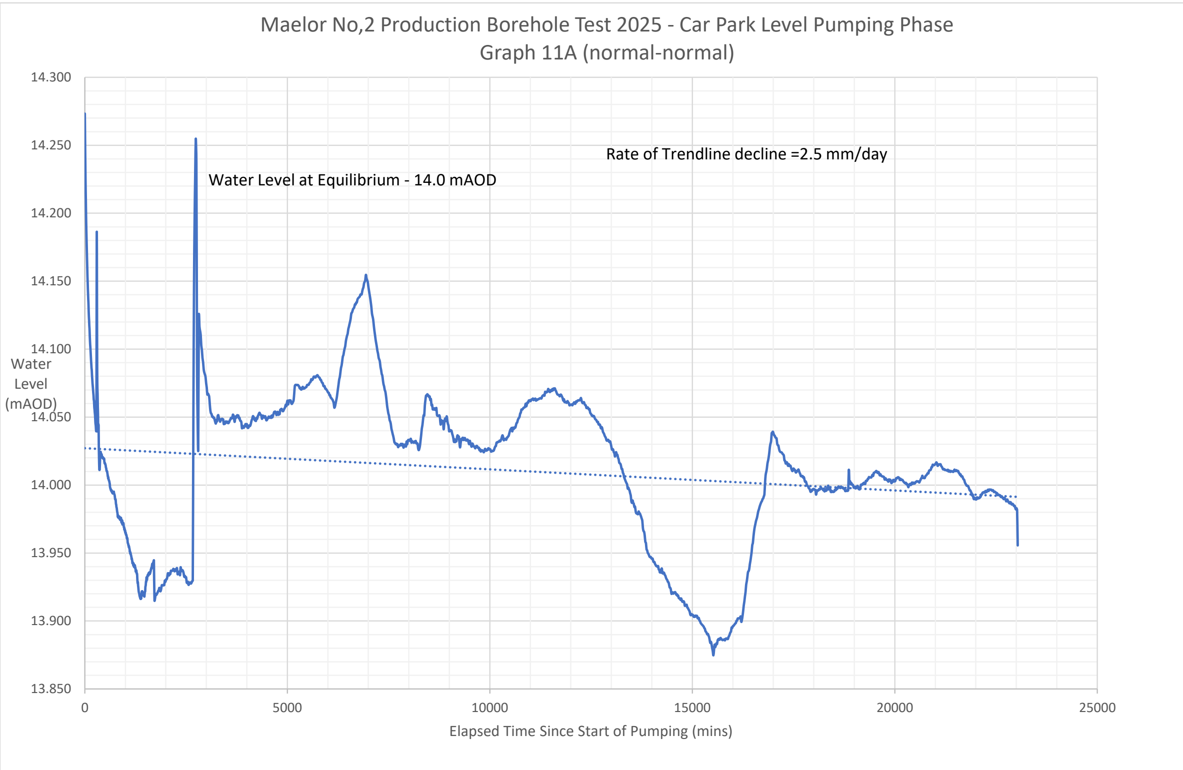
Maelor No.2 Production Borehole Test 2025 - No.1 Borehole Pumping Phase
Graph 9C (log-log)
Q = 1349 m3/day
s = 0.25 m
t = 120 min
Wu = 2.5
1/u = 20
r = 127 m
T = 1073 m2/day
S = 1.1 x 10-3
Drawdown (m)
100
10
1
0.1
0.01
0.001
1
10
100
1000
10000
Elapsed Time (mins)



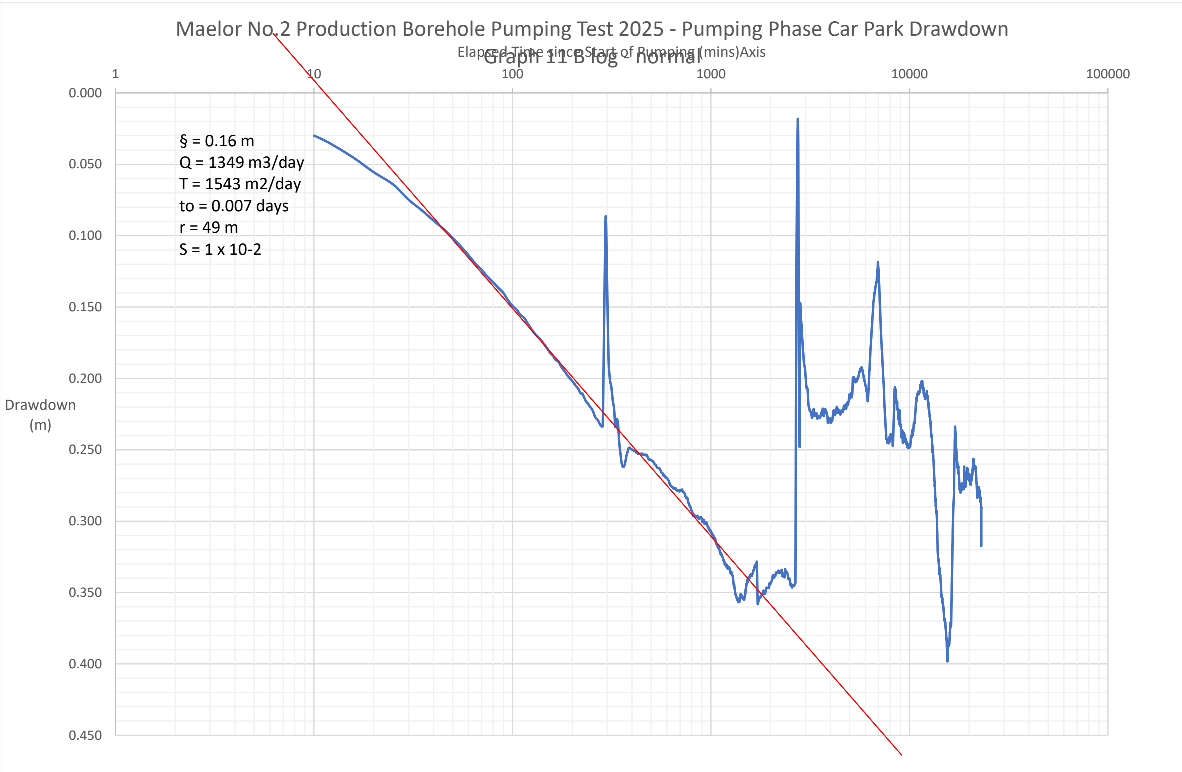
Maelor No. 2 Production Borehole Test 2025 - No, 2 Borehole Pumping
Graph 10A
Water Level mAOD
-22
-23
-24
-25
-26
-27
-28
0
5000
10000
15000
20000
25000
Level declining at 23mm/day
Elapsed Time since the start of Pumping (min)

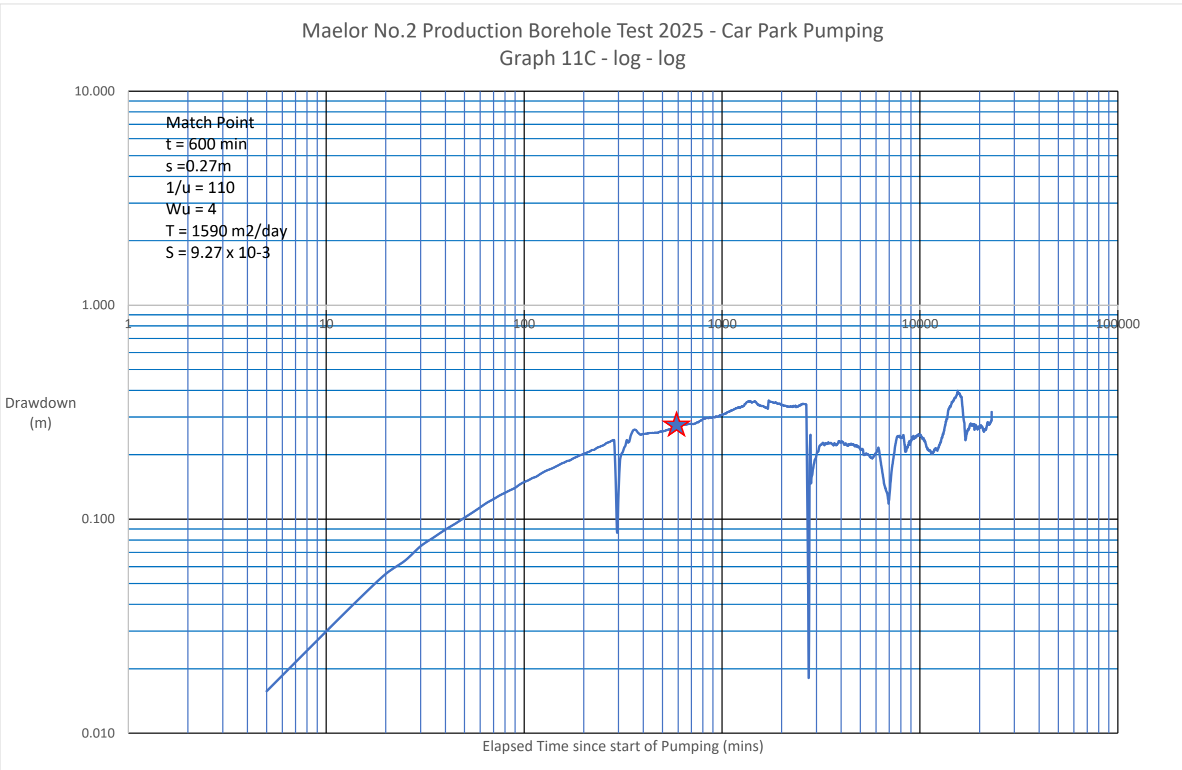


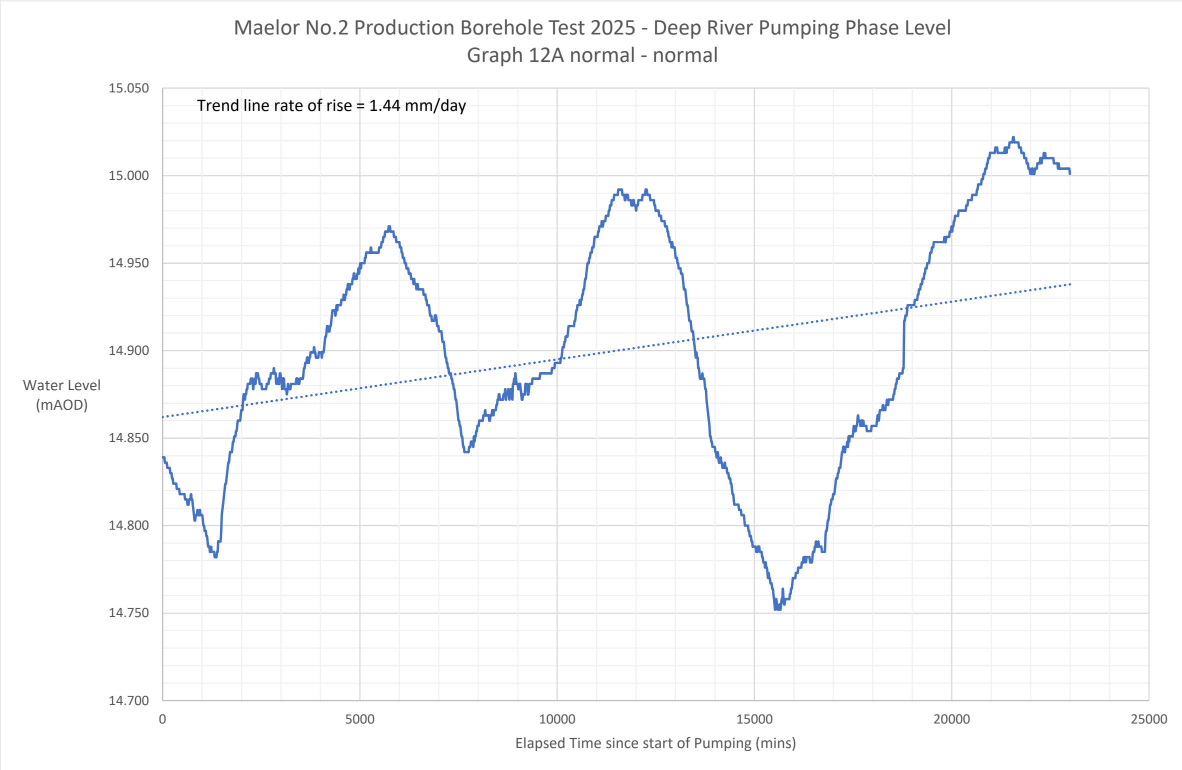
Maelor No2 Production Borehole Test 2025 - No. 2 Pumping Phase Level
Graph 10B (Log - Normal)
Elapsed Time (mins)
1
10
100
1000
10000
100000
15
20
25
30
35
40
45
Drawdown (m)
Q = 1349 m3/day
$s - 2.75 m
T = 90 m2/day
Equilibrium achieved after 270mins

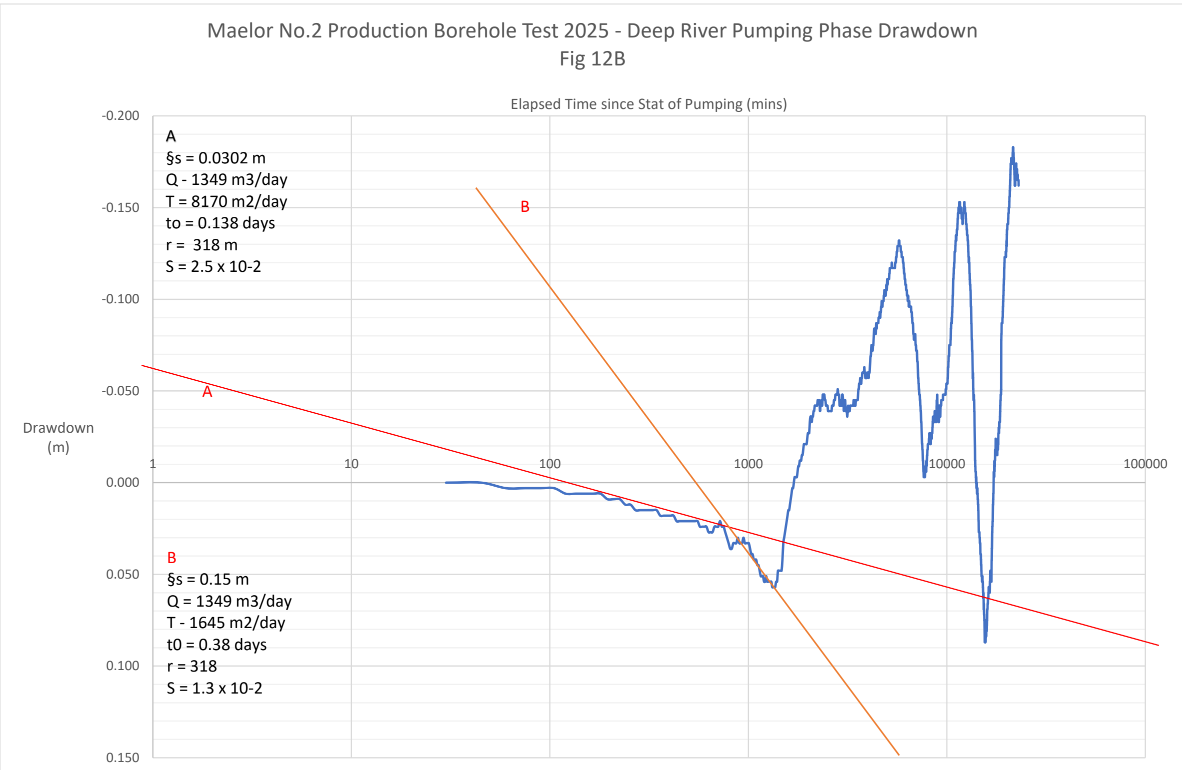


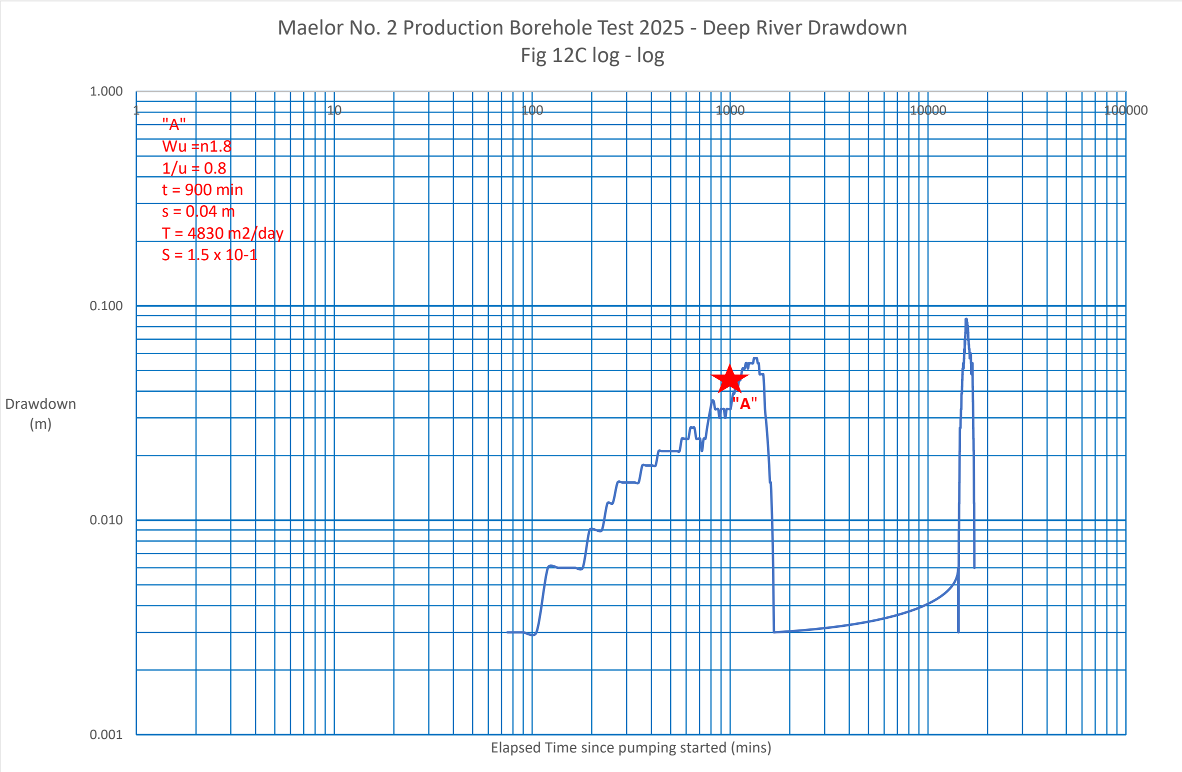
Maelor No,2 Production Borehole Test 2025 - Car Park Level Pumping Phase
Graph 11A (normal-normal)
14.300
14.250
14.200
14.150
14.100
14.050
14.000
13.950
13.900
13.850
Water Level (mAOD)
Water Level at Equilibrium - 14.0 mAOD
Rate of Trendline decline =2.5 mm/day
0
5000
10000
15000
20000
25000
Elapsed Time Since Start of Pumping (mins)

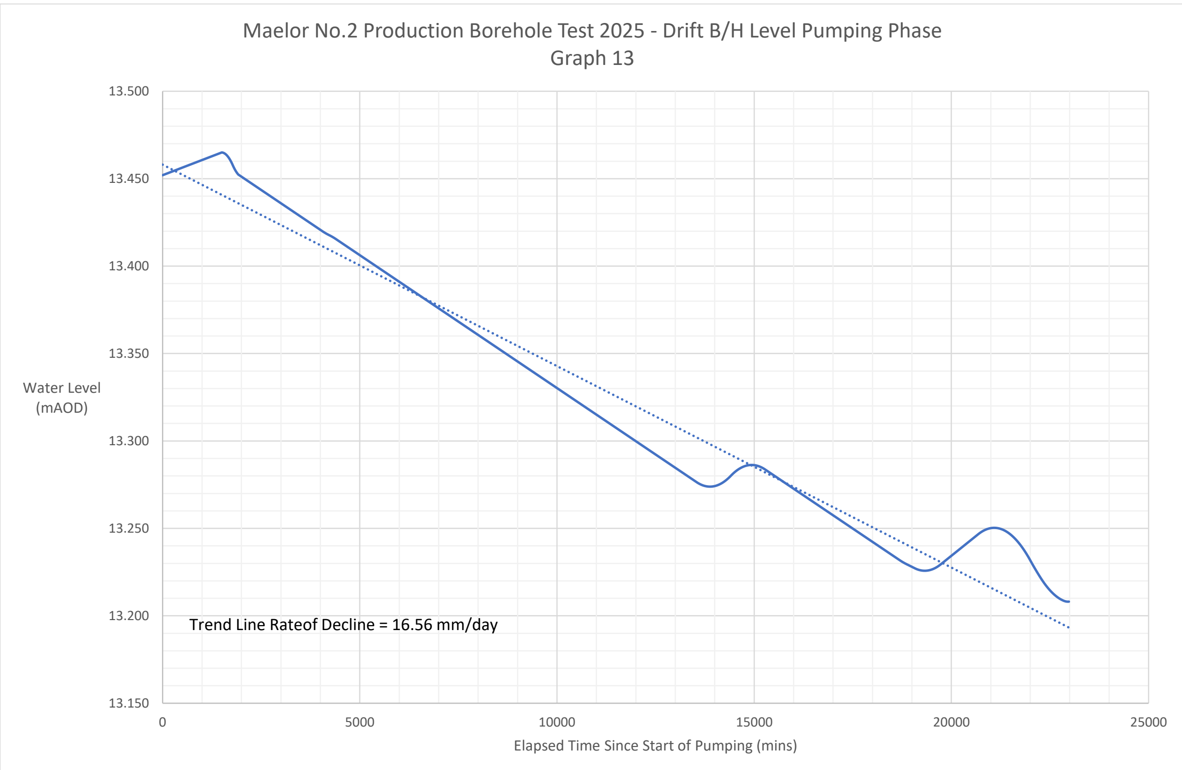

Maelor No.2 Production Borehole Pumping Test 2025 - Pumping Phase Car Park Drawdown
Graph 11 B log - normal
Elapsed Time since Start of Pumping (mins)Axis
§ = 0.16 m
Q = 1349 m3/day
T = 1543 m2/day
to = 0.007 days
r = 49 m
S = 1 x 10-2
Drawdown (m)
1
10
100
1000
10000
100000
0.000
0.050
0.100
0.150
0.200
0.250
0.300
0.350
0.400
0.450

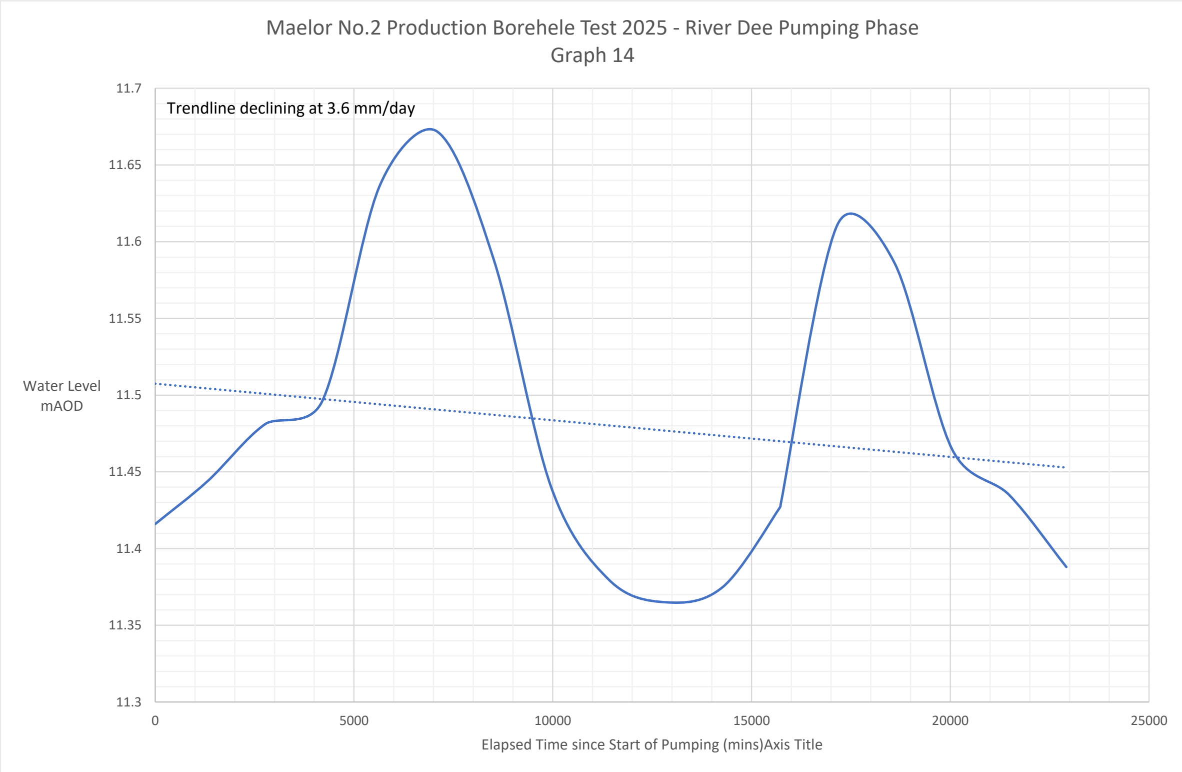

Maelor No.2 Production Borehole Test 2025 - Car Park Pumping
Graph 11C - log - log
Match Point
t = 600 min
s =0.27m
1/u = 110
Wu = 4
T = 1590 m2/day
S = 9.27 x 10-3
Drawdown (m)
Elapsed Time since start of Pumping (mins)
10.000
1.000
0.100
0.010
1
10
100
1000
10000
100000

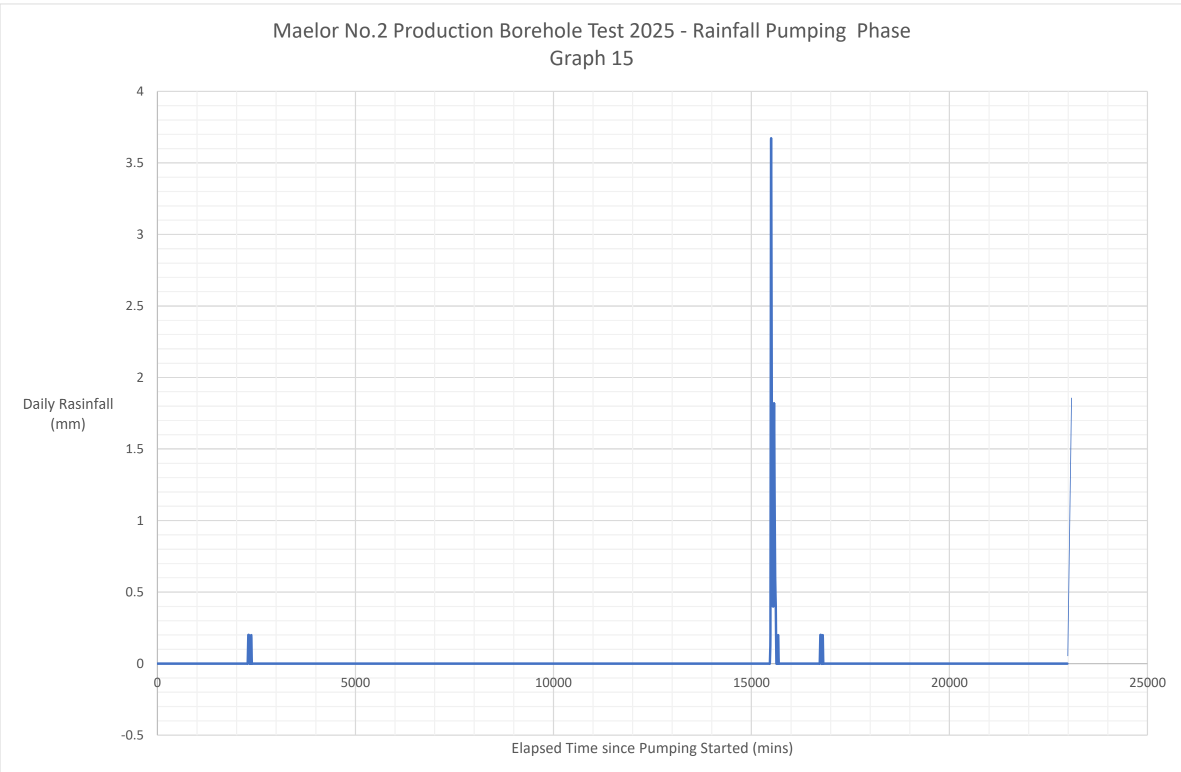

Maelor No.2 Production Borehole Test 2025 - Deep River Pumping Phase Level
Graph 12A normal - normal
Trend line rate of rise = 1.44 mm/day
Water Level (mAOD)
15.050
15.000
14.950
14.900
14.850
14.800
14.750
14.700
0
5000
10000
15000
20000
25000
Elapsed Time since start of Pumping (mins)

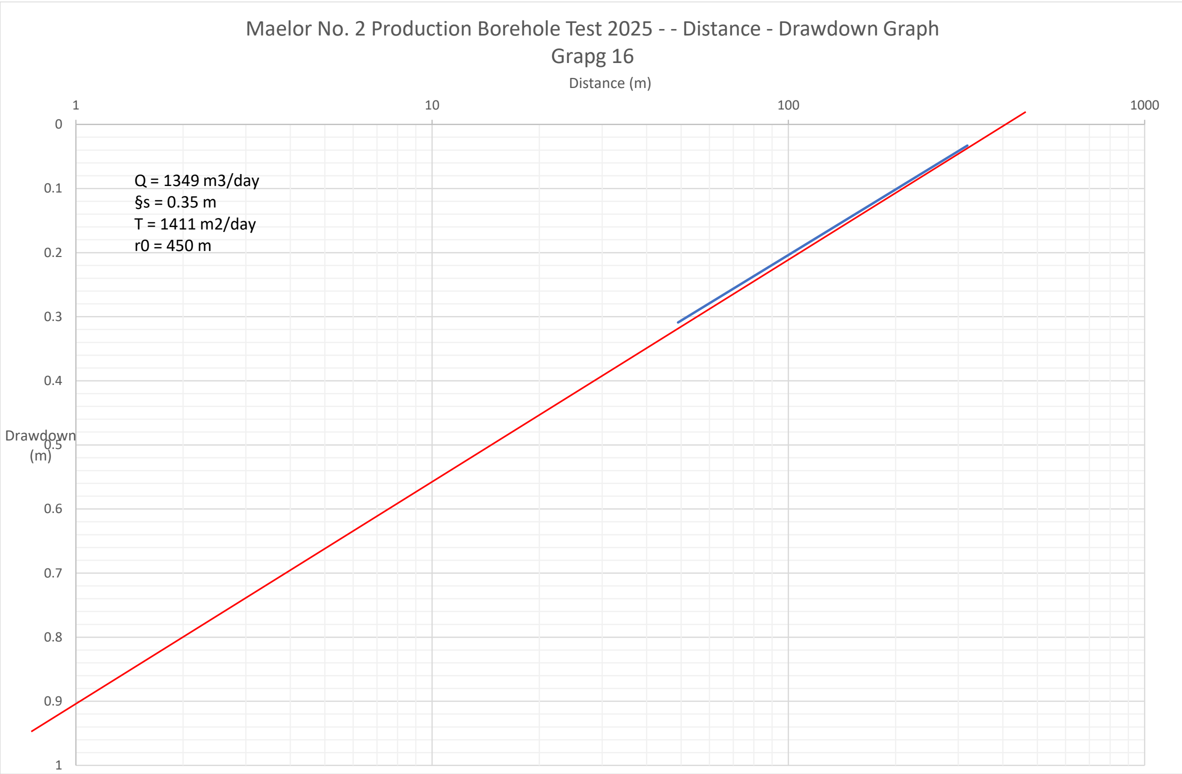

Maelor No.2 Production Borehole Test 2025 - Deep River Pumping Phase Drawdown
Fig 12B
Elapsed Time since Stat of Pumping (mins)
A
§s = 0.0302 m
Q - 1349 m3/day
T = 8170 m2/day
to = 0.138 days
r = 318 m
S = 2.5 x 10-2
B
§s = 0.15 m
Q = 1349 m3/day
T - 1645 m2/day
t0 = 0.38 days
r = 318
S = 1.3 x 10-2
Drawdown (m)
-0.200
-0.150
-0.100
-0.050
0.000
0.050
0.100
0.150
1
10
100
1000
10000
100000

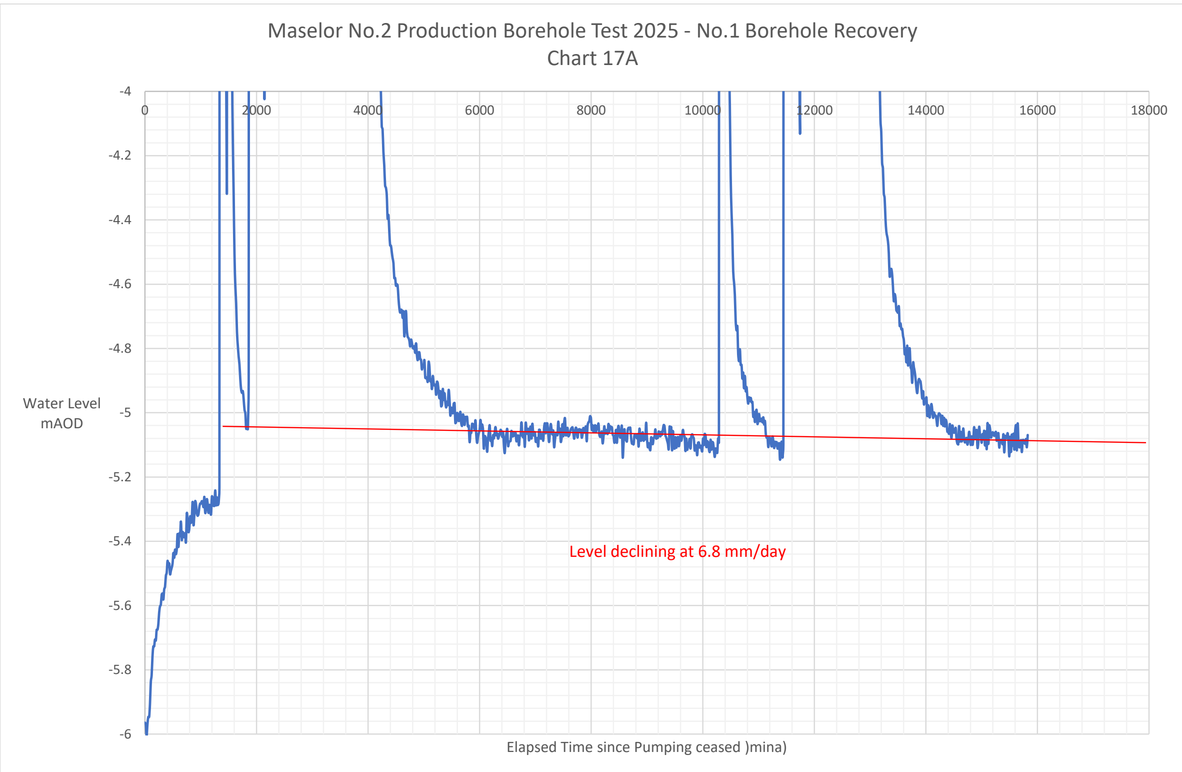

Maelor No. 2 Production Borehole Test 2025 - Deep River Drawdown
Fig 12C log - log
"A"
Wu =n1.8
1/u = 0.8
t = 900 min
s = 0.04 m
T = 4830 m2/day
S = 1.5 x 10-1
"A"
Drawdown (m)
Elapsed Time since pumping started (mins)

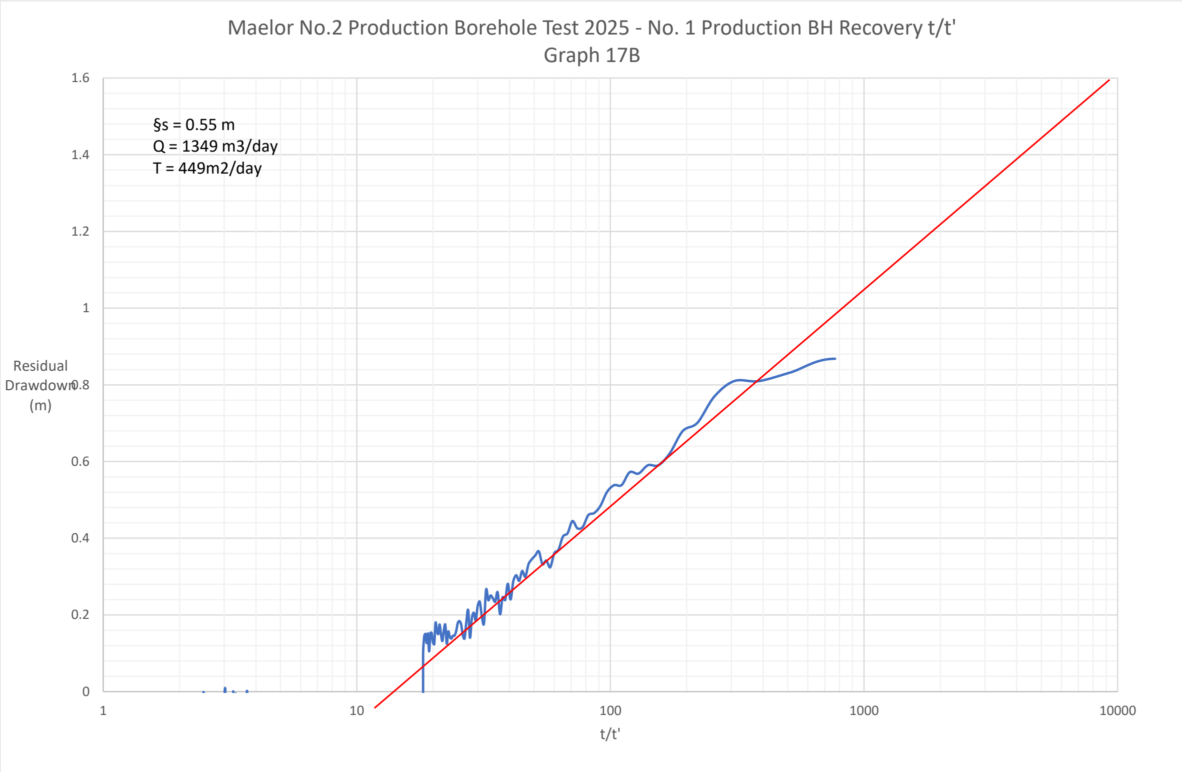

Maelor No.2 Production Borehole Test 2025 - Drift B/H Level Pumping Phase
Graph 13
Water Level (mAOD)
Trend Line Rateof Decline = 16.56 mm/day
Elapsed Time Since Start of Pumping (mins)

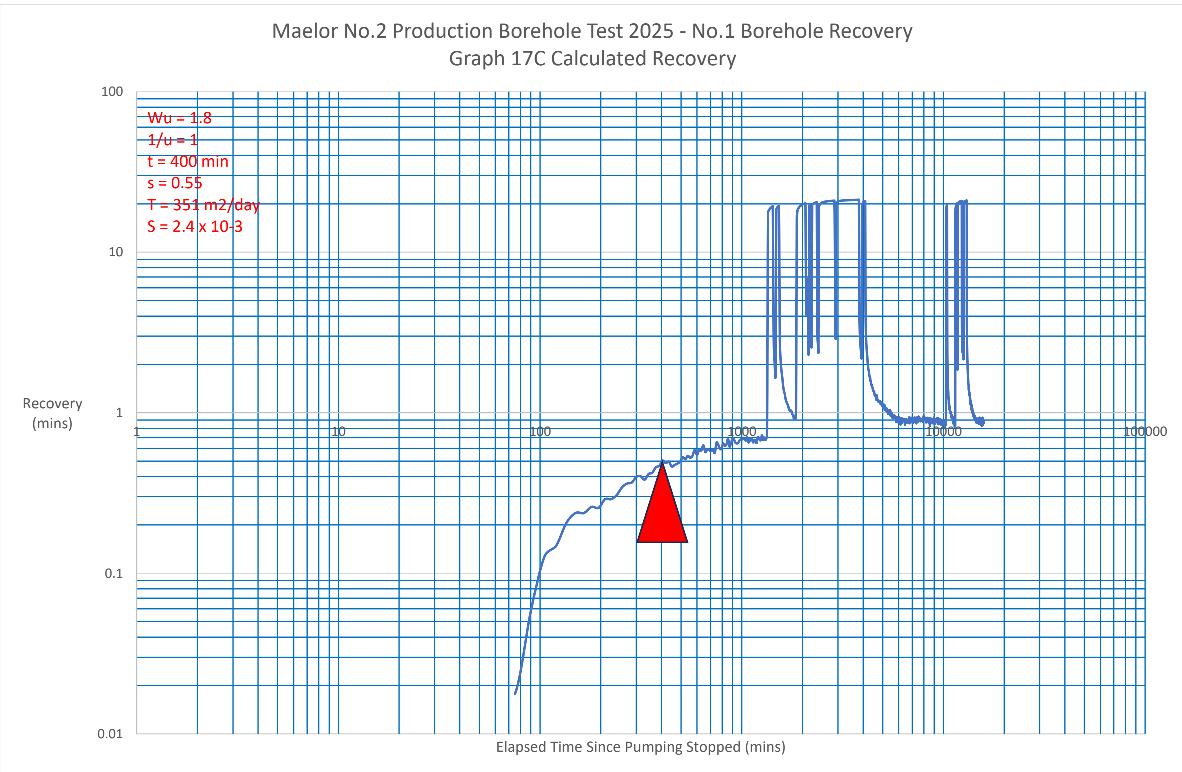

Maelor No.2 Production Borehele Test 2025 - River Dee Pumping Phase
Graph 14
Trendline declining at 3.6 mm/day
Water Level mAOD
11.7
11.65
11.6
11.55
11.5
11.45
11.4
11.35
11.3
0
5000
10000
15000
20000
25000
Elapsed Time since Start of Pumping (mins)Axis Title

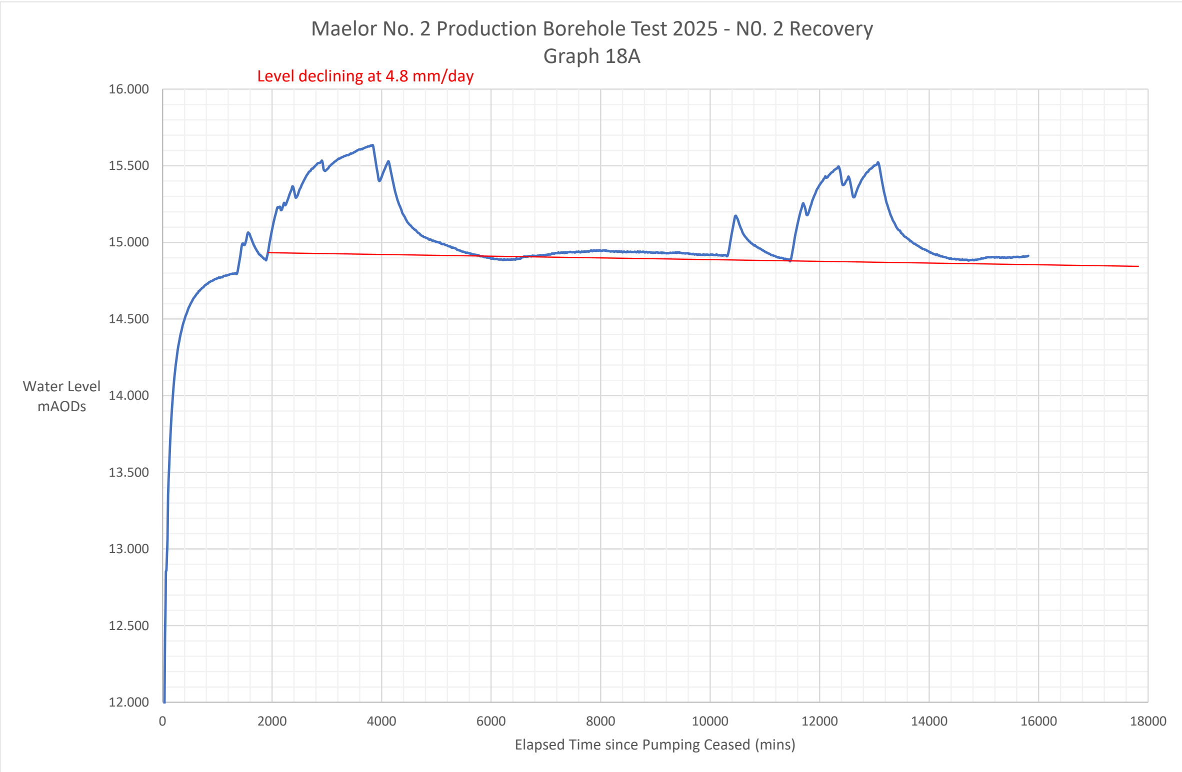

Maelor No.2 Production Borehole Test 2025 - Rainfall Pumping Phase
Graph 15
Daily Rasinfall (mm)
4
3.5
3
2.5
2
1.5
1
0.5
0
-0.5
0
5000
10000
15000
20000
25000
Elapsed Time since Pumping Started (mins)

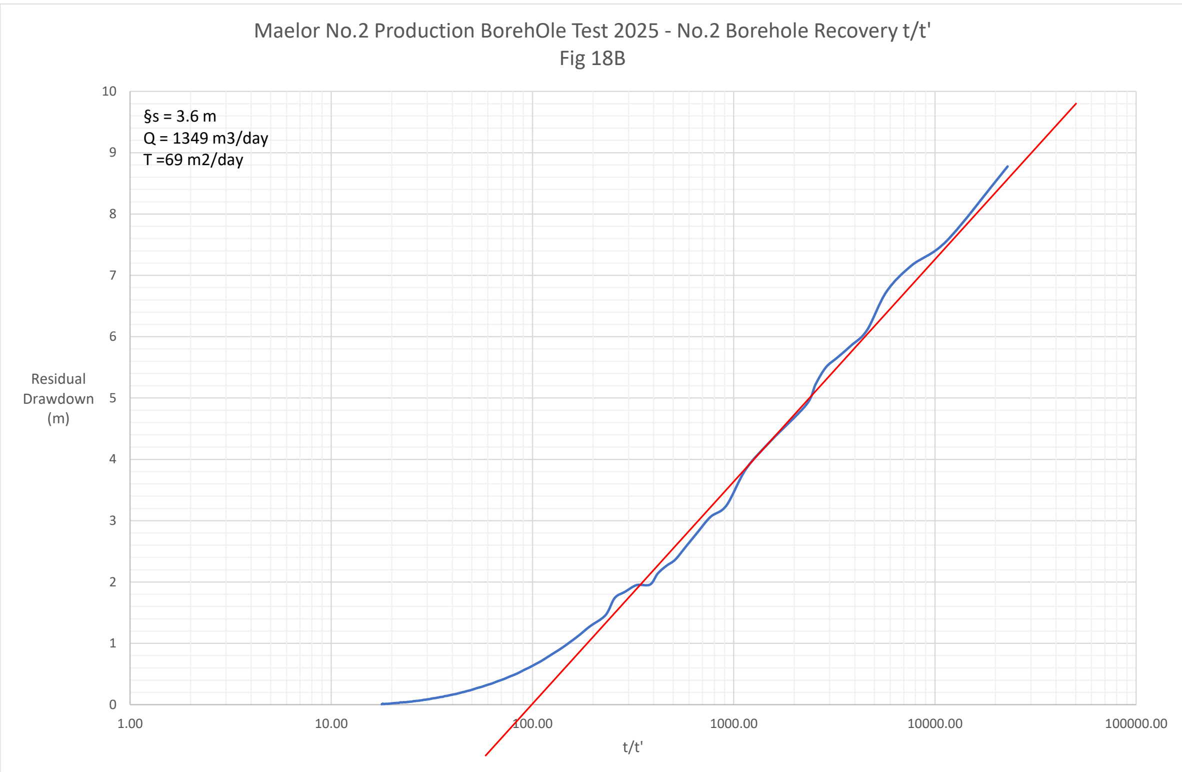

Maelor No. 2 Production Borehole Test 2025 - - Distance - Drawdown Graph
Grapg 16
Distance (m)
1
10
100
1000
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
Drawdown (m)
Q = 1349 m3/day
§s = 0.35 m
T = 1411 m2/day
r0 = 450 m

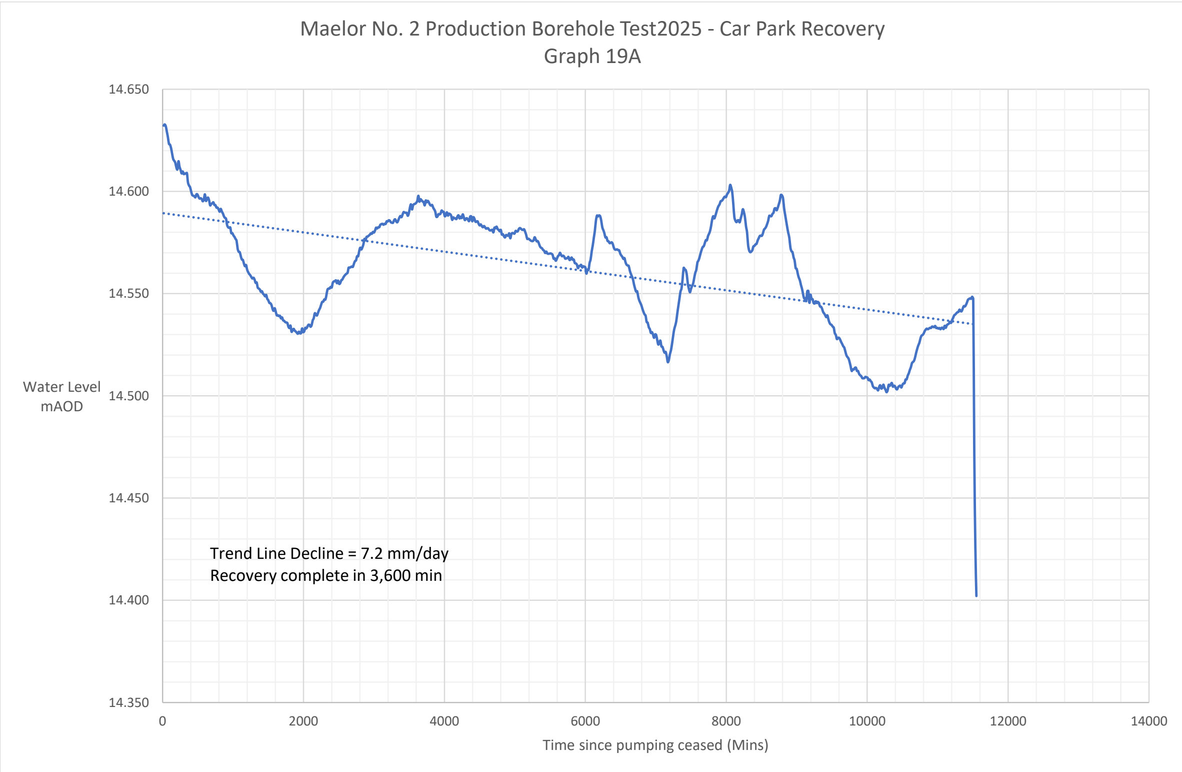

Maselor No.2 Production Borehole Test 2025 - No.1 Borehole Recovery
Chart 17A
-4
-4.2
-4.4
-4.6
-4.8
-5
-5.2
-5.4
-5.6
-5.8
-6
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
Water Level mAOD
Level declining at 6.8 mm/day
Elapsed Time since Pumping ceased)mina)

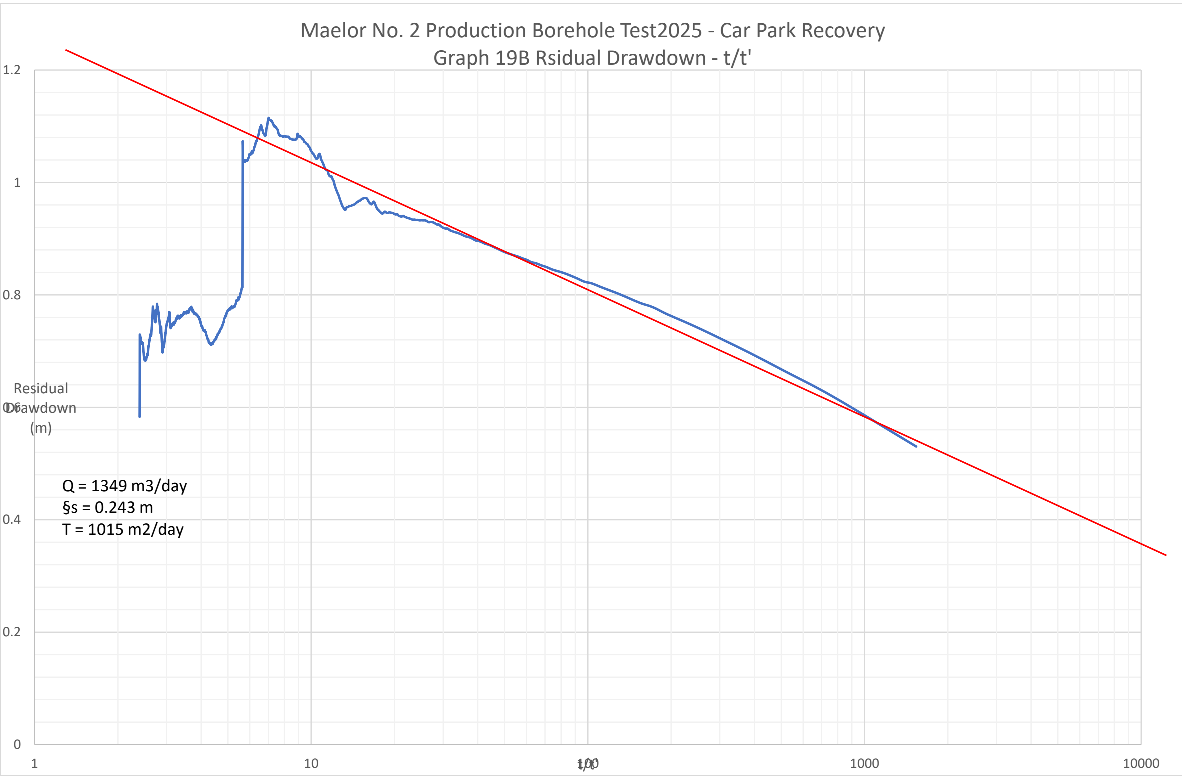

Maelor No.2 Production Borehole Test 2025 - No. 1 Production BH Recovery t/t'
Graph 17B
§s = 0.55 m
Q = 1349 m3/day
T = 449m2/day
Residual Drawdown (m)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
1
10
100
1000
10000
t/t'

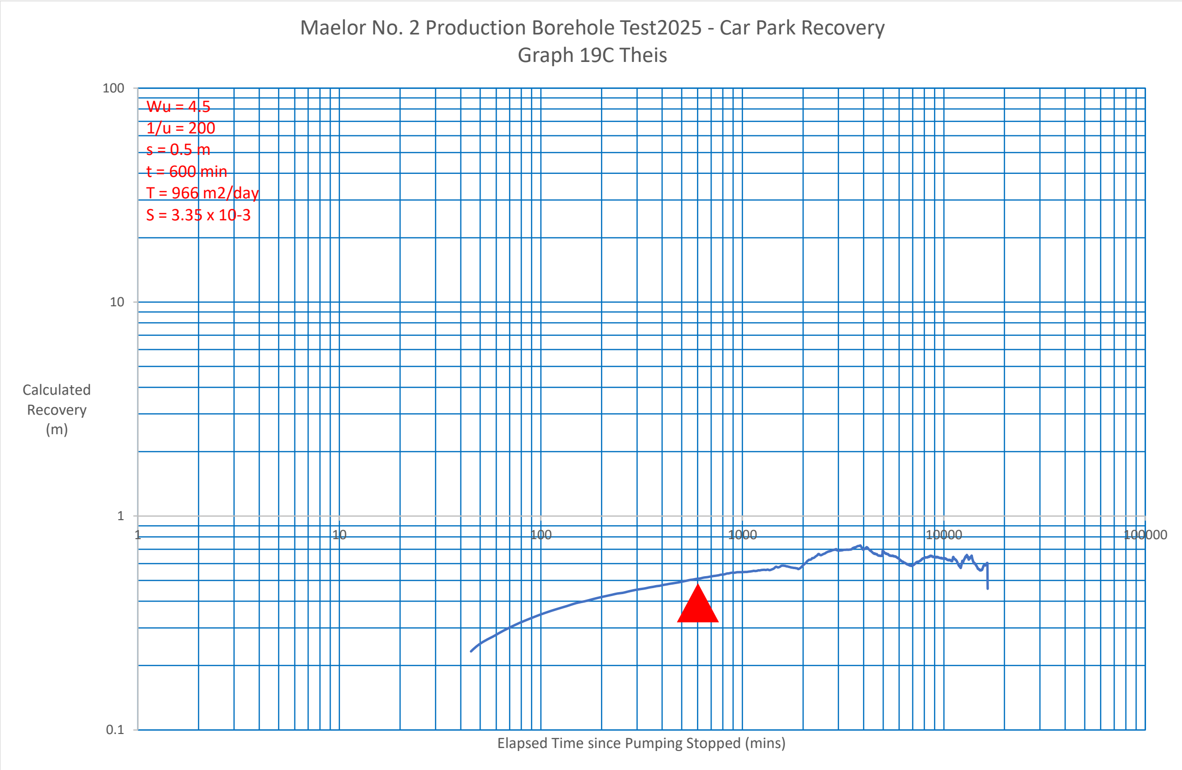

Maelor No.2 Production Borehole Test 2025 - No.1 Borehole Recovery
Graph 17C Calculated Recovery
Wu = 1.8
1/u = 1
t = 400 min
s = 0.55
T = 351 m2/day
S = 2.4 x 10-3
Recovery (mins)
100
10
1
0.1
0.01
1
10
100
1000
10000
100000
Elapsed Time Since Pumping Stopped (mins)

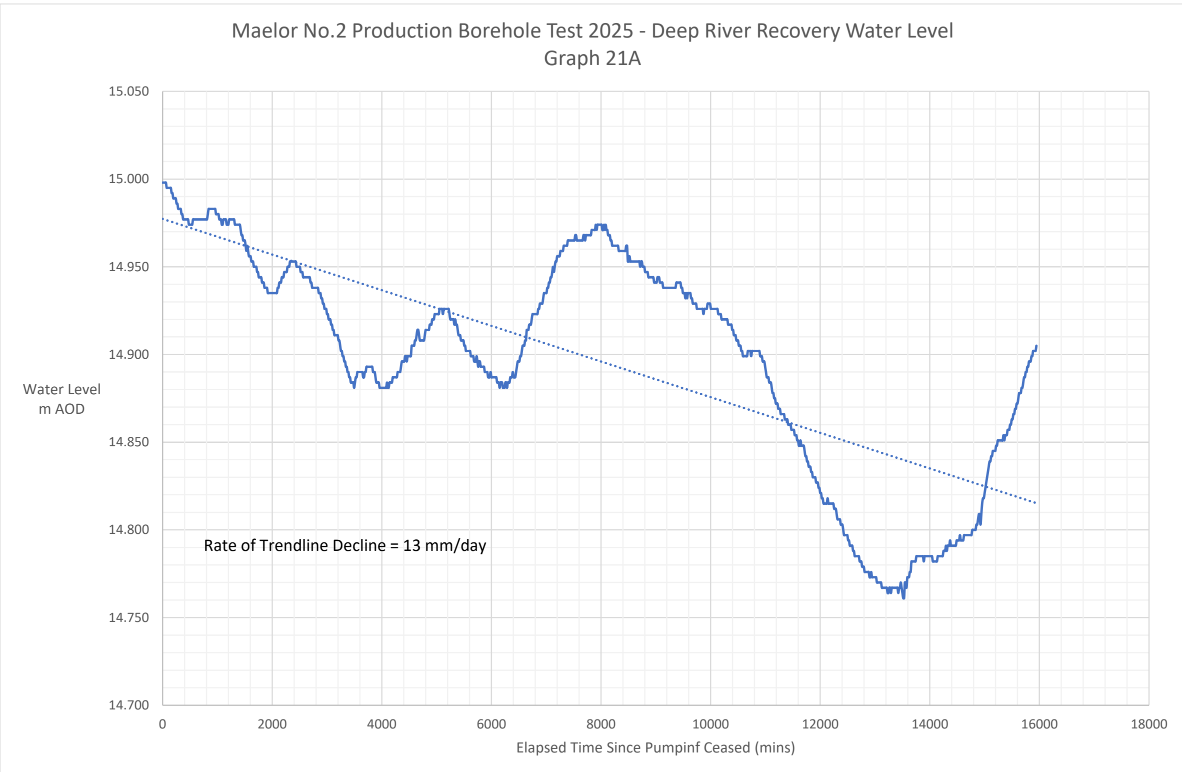

Maelor No. 2 Production Borehole Test 2025 - N0. 2 Recovery
Graph 18A
Level declining at 4.8 mm/day
16.000
15.500
15.000
14.500
14.000
13.500
13.000
12.500
12.000
Water Level mAODs
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
Elapsed Time since Pumping Ceased (mins)

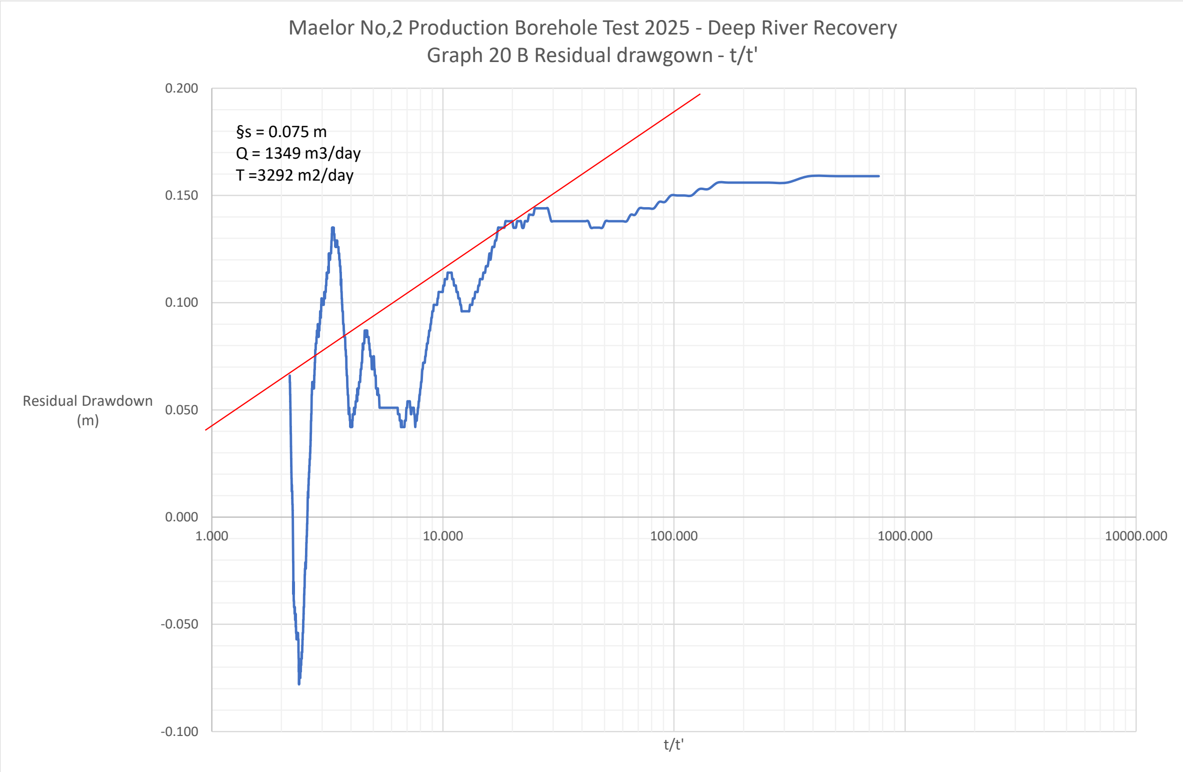

Maelor No.2 Production BorehOle Test 2025 - No.2 Borehole Recovery t/t'
Fig 18B
§s = 3.6 m
Q = 1349 m3/day
T =69 m2/day
10
9
8
7
6
5
4
3
2
1
0
Residual Drawdown (m)
1.00
10.00
100.00
1000.00
10000.00
100000.00
t/t'

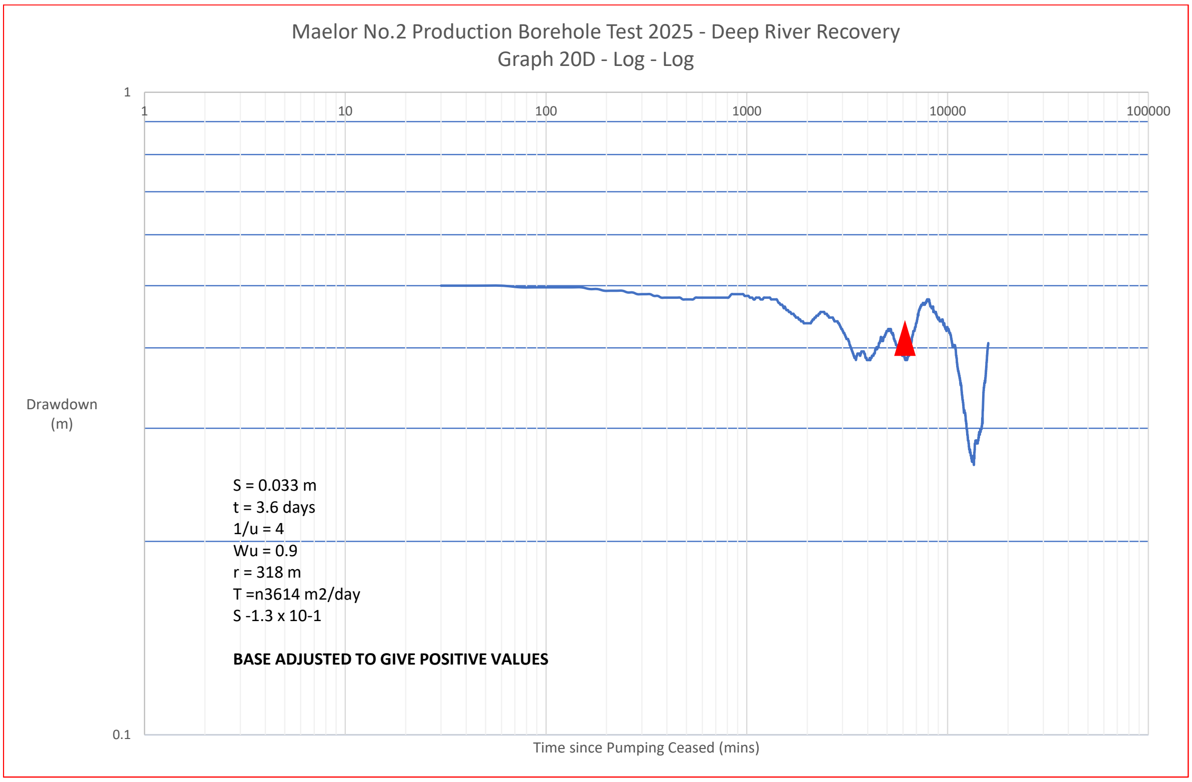

Maelor No. 2 Production Borehole Test2025 - Car Park Recovery
Graph 19A
14.650
14.600
14.550
14.500
14.450
14.400
14.350
Water Level
mAOD
Trend Line Decline = 7.2 mm/day
Recovery complete in 3,600 min
0
2000
4000
6000
8000
10000
12000
14000
Time since pumping ceased (Mins)

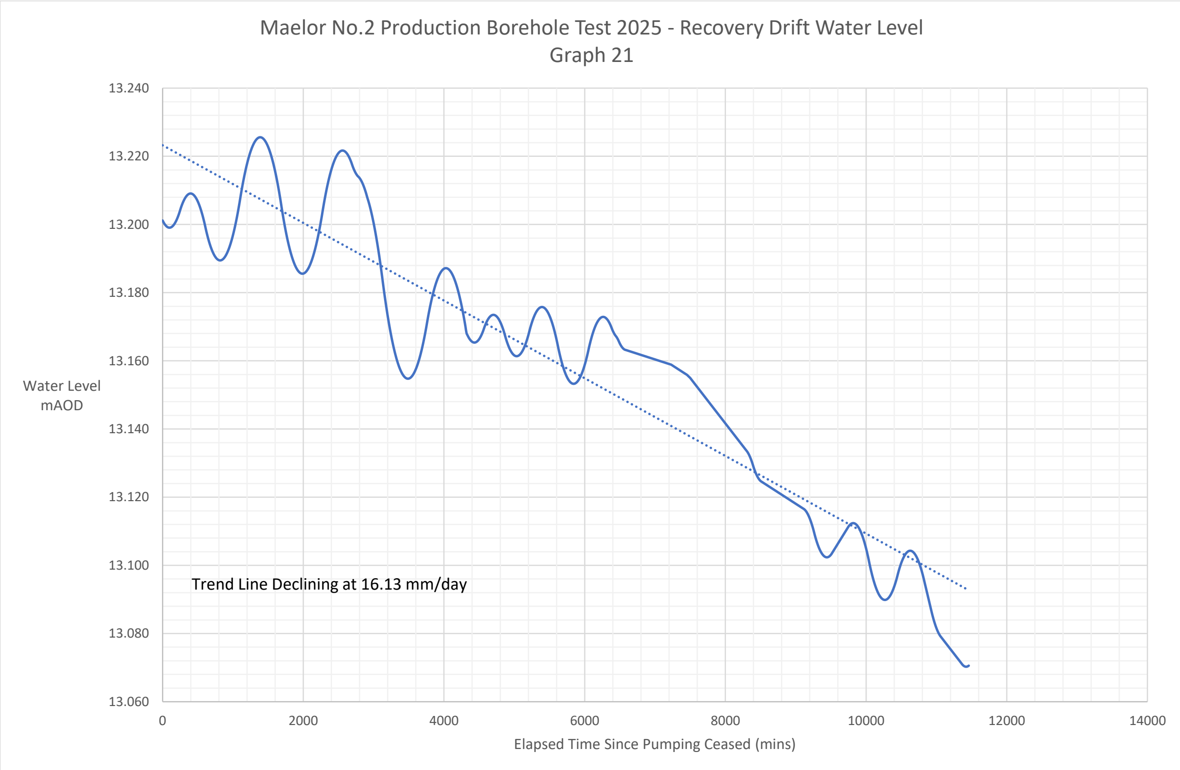

Maelor No. 2 Production Borehole Test2025 - Car Park Recovery
Graph 19B Rsidual Drawdown - t/t'
1.2
1
0.8
0.6
0.4
0.2
0
Residual
Drawdown
(m)
Q = 1349 m3/day
§s = 0.243 m
T = 1015 m2/day
1
10
100
1000
10000

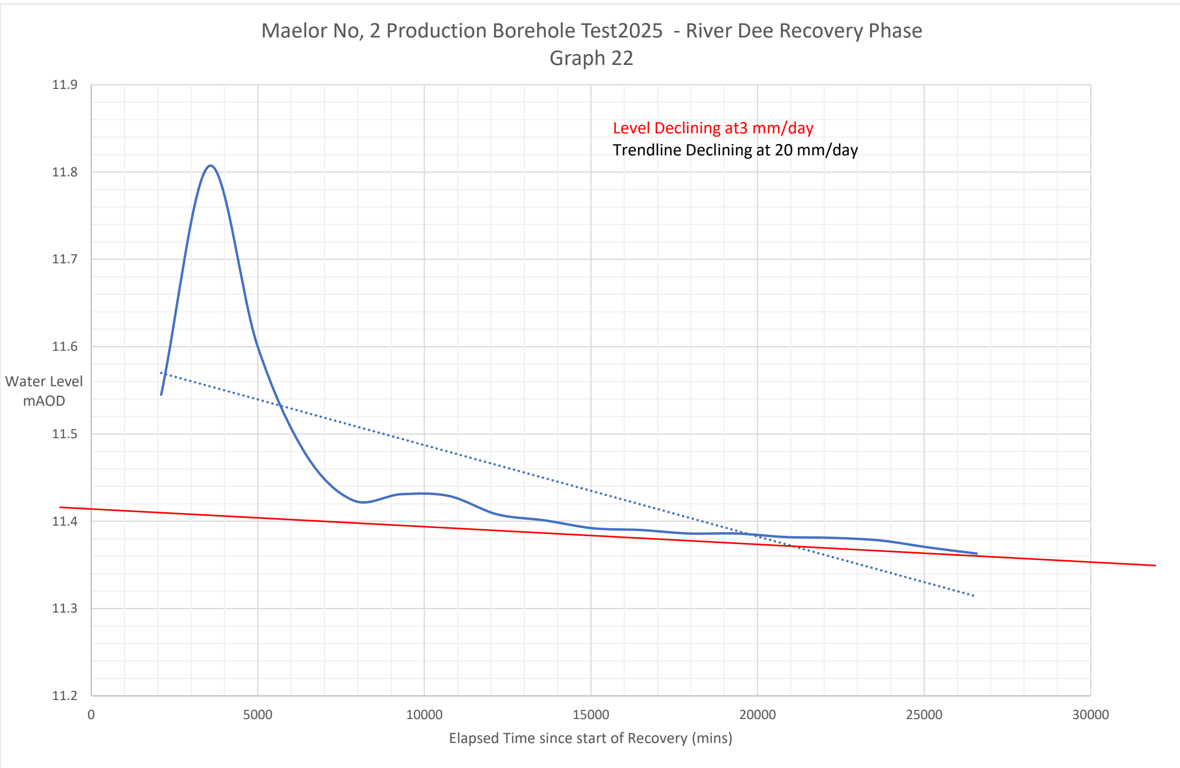

Maelor No. 2 Production Borehole Test2025 - Car Park Recovery
Graph 19C Theis
Wu = 4.5
1/u = 200
s = 0.5 m
t = 600 min
T = 966 m2/day
S = 3.35 x 10-3
Calculated Recovery (m)
100
10
1
0.1
1
10
100
1000
10000
100000
Elapsed Time since Pumping Stopped (mins)

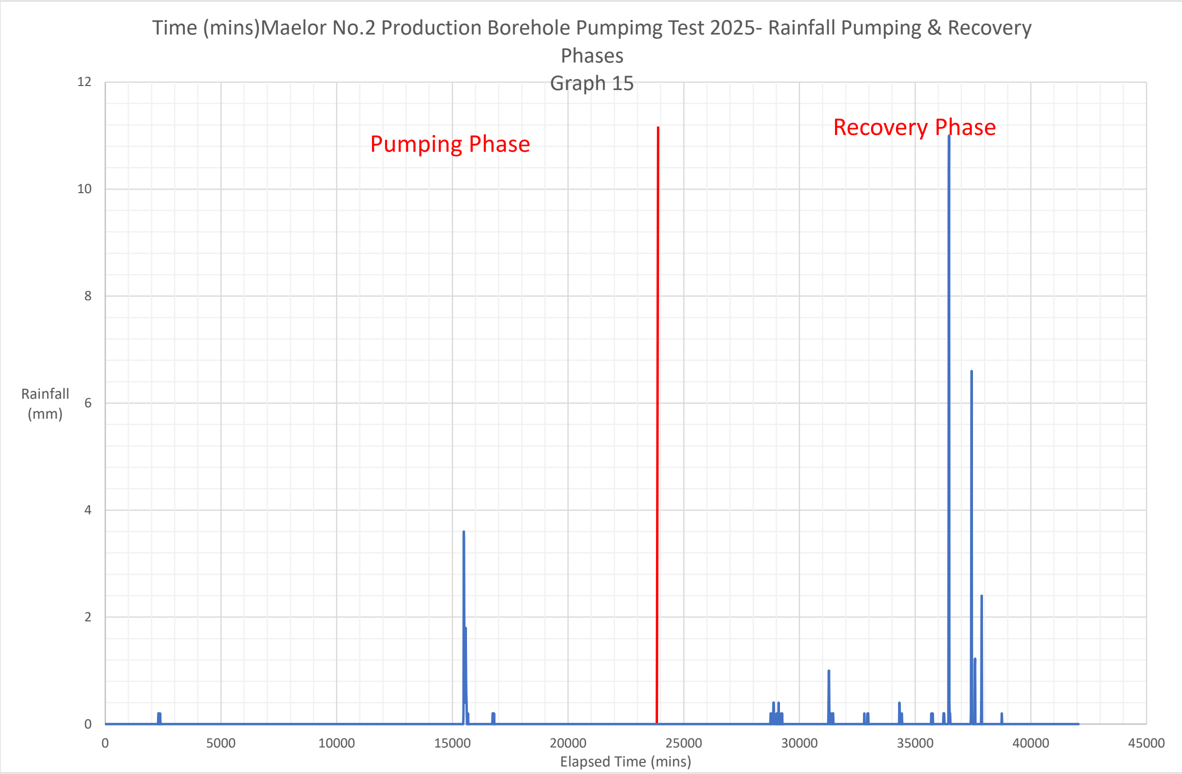

Maelor No.2 Production Borehole Test 2025 - Deep River Recovery Water Level
Graph 21A
Water Level m AOD
15.050
15.000
14.950
14.900
14.850
14.800
14.750
14.700
Rate of Trendline Decline = 13 mm/day
0
2000
4000
6000
8000
10000
12000
14000
16000
18000
Elapsed Time Since Pumpinf Ceased (mins)

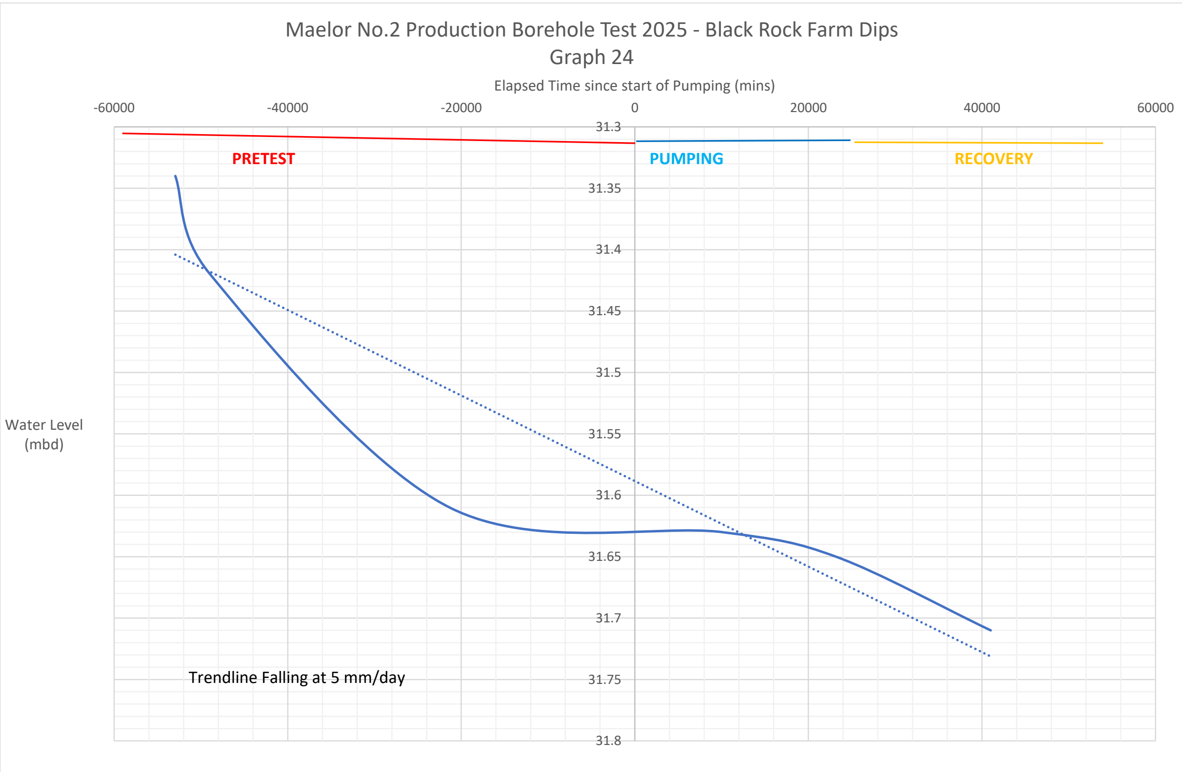

Maelor No,2 Production Borehole Test 2025 - Deep River Recovery
Graph 20 B Residual drawgown - t/t'
§s = 0.075 m
Q = 1349 m3/day
T =3292 m2/day
Residual Drawdown (m)
0.200
0.150
0.100
0.050
0.000
-0.050
-0.100
1.000
10.000
100.000
1000.000
10000.000
t/t'

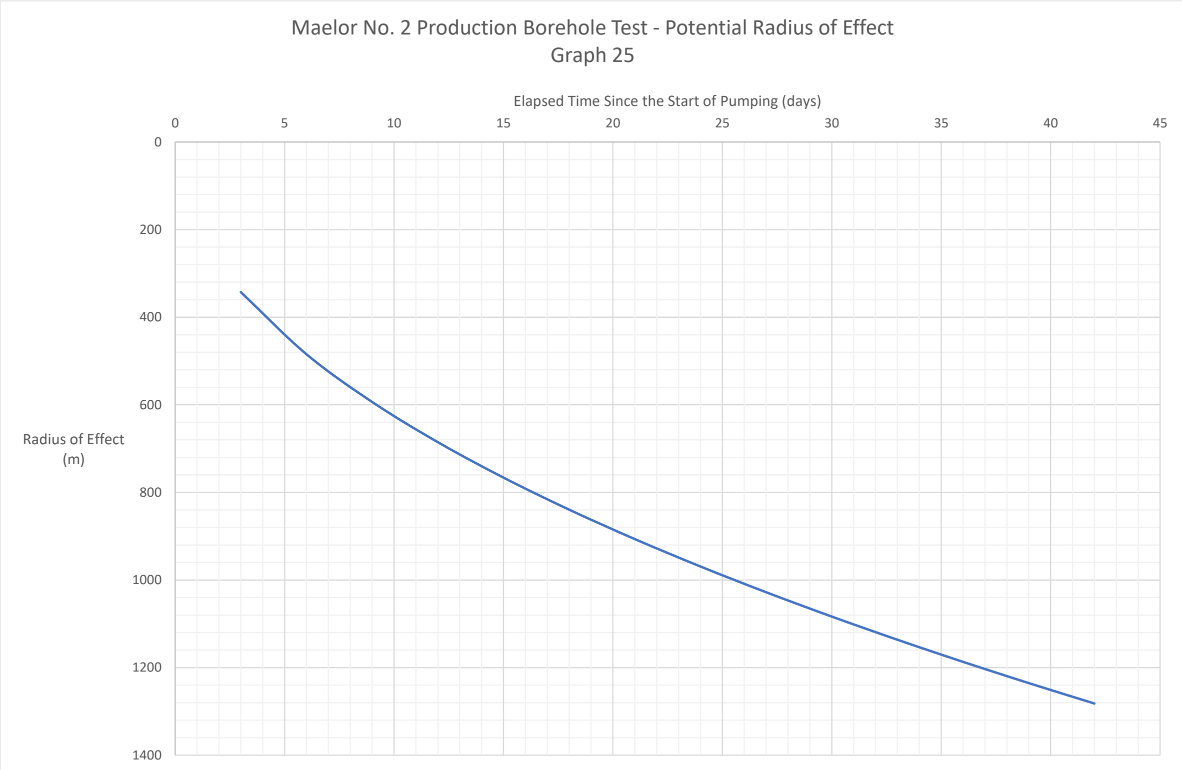

Maelor No.2 Production Borehole Test 2025 - Deep River Recovery
Graph 20D - Log - Log
Drawdown (m)
1
0.1
1
10
100
1000
10000
100000
S = 0.033 m
t = 3.6 days
1/u = 4
Wu = 0.9
r = 318 m
T =n3614 m2/day
S -1.3 x 10-1
BASE ADJUSTED TO GIVE POSITIVE VALUES
Time since Pumping Ceased (mins)

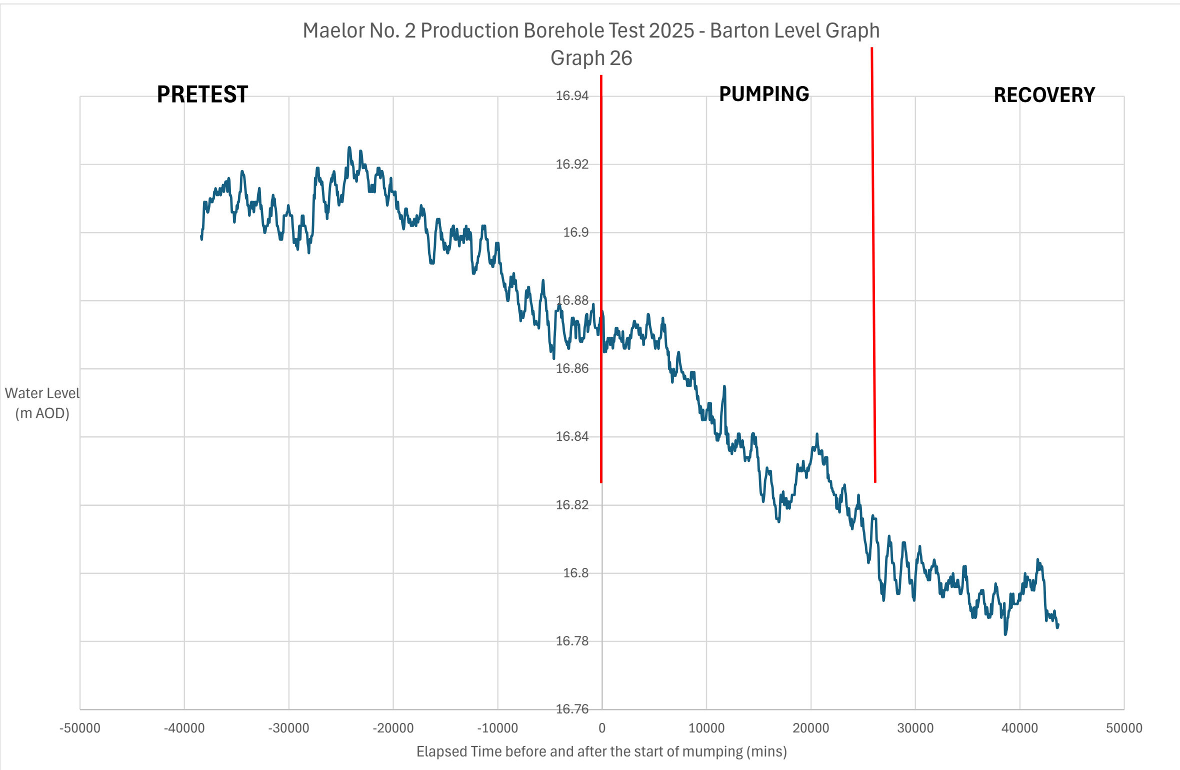

Maelor No.2 Production Borehole Test 2025 - Recovery Drift Water Level
Graph 21
Water Level mAOD
13.240
13.220
13.200
13.180
13.160
13.140
13.120
13.100
13.080
13.060
Trend Line Declining at 16.13 mm/day
0
2000
4000
6000
8000
10000
12000
14000
Elapsed Time Since Pumping Ceased (mins)

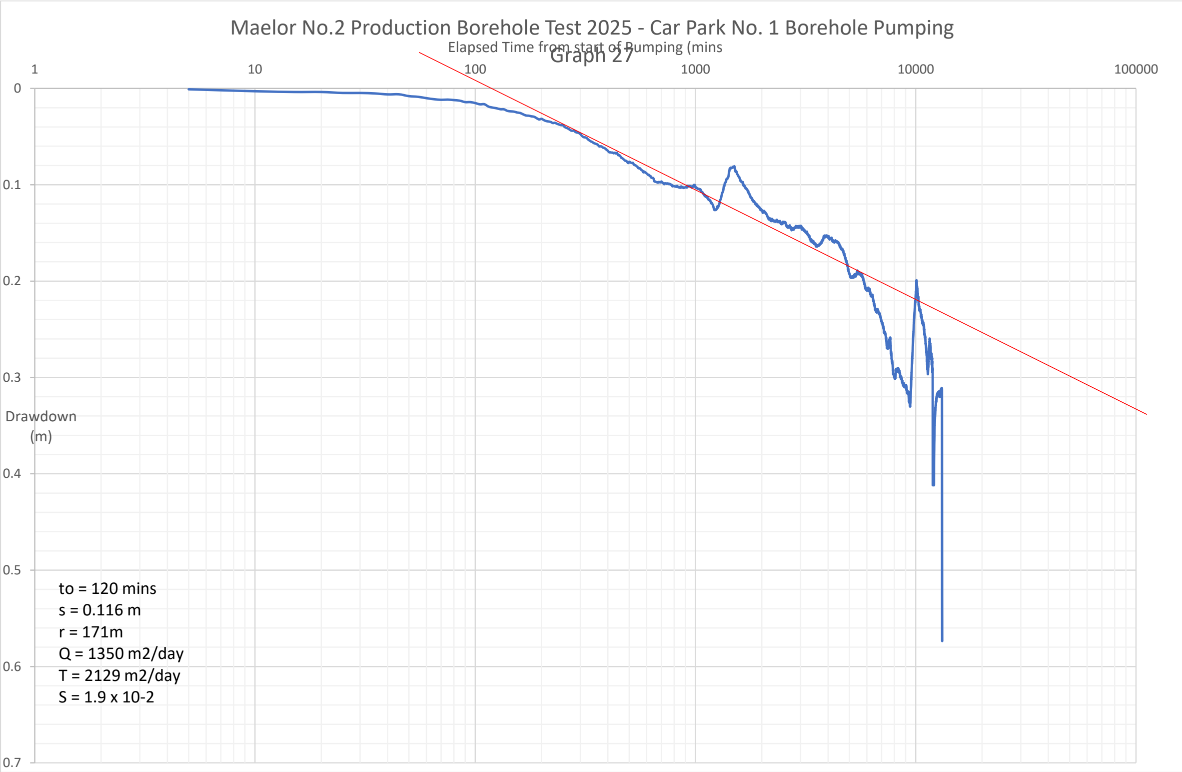

Maelor No, 2 Production Borehole Test2025 - River Dee Recovery Phase
Graph 22
Level Declining at3 mm/day
Trendline Declining at 20 mm/day
Water Level mAOD
11.9
11.8
11.7
11.6
11.5
11.4
11.3
11.2
0
5000
10000
15000
20000
25000
30000
Elapsed Time since start of Recovery (mins)

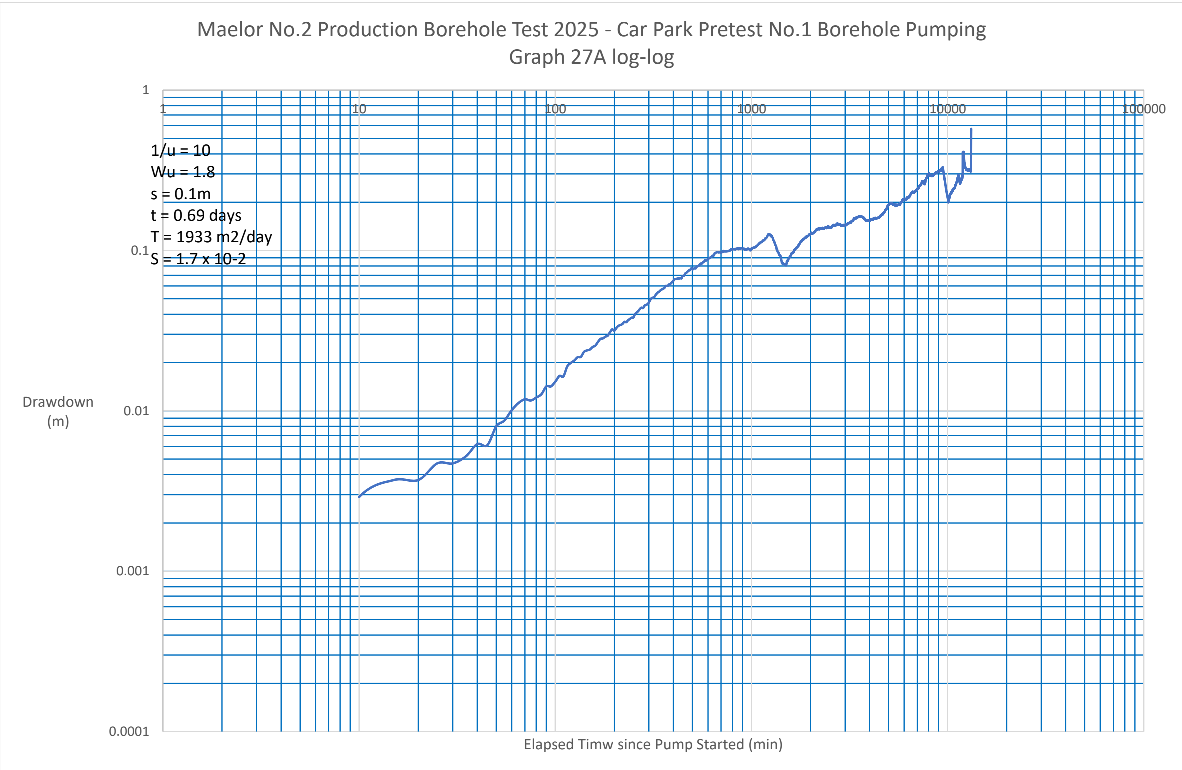

Time (mins)Maelor No.2 Production Borehole Pumpimg Test 2025- Rainfall Pumping & Recovery Phases
Graph 15
Pumping Phase
Recovery Phase
Rainfall (mm)
Elapsed Time (mins)

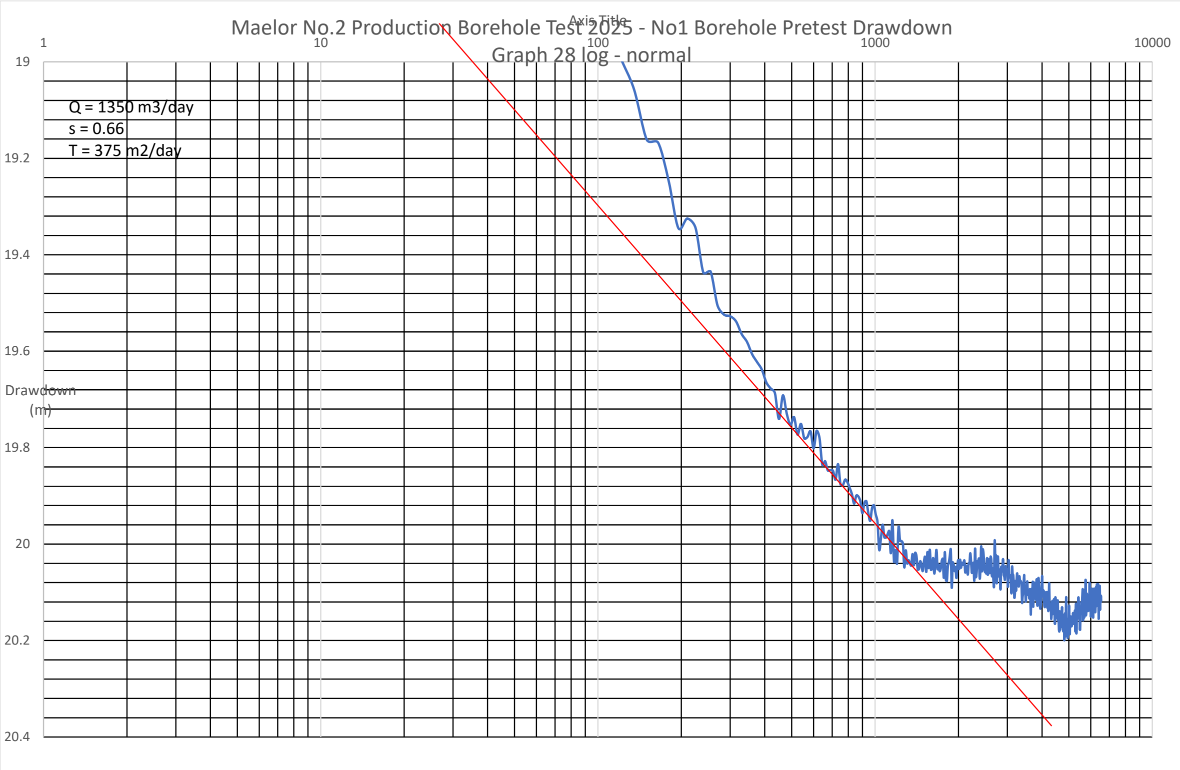

Maelor No.2 Production Borehole Test 2025 - Black Rock Farm Dips
Graph 24
Elapsed Time since start of Pumping (mins)
PRETEST
PUMPING
RECOVERY
Water Level (mbd)
Trendline Falling at 5 mm/day

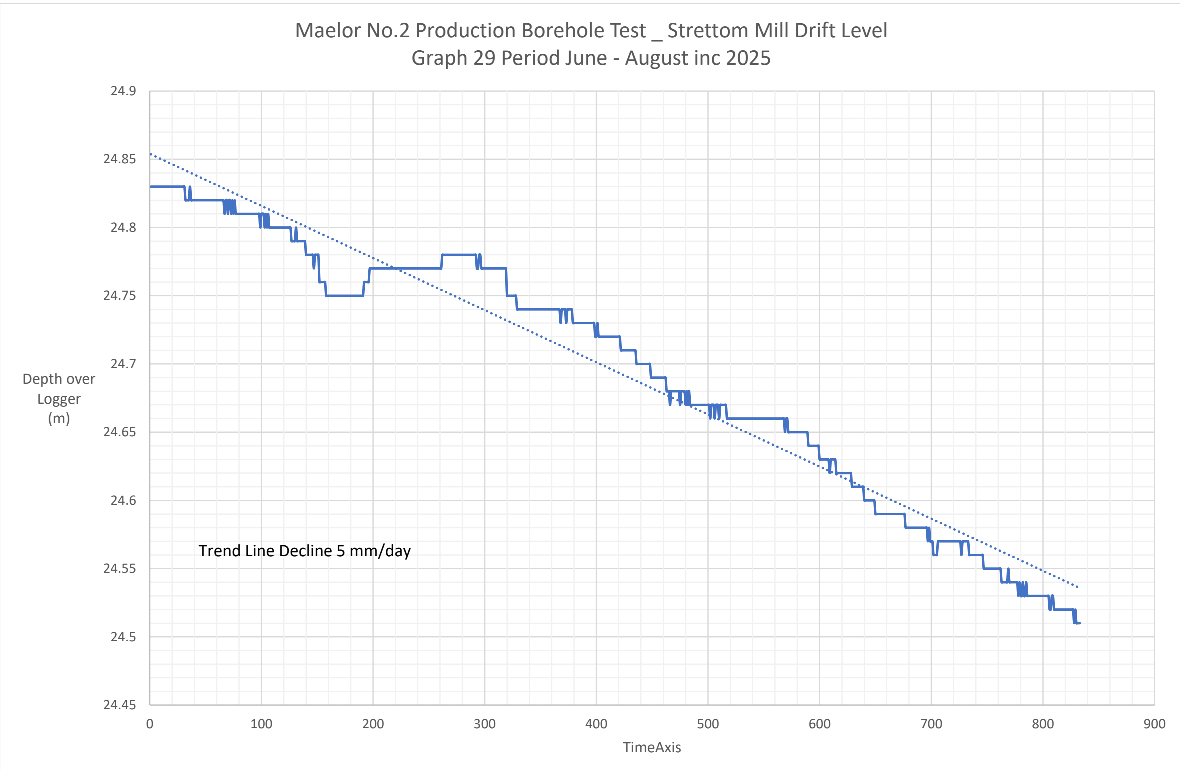

Maelor No. 2 Production Borehole Test - Potential Radius of Effect
Graph 25
Elapsed Time Since the Start of Pumping (days)
0
5
10
15
20
25
30
35
40
45
Radius of Effect
(m)
0
200
400
600
800
1000
1200
1400


Maelor No. 2 Production Borehole Test 2025 - Barton Level Graph
Graph 26
PRETEST
PUMPING
RECOVERY
Water Level
(m AOD)
16.94
16.92
16.9
16.88
16.86
16.84
16.82
16.8
16.78
16.76
-50000
-40000
-30000
-20000
-10000
0
10000
20000
30000
40000
50000
Elapsed Time before and after the start of mumping (mins)


Maelor No.2 Production Borehole Test 2025 - Car Park No. 1 Borehole Pumping
Graph 27
Elapsed Time from start of Pumping (mins
1
10
100
1000
10000
100000
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
Drawdown (m)
to = 120 mins
s = 0.116 m
r = 171m
Q = 1350 m2/day
T = 2129 m2/day
S = 1.9 x 10-2


Maelor No.2 Production Borehole Test 2025 - Car Park Pretest No.1 Borehole Pumping
Graph 27A log-log
1
0.1
0.01
0.001
0.0001
1
10
100
1000
10000
100000
1/u = 10
Wu = 1.8
s = 0.1m
t = 0.69 days
T = 1933 m2/day
S = 1.7 x 10-2
Drawdown (m)
Elapsed Timw since Pump Started (min)


Maelor No.2 Production Borehole Test 2025 - No1 Borehole Pretest Drawdown
Graph 28 log - normal
Axis Title
1
10
100
1000
10000
19
19.2
19.4
19.6
19.8
20
20.2
20.4
Drawdown (m)
Q = 1350 m3/day
s = 0.66
T = 375 m2/day


Maelor No.2 Production Borehole Test _ Strettom Mill Drift Level
Graph 29 Period June - August inc 2025
24.9
24.85
24.8
24.75
24.7
24.65
24.6
24.55
24.5
24.45
Depth over Logger (m)
Trend Line Decline 5 mm/day
0
100
200
300
400
500
600
700
800
900
TimeAxis

REFFERENCES

1 Maelor Foods Ltd – Hydrogeological Impact Assessment for Borehole at the Cross Lanes Site – G.H.Saul - June 2017

2. Maelor Foods Ltd – Hydrogeological Impact Assessment for Borehole at the Cross Lanes Sitr, in support of an application to increase daily abstraction. – G.H.Saul – June 2018

3. Geology of the country around Nantwich and Whitchurch – BGS – Pge 24 Triassic

4. Triton Resources seismic survey under Cheshire Basin Exploration Licence 1991 **Lines P87-**01 (E-E') and P87-07(D – D')

5. Maelor Foods Ltd – Hydrological Impact Assessment for Borehole at the Cross Lanes Site – G.H.Saul 2017 – Page 69 Production Borehole Drillers Log interpretation.

6. Maelor Foods Ltd – Hydrogeological Assessment for Borehole at the Cross Lanes Site, In support of an application to increase daily abstraction – G.H.Saul June 2018 – Fig 17

7. British Geological Survey 1:50,000 series, Map 121. – Wrexham Solid and Drift Edition.

8. British Geological Survey 1:50,000 series, Map 122. – Nantwich Solid and Drift Editions

9. Geology of the Country around Nantwich and Whitchurch page 91 River Terraces

10. Geology of the Country around Nantwich and Whitchurch page 83 Upper Boulder Clay West of the River Dee.

11. Geology of the Country around Nantwich and Whitchurch page 79 Middle Sands.

12 Geology of the Country around Nantwich and Whitchurch page 78 Lower Boulder Clay

13 Geology of the Country around Nantwich and Whitchurch page 14

Permo-Triassic Lower Mottled Sandstone

14 Physical Properties of Major Aquifers of England and Wales page 206 Kinnertron Sandstone Formation

15 Physical Properties of major aquifers of England and Wales page 206

16. Geology of the Country around Nantwich and Whitchurch page 53 faults

17. Map of the Geological Structure affecting the Triassic Sherwood Sandstone Aquifer, where confined by the Mercia Mudstone Group across part of the Vale of York. – Hawkins and Saul

18. Rivers Swale and Ure Catchment Study. Final Report of Geophysical Surveys and interpretation of the structural geology (for the Environment Agency) – Hawkins and Saul

19. Physical Properties of Major Aquifers of England and Wales page 214 Stratigraphy, and page 218 Kinnerton Sandstone Formation

20. The geology of the country around Nantwich and Whitchurch – page 24 – Lower Mottled Sandstone.

21. Physical Properties of Major Aquifers of England and Wales page 214 Stratigraphy, and page 218 Chester Pebble Bed Formation..

22. The geology of the country around Nantwich and Whitchurch – page 24 – Pebble Beds.

23. Physical Properties of Major Aquifers of England and Wales page 215 Fractures.

24. Physical Properties of Major Aquifers of England and Wales page 215 Hydrogeology.

25. Physical Properties of Major Aquifers of England and Wales page 218 Chester Pebble Beds Formation.

26. Physical Properties of Major Aquifers of England and Wales page 220 Variation with grain size and core scale anisotropy.

27. Physical Properties of Major Aquifers of England and Wales page 209 table 7.4.4

28. Physical Properties of Major Aquifers of England and Wales page 212table 7.4.6

29. Physical Properties of Major Aquifers of England and Wales page 209 Pumping test case studies- para 4

30 Groundwater and wells 2nd edition – F.G.Driscoll- page 218 – Nonequilibrium Equation

31 Groundwater and wells 2nd edition – F.G.Driscoll- page 219 – Modified Nonequilibrium Equation

32 Maelor Foods Ltd – Hydrogeological Impact Assessment for Borehole at the Cross Lanes Sitr, in support of an application to increase daily abstraction. – G.H.Saul – June 2018, section 14 page 24

33 Maelor Foods Ltd – Hydrogeological Impact Assessment for Borehole at the Cross Lanes Sitr, in support of an application to increase daily abstraction. – G.H.Saul – June 2018, Figs 7,8,&9