Appendix 13.1E

Assessment of Proposed Dredge on Marsh Hydrology

BYRNELOOBY

Wicklow County Council

Arklow Flood Relief Scheme

Assessment of Proposed Dredging on Marsh Hydrology

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1 Introduction

1.1 Background

The town of Arklow is located approximately 63km south of Dublin, 66km north of Wexford and 23km south of Wicklow. Arklow is the southern most major town within County Wicklow and is served by the M11 National Primary Route. Arklow is situated on the estuary of the Avoca River and is a traditional fishing town served locally by a harbour.

Arklow has experienced recurring flooding problems that have caused widespread damage to public and private property. The largest flood event recorded was in August 1986 resulting from extreme meteorological conditions commonly referred to as "Hurricane Charlie". Further recent flooding events occurred in December 1989, November 2000, February 2002 and in October 2004, October 2005, January 2010, January 2013 and December 2015.

A Flood Relief Feasibility Study was prepared by ByrneLooby. The report in the feasibility study included the following recommendations for capital flood relief works:

- Lowering of the floor of Arklow Bridge by 1m with underpinning of the bridge and scour protection for the river bed;
- Channel improvement works comprising extensive upstream and downstream dredging of the river channel.

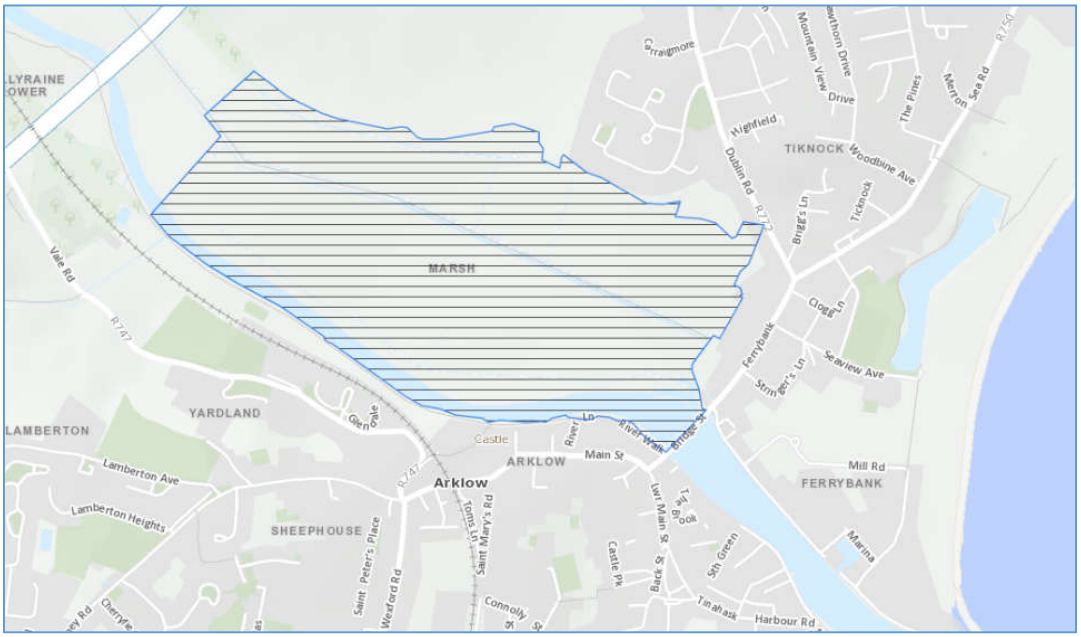

Figure 1.1: Arklow Town Marsh pNHA

Arklow Town Marsh is a proposed Natural Heritage Area (site code 001931). It is located on the left bank and along the Avoca River and extends upstream from Arklow Bridge to within 235m of the M11 motorway. The extent of the pNHA is shown Figure 1.1 above.

There is a concern that the proposed dredging works in the Avoca River estuary may alter the hydrology and hydrogeology of Arklow Town Marsh and consequently impact on the ecology of the marsh.

1.2 Stage 1 Report Findings

An initial assessment (the Stage 1 assessment) was carried out and considered the impact on river levels due the proposed river dredging for low flows, mean flows and typical winter flood flows. The assessment for the mean river flow determined that for Spring tidal conditions, the predicted high-water levels are similar at all four locations shown in Figure 1.2 below for the existing situation and for the proposed situation (post flood scheme works).

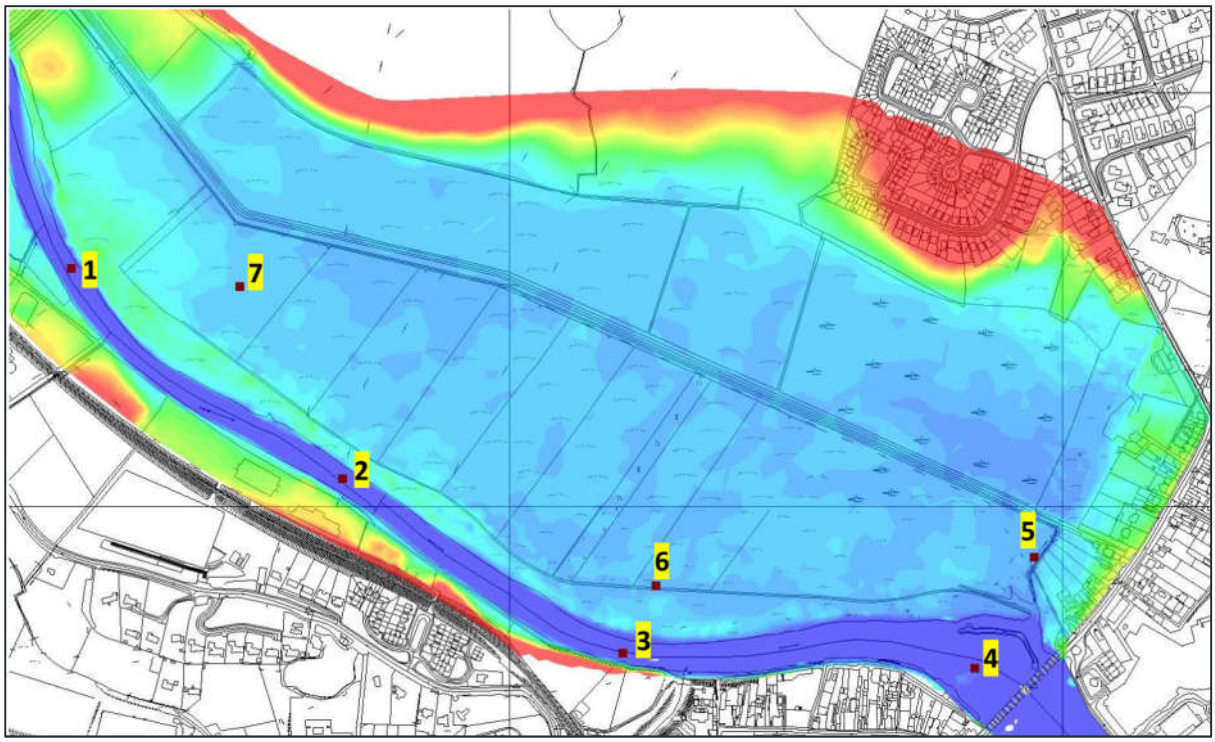

Figure 1.2: Reference Site

For Spring tidal conditions, the predicted low water levels are lower at all four locations for the proposed situation that for the existing situation. The difference varies from 520mm immediately upstream of Arklow Bridge (ref. point 4) to 40mm at the upstream extent of the pNHA (ref. point1).

For Neap tidal conditions, the predicted high-water levels are slightly lower at all four locations for the proposed situation than for the existing situation. The difference is approximately 40 to 100mm at all locations.

For Neap tidal conditions, the predicted low water levels are lower at all four locations for the proposed situation than for the existing situation. The difference varies from 500mm immediately

upstream of Arklow Bridge (ref. point 4) to 40mm at the upstream extent of the pNHA (ref. point 1).

The impacts on water levels are largely similar for the low flow and typical winter flood flow conditions.

1.3 Report Objective

A ground investigation was carried out to investigate the soil and groundwater conditions at the site and to assess the groundwater connectivity with the adjacent tidal Avoca River.

This report has been produced to detail the ground investigation and any initial findings from the works as well as considering the surface water regime. The potential ecological impacts, particularly with respect to vegetation at the site, is also considered.

Additional exploratory holes and monitoring wells were conducted, and findings were incorporated into this report following these works.

This is stage 2 of a possible three stage approach to consider the potential impacts of the ecology of the marsh and recommend mitigation measures if necessary.

2 Desk Study

2.1 Introduction

A desk-based study has been carried out to detail the quaternary geology and hydrogeology and is summarised in the following sections.

2.2 Subsoils and Quaternary Geology

The GSI Quaternary Sediments map details the site's subsoils to be made up of Alluvium, as shown in Figure 2.1.

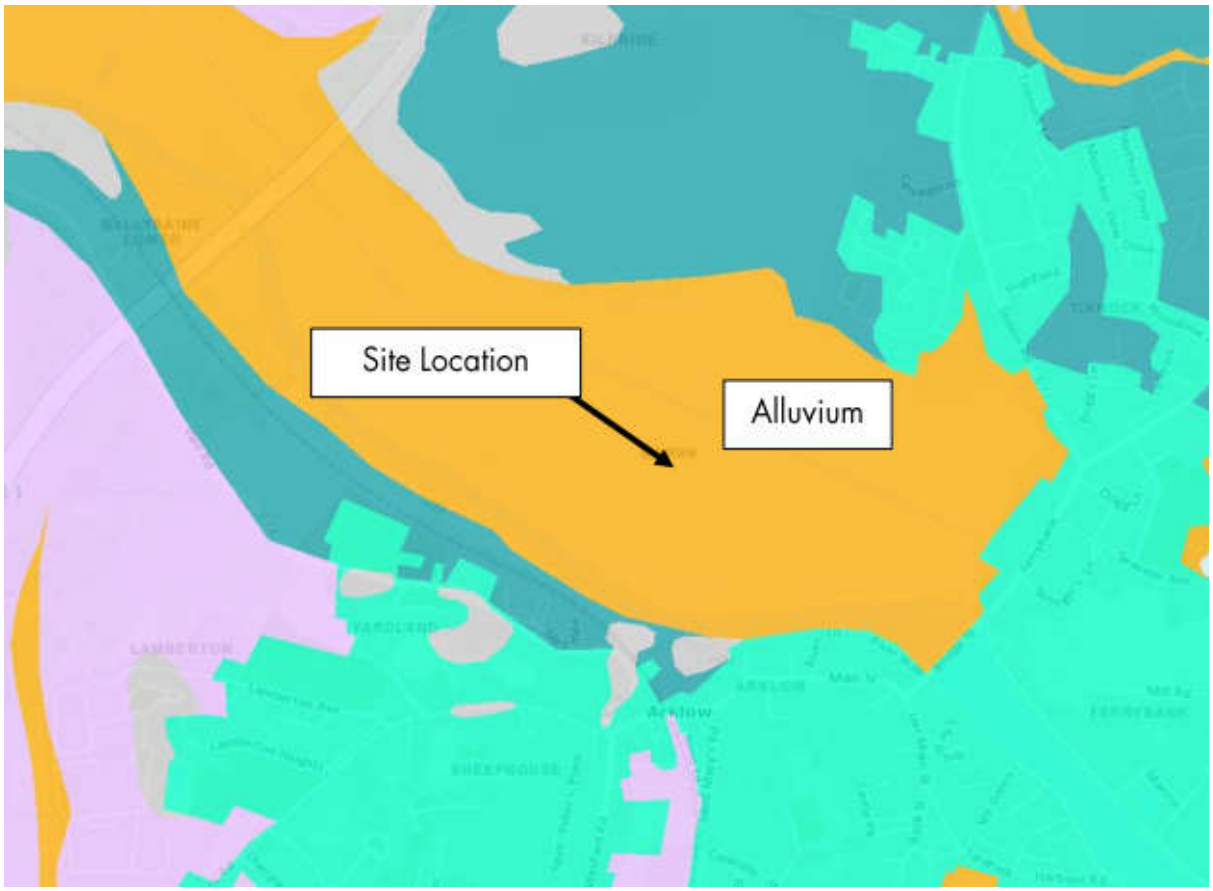

Figure 2.1: Quaternary Sediments (source ref. GSI)

2.3 Groundwater Resources

The GSI Groundwater Resources map details the underlying Sand & Gravel layer to be locally important aquifer, as shown in Figure 2.2 overleaf.

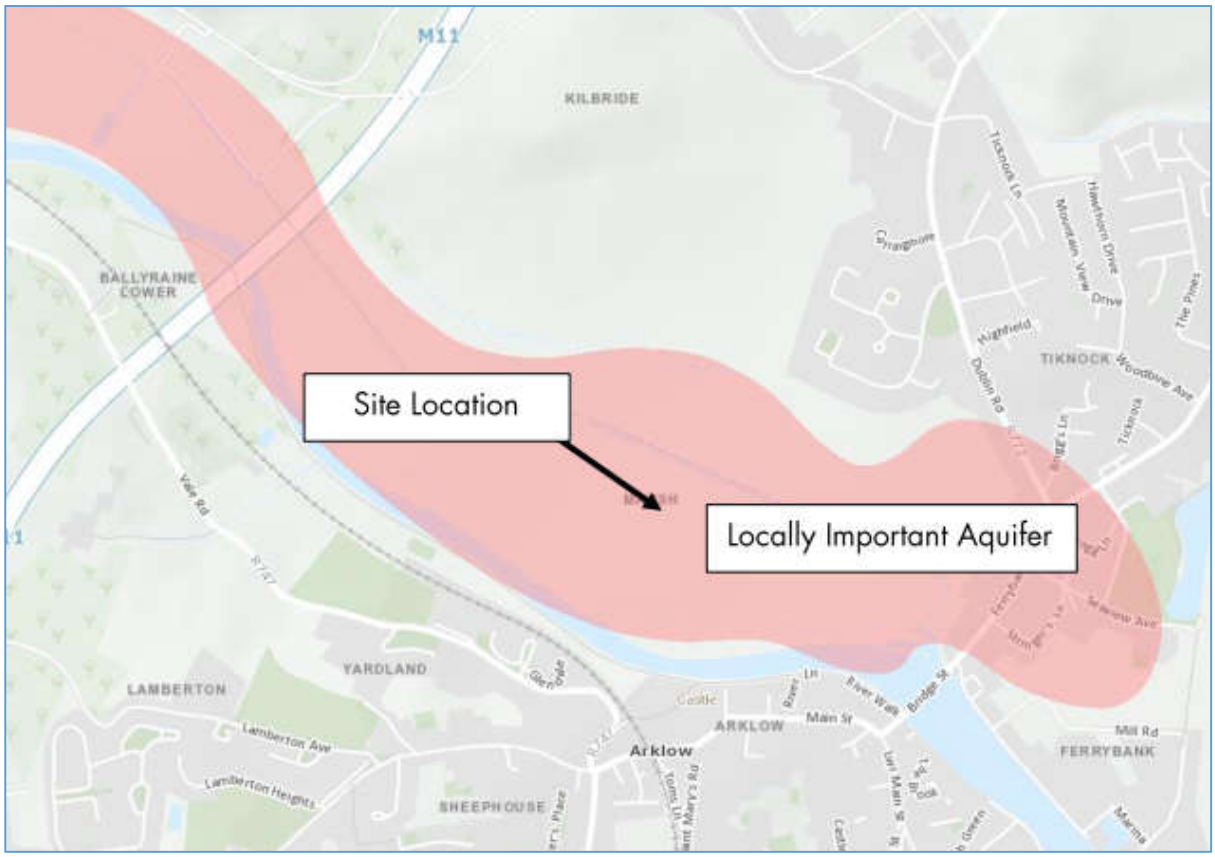

Figure 2.2: Groundwater Resources (ref. GSI)

2.4 Subsoil Permeability

The GSI Subsoil Permeability map classifies how easy water can infiltrate through subsoils downwards at any point in the land surface. Permeability across the country is classified as either 'High', 'Moderate' or 'Low'. The GSI map classifies the subsoil at the site to have a Moderate Permeability, as shown in Figure 2.3 overleaf.

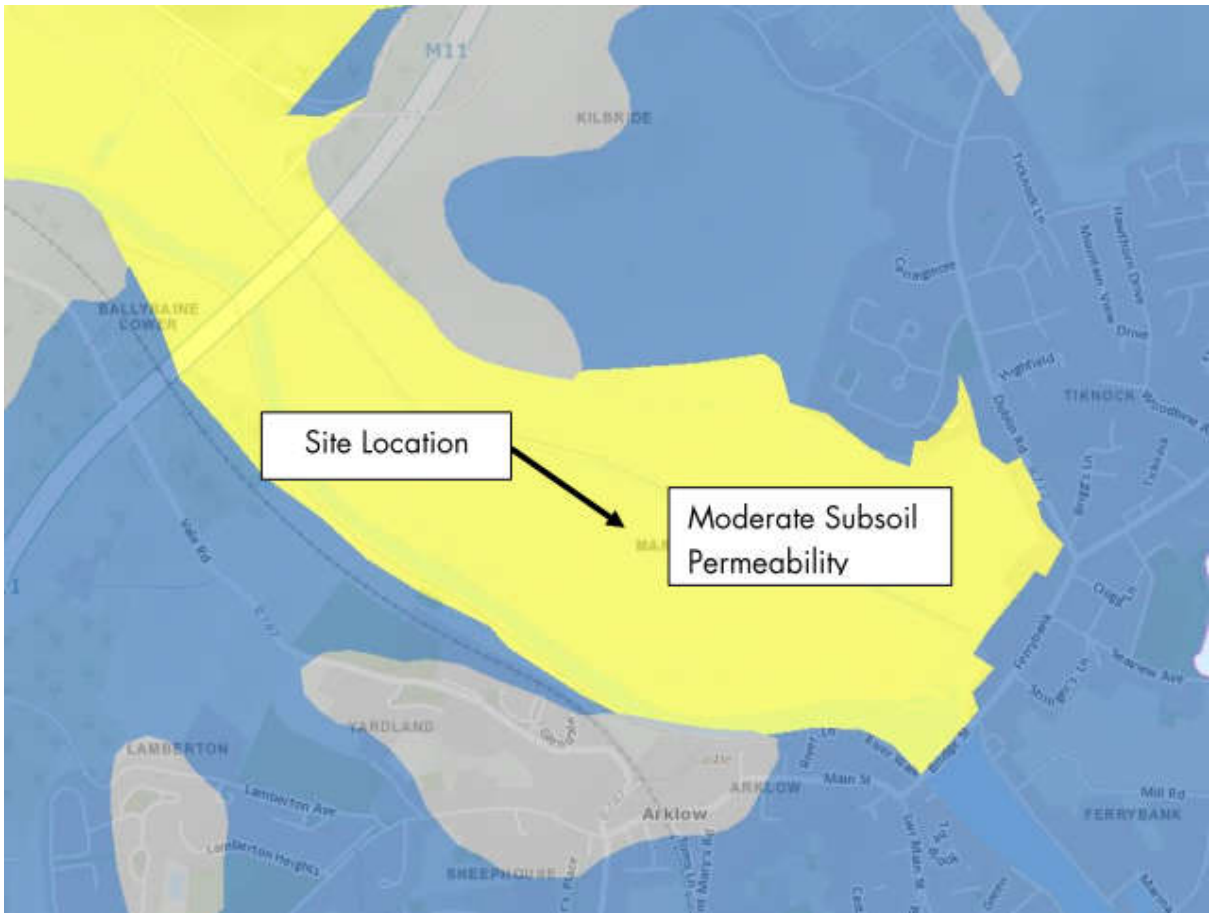

Figure 2.3: Groundwater Subsoil Permeability (ref. GSI)

2.5 Groundwater Recharge

The GSI groundwater recharge map provides an estimate of the average amount of rainfall that percolates down through the subsoils to the water table over a year.

The GSI describes the site as a moderate permeability subsoil, overlain by a poorly drained gley soil with an average recharge of 133mm/yr.

The subsoil typically comprised gravelly clayey SAND during the ground investigation. An area to the north of the site is described as Sands & Gravels aquifer, overlain by poorly drained soil with an average recharge of 251mm/yr.

Based on this, the average recharge values are estimated as ranging between 133mm/yr and 251mm/yr.

2.6 Rainfall

Rainfall data was obtained from Met Eireann for the Arklow area for the 30-year period from 1981 to 2010. This is shown in the Table 2-1 below.

Table 2-1: Rainfall Data

Period 1981-2010	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Mean Monthly Total	81	58	66	60	61	68	66	82	71	93	81	82	864

3 Ground Investigation

3.1 Objectives of Investigation

ByrneLooby specified a ground investigation with Ground Investigation Ireland (GII) appointed as the preferred contractor. The key objectives of the investigations were as follows:

- Confirm the geological and hydrogeological regime of the site;
- Assess permeability of underlying materials.

3.2 Scope of Investigations

The initial phase of works was carried out between September and October 2019. The ground investigation consisted of:

- Carry out 12 No. Window Sample Boreholes to a maximum depth of 4m bgl;
- Installation of 5 No. groundwater monitoring wells;
- Carry out 5 No. rising head test;
- Groundwater monitoring

The locations of the windows sample boreholes were proposed by ByrneLooby. However, a number of these were amended on site dues to access constraints (water logged ground). As built locations of the boreholes are shown in Figure 3.1 below.

Figure 3.1: Exploratory Hole Plan

The boreholes marked in red were not carried out due to the waterlogged nature of the ground.

Groundwater data loggers were installed on the 11th September 2019 and monitoring of groundwater levels was carried out for a 6-week period.

3.3 Ground Conditions

Ground conditions typically comprised of soft to firm SILT/PEAT overlying SAND. A number of boreholes encountered topsoil overlying the SILT/PEAT. The base of the SILT/PEAT was penetrated in all boreholes, with the exception of WS07 and WS14.

The soft to firm SILT/PEAT was encountered in all boreholes, with the exception of WS10, and was generally described as soft to firm mottled organic sandy SILT with rootlets and soft spongy fibrous PEAT. The depth of the SILT/PEAT generally ranged from 1.35m to 2m in thickness.

The sand was generally described as slightly gravelly clayey fine to medium SAND with occasional rootlets.

3.4 Groundwater

The response zones for the groundwater installations were installed within the lower depths of the Silt/Peat and Sand Layers to record the groundwater within the Sand Layer, as shown in Figure 3.2 below.

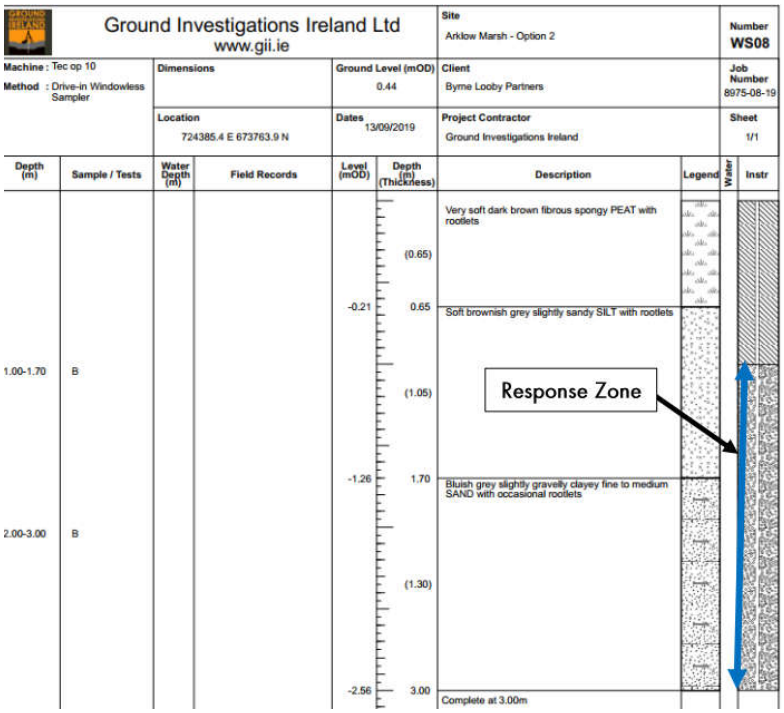

Figure 3.2: Installation Detail

Groundwater dataloggers were installed in 5 No. installations with groundwater levels monitored between 11th September 2019 and 23rd October 2019. The monitored groundwater levels are shown in Figure 3.3, with water levels generally ranging from approximately – 1.6m OD to 0.4m OD. Please note that the data logger in WS10 was damaged during the monitoring works with the data corrupted following this damage.

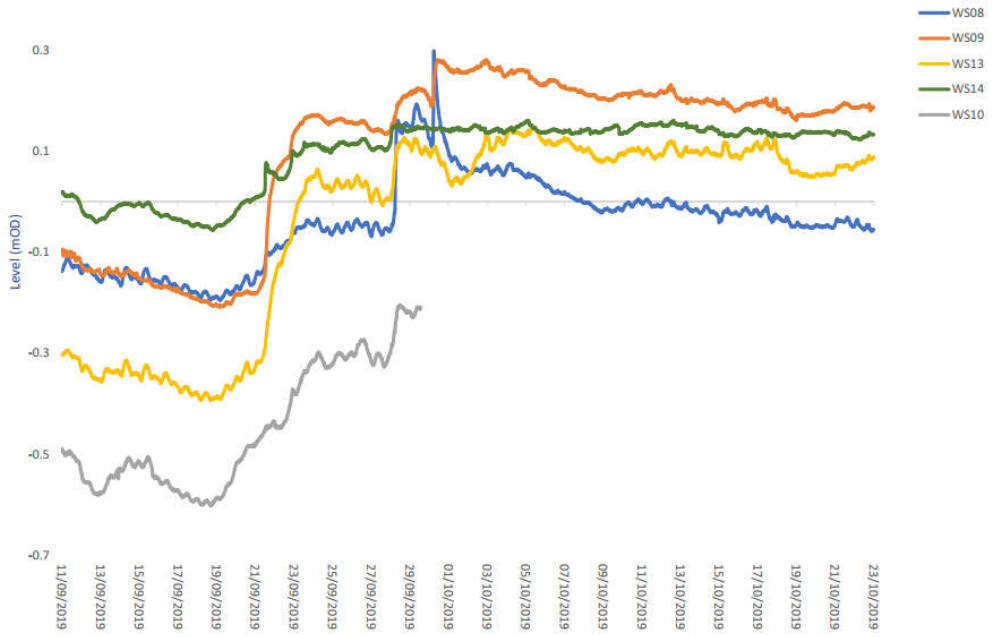

Figure 3.3: Groundwater Monitoring

3.5 In Situ Testing

3.5.1 Permeability Testing

5 No. Rising Head Tests were carried out in the exploratory holes, with permeability values ranging from 1E-6m/s to 7E-6m/s, which would be typical for a fine sand.

3.6 Laboratory Testing

3.6.1 Particle Size Distribution Tests

14 No. particle size distribution tests were carried out from samples obtained during the ground investigation. The results of the tests have been plotted and are shown in Figure 3.4 overleaf, with the red samples representing the soft SILT/PEAT layer and the blue lines representing the SAND layer. The results show the SAND to be a slightly gravelly silty CLAY.

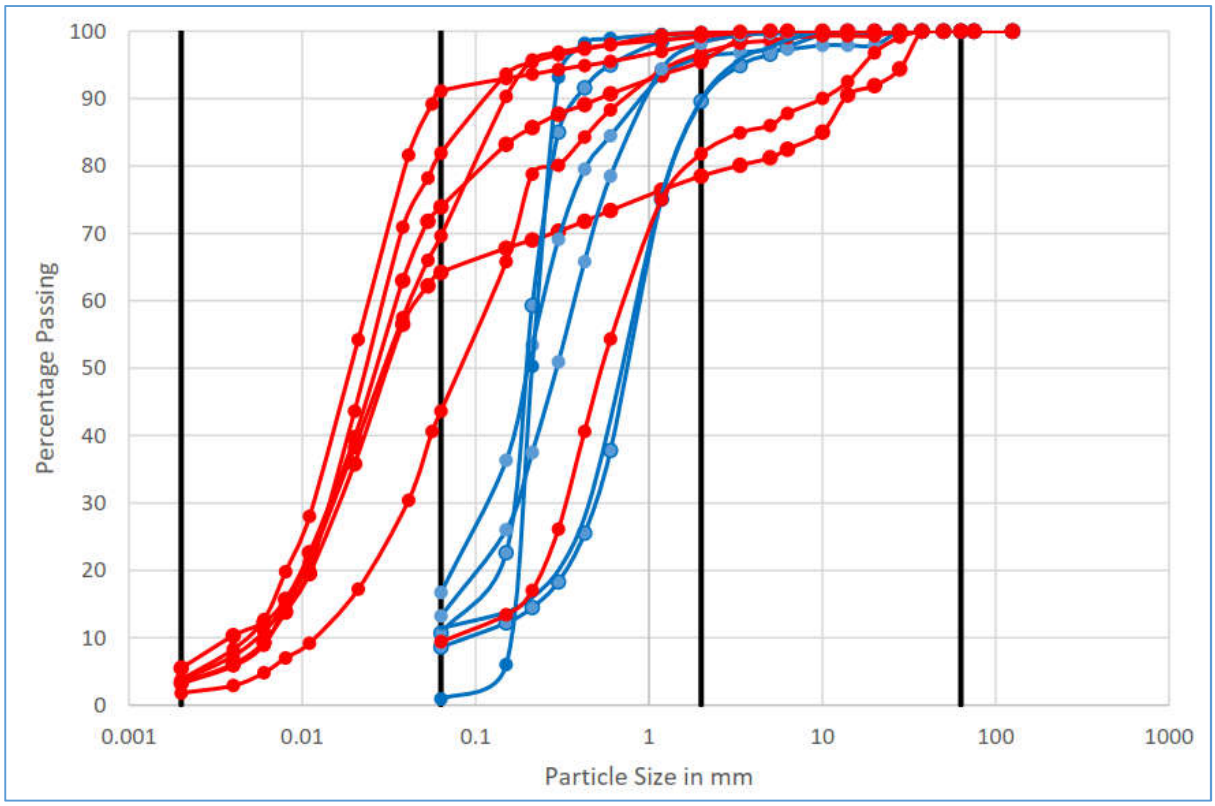

Figure 3.4: Particle Size Distribution Results

4 Assessment of Water Levels

4.1 Groundwater Levels

The lowest water levels were monitored in WS08 and WS10 (circled red in Figure 4.2) which were the nearest installations to the River Avoca, with the highest water levels recorded in WS09 and WS14 (outlined in green in Figure 4.2) which were furthest installations from the River. Groundwater levels and monitoring locations are shown in Figure 4.1and. Figure 4.2 respectively.

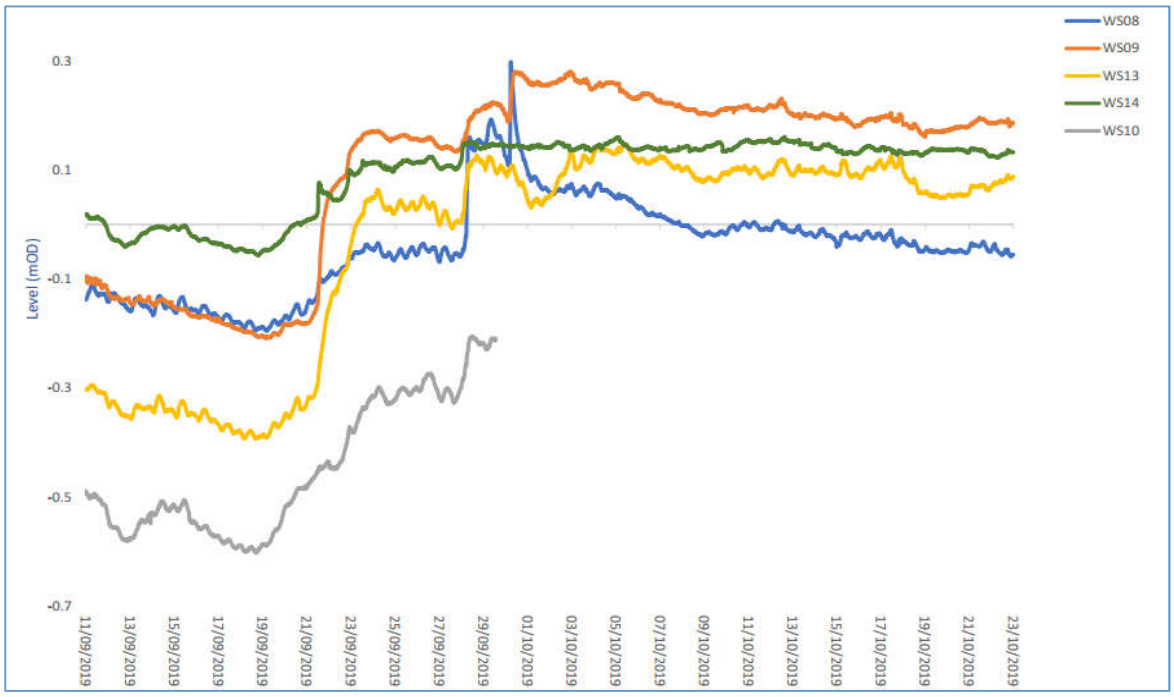

Figure 4.1: Groundwater Levels

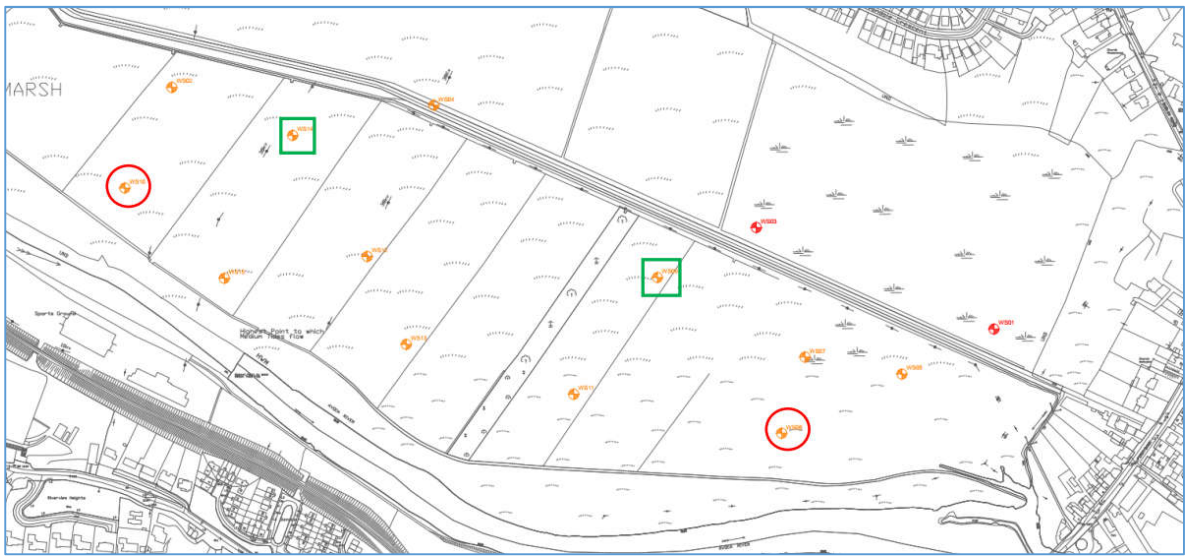

Figure 4.2: Exploratory Hole locations

4.2 Comparison with River Levels

ByrneLooby carried out a review of the river levels in the Avoca River to access the connectivity between the groundwater levels in the marsh and the river. The river levels were provided by the OPW with the nearest Gauge Station located at the upstream face of Arklow Town bridge. The recorded river levels are presented in Figure 4.3 with the groundwater monitoring data also presented.

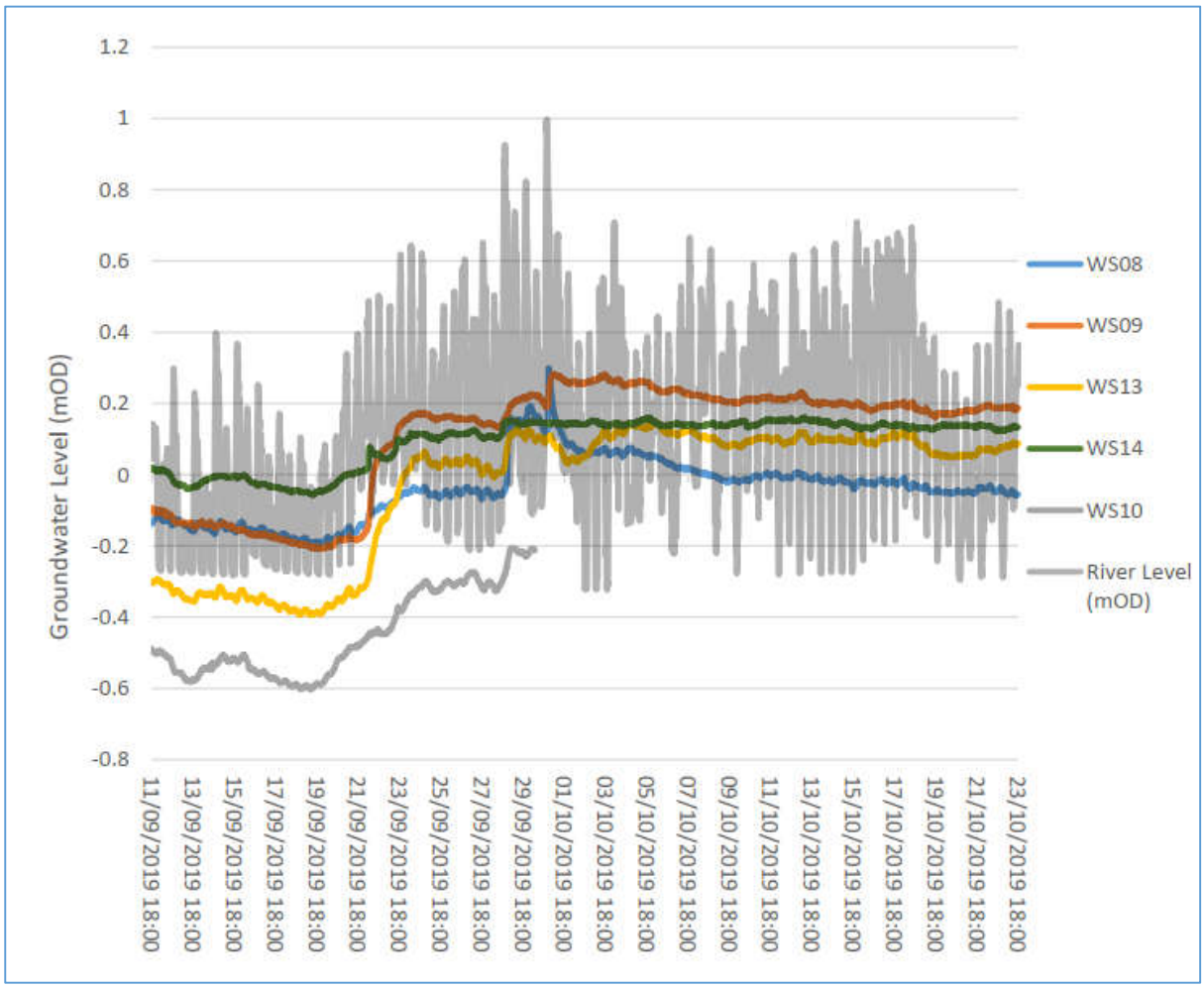

Figure 4.3: Arklow Bridge River Level -v- Monitored Groundwater Levels

All levels are shown for the same time each day i.e.18:00. Note that the predicted spring and neap tides occurred around the following dates:

Spring Tide	15/09/2019	30/09/2019	14/10/2019
Neap Tide	22/09/2019	07/10/2019	21/10/2019

As can be seen, the ground water levels closer to the river (WS08, WS10 and WS13) are generally lower than those further from the river. Of significance also is that groundwater levels generally lie between the high and low tide levels in the river.

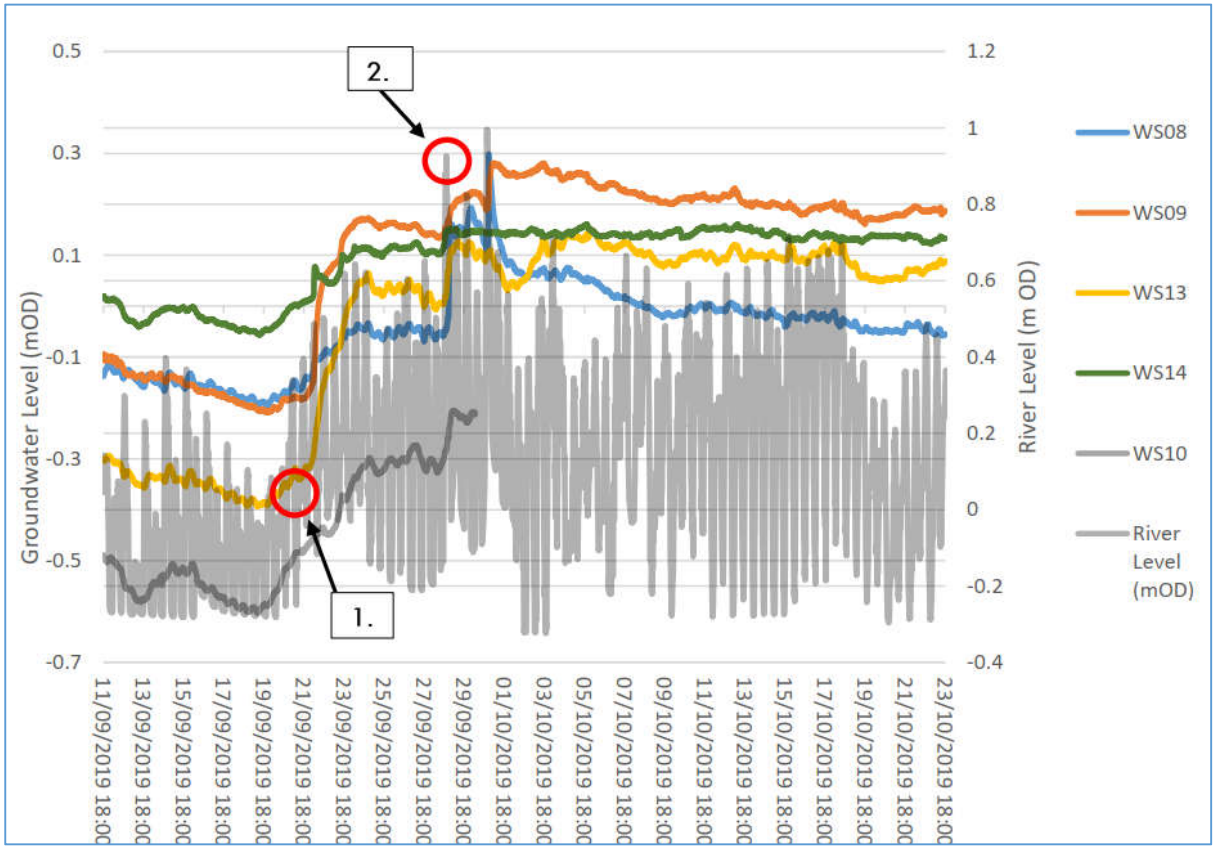

Figure 4.4: Arklow Bridge River Level -v- Monitored Groundwater Levels

As can be seen in Figure 4.4 the groundwater levels in the Arklow Marsh area are clearly linked to the water levels in the River Avoca with the groundwater levels changing when the water levels in the river changed for a sustained period.

During a neap tide the change in water level in the river was approximately 400mm. During the same period, the maximum change in groundwater level across all the installations was found to be 15mm, which occurred in an installation directly adjacently to the river.

During the largest tide recorded during the monitoring period the change in water level in river was 800mm. During the same period, the maximum change in groundwater level across all the installations was found to be 50mm.

A significant sustained rise in river level occurred starting on the 21st of September 2019 (Point 1), as shown on Figure 4.4, with the average river level 400mm higher on the 23rd of September than on the 19th September. This increase in river level caused an average increase in the groundwater level of 200mm across the monitoring wells. From review of the rainfall data, this increase in water level was caused by a significant rainfall events, as shown in Figure 4.5 overleaf.

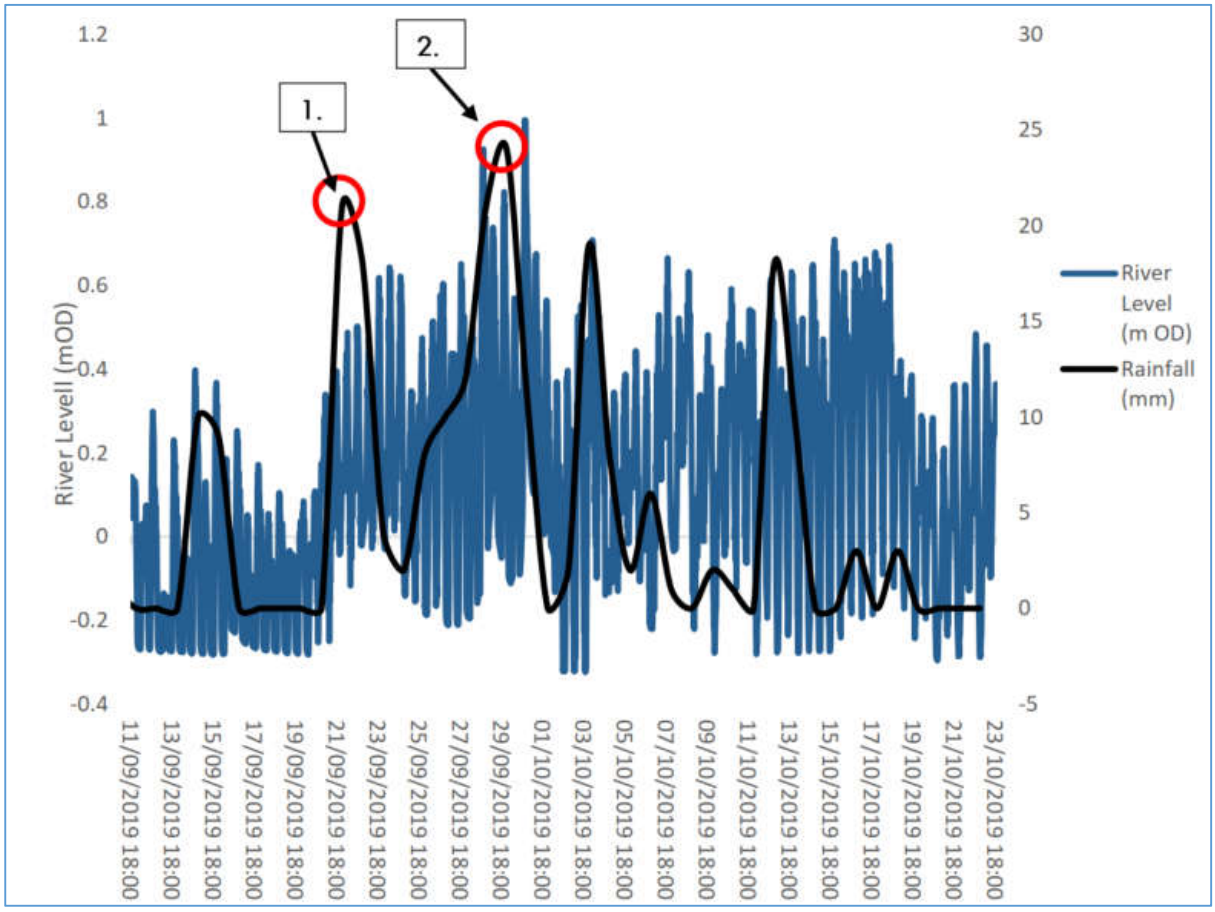

Figure 4.5: River Levels -v- Rainfall Data

An additional significant rainfall event occurred on the 29th September (point 2), which caused the river levels and subsequently groundwater levels to rise further. Following this, groundwater levels gradually decreased slowly with a number of minor peaks caused by additional rainfall events.

4.3 Groundwater

Figure 4.6 overleaf shows the monitored groundwater levels as depths below ground level, with groundwater levels ranging from 0.1m bgl to 1.5m bgl. Based on this the groundwater from the underlying sandy gravel layers extends into the overlying peat/ silt layer at all of the monitoring well locations throughout the monitoring period.

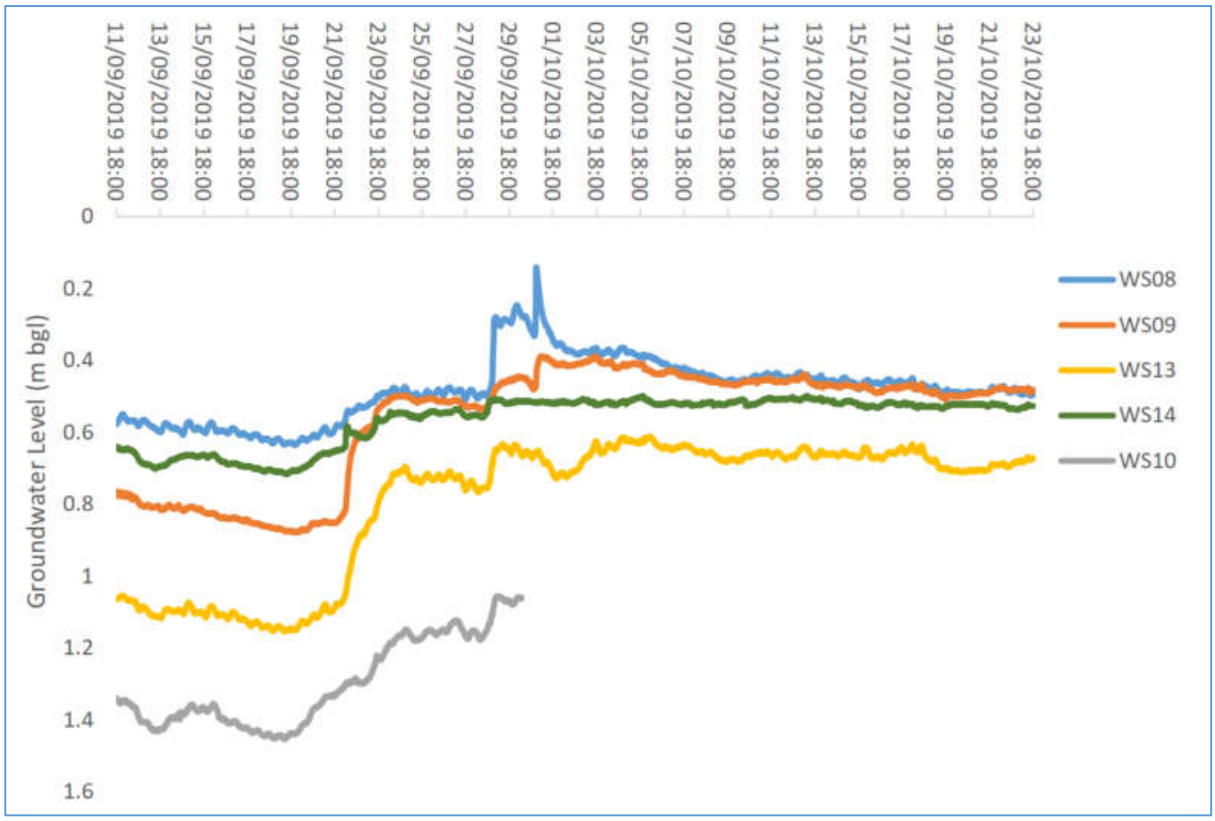

Figure 4.6: Ground Levels

5 Surface Water Assessment

Surface water from rainfall is typically dissipated through infiltration, evaporation, transpiration and run-off.

The average monthly rainfall, from the data in section 2.6, varies from 58m to 93m with an annual total of 864mm.

Section 2.4 reports that the GSI Subsoil Permeability map classifies the subsoils at the site to have a Moderate permeability.

Section 2.5 reports that the average recharge values i.e. infiltration, are estimated as ranging between 133mm/yr and 251mm/yr for the marsh.

The marsh is observed as being waterlogged over significant areas for long periods of the year.

6 Conclusions of Hydrogeology and Hydrology Assessment

6.1 Summary of Findings

The findings are summarised below.

Hydrogeology

- There is a clear linkage between ground water levels in the marsh and levels in the Avoca River;
- The change in groundwater levels is significantly dampened when compared to the changes in river levels e.g. 15mm to 50mm change in groundwater levels for 400mm to 800mm change in river levels;
- Groundwater levels typically lie between high and low levels in the river.
- The river level will return to existing tide levels typically every two weeks (at spring high tides) and return to within 100mm of the current high tide levels for the intervening weeks (at neap high tides) following the river dredging;
- It is likely that peak ground water levels will be influenced by the river dredging by up to a maximum of 100mm;
- The groundwater levels typically intrude into the upper silt/ peat layers.

Hydrology

- The marsh is waterlogged for significant periods of the year;
- Average annual rainfall amounted to approximately 864mm for the period 1981 to 2010;
- Average monthly rainfall varied from 58mm to 93mm for the period 1981 to 2010.

7 Assessment of Ecological Impacts

Water that is present in the Arklow Marsh comes from a number of sources and these are:

i. Rain falling on the marsh surface
ii. Water entering underneath it from the Arklow River
iii. Arklow River flooding events that inundated the marsh
iv. Normal tidal cycle events and;
v. Extreme storm/ wave surge events such as Charlie, Darwin, Opheila, Emma and most recently, Brendan.

With regards to rainfall data presented in Table 2-1 (Section 2.6) above for a period between 1981 – 2010, the monthly mean data do not show any great variation with ranges from 60mm in the month of April to 93mm in October (mean = 72mm, median = 70mm). This indicates that the marsh receives a relatively similar level of rain both seasonally and intra-annually.

Similarly, the water that enters under the marsh from the Arklow River at mean flow levels is also relatively similar both over a year and also over an extended number of years. Figure 7.1 overleaf shows river flow data over the period of 2003 – 2020 and the R^2 value of 0.0021 is very low indicating little or no trend over that time period.

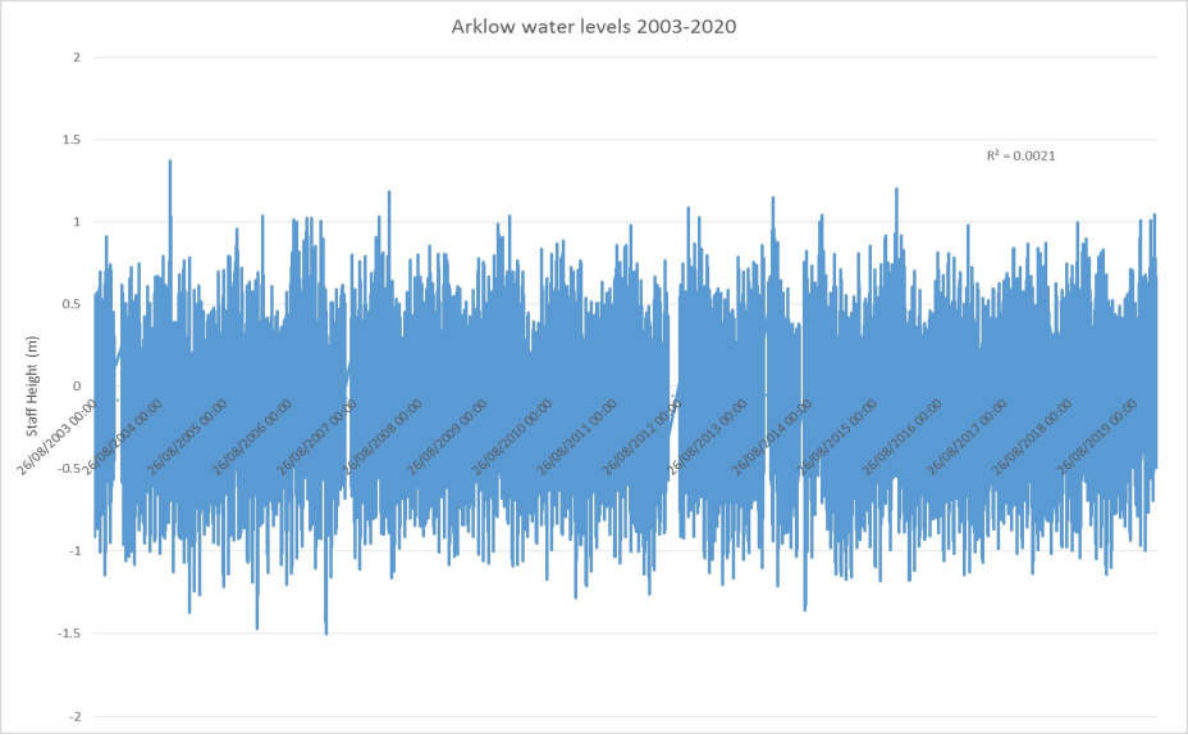

Figure 7.1: Arklow River Flow Data (2003-2020)

The conclusions of the hydrology assessment presented in Section 6 above also note this and state that there is a clear link between groundwater levels in the marsh and in the river. In Section 4.2 above (Figure 4.3 and Figure 4.5), it can be seen that the river flow and rainfall levels can have a greater impact on water levels in the marsh in comparison to the tidal contribution.

When the river is in flood, the amount of water that enters the marsh both underneath it and by over topping the surface of the marsh will be significantly greater than sources 1 or 2 listed above. However, such events occur irregularly and will only have a short-term effect on the ecology of the marsh.

As for normal levels of rainfall and mean river flow levels, volumes of water entering under the marsh due to the Spring Neap tidal cycle are considered to be relatively similar over each lunar cycle. Another conclusion of the hydrology assessment (Section 6) is that groundwater levels typically lie between High water and Low water Levels in the river.

Of greatest impact on water levels in the marsh is the occurrence of extreme storm/wave surge events that can elevate tidal ranges to *ca* +m over Malin and inundate the marsh with saline water. As for flood periods for the river, such events occur irregularly and will only have a short-term effect on the ecology of the marsh.

One prediction of the hydrological assessment is that the peak ground water levels will be reduced by 100mm by the dredging of the river. However, given the natural variation in all sources of water that enters the marsh, it is considered highly unlikely that this reduction will have any significant impact on the ecology of the marsh.

Section 5 above notes that the marsh is observed as being waterlogged over significant areas for long periods of the year. Given the variations within each source of water that enters the marsh, it is considered that this will continue to be the case into the future and it is considered highly unlikely that there can be any significant impact on the ecology of the marsh.

8 Conclusion

Assessment of the proposed dredging works on the marsh hydrology deduced significant findings on the behaviour of the water regime. Section 6 of this report summarises findings of the hydrology and hydrogeology in the marsh, while Section 7 assessed the ecological impact thereof.

In conclusion, the objectives of this report have been reached and the following were deduced:

- There is a linkage between groundwater levels in the marsh and in the Avoca river,
- The marsh is waterlogged for significant periods of the year,
- River flow and rainfall levels can have a greater impact on water levels (i.e. flooding and extreme rainfall conditions) in comparison to tidal contribution. These flood periods occur irregularly and have a short-term effect on the marsh;
- There is a natural variation in all sources of water that enter the marsh,
- Peak ground water levels are likely to be influenced by the river dredging by a maximum of 100mm;

Taking the above into consideration, there will be minimum impact on the ecology of the marsh due to the proposed dredging works.

Appendix A – Factual Report

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Ground Investigations Ireland

Arklow Marsh, Arklow Town, Co. Wicklow

Ground Investigation Report

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APPENDICES

1.0 Preamble

On the instructions of ByrneLooby Consulting Engineers, a site investigation was carried out by Ground Investigations Ireland Ltd., between September and October 2019 at the marsh in Arklow Town, Co Wicklow.

2.0 Overview

2.1. Background

It is proposed to dredge the River Avoca at the northern side of the bridge and as such, the ground investigation in the Marsh area was carried out to gain information on groundwater levels in the marsh over a period of time prior to any dredging works being conducted. The ground investigation in the marsh is part of the overall Flood Relief Scheme designed by Wicklow County Council.

2.2. Purpose and Scope

The purpose of the site investigation was to investigate subsurface conditions utilising a variety of investigative methods in accordance with the project specification. The scope of the work undertaken for this project included the following:

- Visit project site to observe existing conditions
- Carry out 12 No. Window Sample Boreholes to recover soil samples
- Installation of 5 No. Groundwater monitoring wells
- Carry out 5 No. Rising Head Tests
- Carry out 5 No. Permeability Tests
- Geotechnical & Environmental Laboratory testing
- Factual Report

3.0 Subsurface Exploration

3.1. General

During the ground investigation a programme of intrusive investigation specified by the Consulting Engineer was undertaken to determine the sub surface conditions at the proposed site. Regular sampling and in-situ testing were undertaken in the exploratory holes to facilitate the geotechnical descriptions and to enable laboratory testing to be carried out on the soil samples recovered during excavation and drilling.
The procedures used in this site investigation are in accordance with Eurocode 7 Part 2: Ground Investigation and testing (ISEN 1997 – 2:2007) and B.S. 5930:2015.

3.2. Window Sampling

The window sampling was carried out at the locations shown in the location plan in Appendix 1 using a Dando Terrier/Tecop Tec 10 percussion drilling rig. The window sampling consists of a 1m long steel tube with a cutting edge and an internal plastic liner which is mechanically driven into the ground utilising a 50kg weight falling a height of 500mm. Upon completion of the 1m sample, the tube is withdrawn, and the plastic liner removed and sealed for logging and sub sampling by a Geotechnical Engineer/Engineering Geologist. The tube is replaced in the borehole and a subsequent 1m sample can be recovered. Occasionally outer casing or a reduced diameter tube is utilised to enable the window sample to progress in difficult drilling conditions. Geotechnical or environmental soil samples can be recovered from each of the liners following logging. The window sample records are provided in Appendix 2 of this Report.

3.3. Groundwater

Groundwater Installations were installed upon the completion of the window samples at the locations shown in the location plan in Appendix 1 to enable sampling and the determination of the equilibrium groundwater level. The typical groundwater monitoring installation consists of a 50mm HDPE slotted pipe with a pea gravel response zone and bentonite seal installed to the Engineers specification. Where required the standpipe is sealed with a gas tap and finished with a durable steel cover fixed in place with a concrete surround. The installation details are provided on the exploratory hole logs in the Appendix 2 of this Report. Data loggers were installed in each standpipe to establish the hydrogeological regime and groundwater levels over a 6-week period and this is provided in Appendix 3 of this Report.

3.4. Permeability Testing

Permeability tests were carried out in the 5 No. locations where standpipes were installed. The test measures the permeability (k) of the soil because it is carried out in-situ. The test method consisted of a rising head test. The rising head test was carried out in window sample locations as specified by the Consulting engineer and requires the pumping out of the groundwater encountered in the borehole. The initial groundwater levels are recorded, and pumping begins, with the volume of groundwater removed recorded. Once the standpipe is emptied, the rise in water level with time in the standpipe was recorded, allowing for the calculation of the rate of groundwater ingress. The results of the permeability tests are provided in Appendix 5 of the Report.

3.5. Surveying

The exploratory hole locations have been recorded using a Trimble R10 GNSS System which records the coordinates and elevation of the locations to ITM or Irish National Grid as required by the project specification. The coordinates and elevations are provided on the exploratory hole logs in the appendices of this Report.

3.6. Laboratory Testing

Geotechnical testing consisting of Particle Size Distribution (PSD), hydrometer tests were carried out in NMTL's Geotechnical Laboratory in Carlow. Organic matter content test was carried out by Element Materials Technology, United Kingdom.

The results of the laboratory testing are included in Appendix 6 of this Report.

4.0 Ground Conditions

4.1. General

The ground conditions encountered during the investigation are summarised below with reference to insitu and laboratory test results. The full details of the strata encountered during the ground investigation are provided in the exploratory hole logs included in the appendices of this report.

The sequence of strata encountered were consistent across the site and are generally comprised;

- PEAT
- COHESIVE DEPOSITS
- GRANULAR DEPOSITS

PEAT: Peat was encountered in all the exploratory holes from ground level and between cohesive deposits and was present to a maximum depth of 3.00m BGL.

COHESIVE DEPOSITS: Cohesive deposits were encountered beneath and between the PEAT and were described typically as *brownish grey or dark brown slightly sandy slightly gravelly SLIT with occasional rootlets and wood fragments.* The secondary sand and gravel constituents varied across the site and with depth, with granular lenses occasionally present in the glacial till matrix.

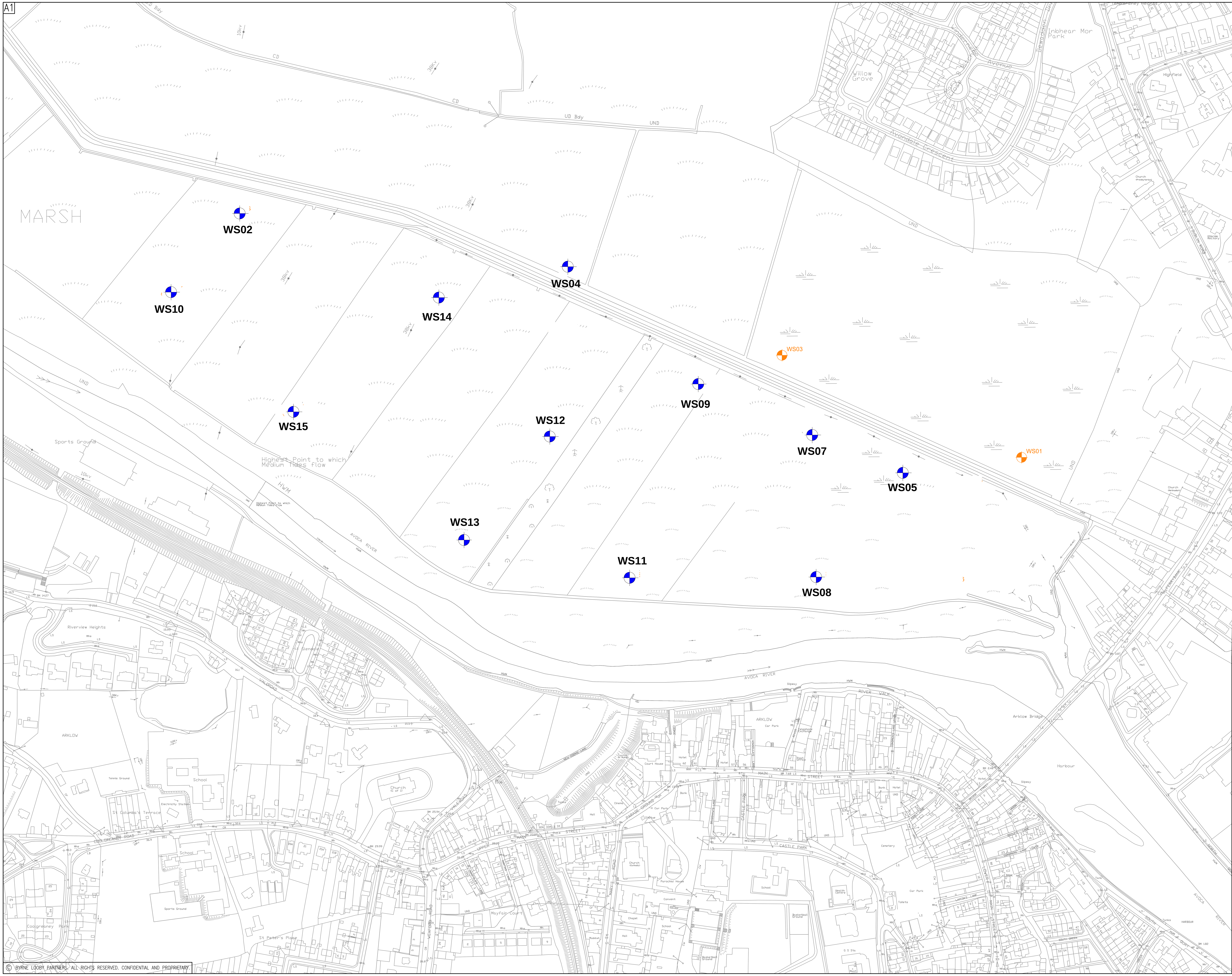
GRANULAR DEPOSITS: The granular deposits were encountered below the base of the cohesive deposits and were typically described as *bluish grey clayey slightly sandy subrounded to subangular fine to coarse SAND with occasional rootlets.* The secondary sand/gravel and silt/clay constituents varied across the site.

4.2. Groundwater

Groundwater was encountered in all the exploratory holes as the ground investigation was conducted in a marsh. Data loggers were installed over a 6-week period to establish the hydrogeological regime and groundwater levels that would be expected to vary with the time of year, rainfall and other factors. For this reason, standpipes were installed at locations WS08, WS09, WS10, WS13 and WS14. The groundwater monitoring is included in Appendix 3 ofthis Report.

APPENDIX 1 - Site Location Plan

A1



N
W E
S

LEGEND
PROPOSED WINDOW SAMPLE LOCATION SHOWN THUS: WS06

NOTES:

1. DO NOT SCALE OFF DRAWING
2. DRAWING TO BE READ IN CONJUNCTION WITH ALL OTHER DRAWINGS
3. DRAWING IS FOR INFORMATION PURPOSES ONLY, NOT FOR CONSTRUCTION
4. FINAL POSITIONS TO BE AGREED WITH INVESTIGATION SUPERVISOR AND CONTRACTOR ON SITE
5. LOCATIONS OF INSTALLATIONS AND IN SITU TESTING TO BE AGREED WITH INVESTIGATION SUPERVISOR AND CONTRACTOR ON SITE

Note: Approximate locations - please refer to window samples logs in Appendix 2 for location coordinates

Rev	Date	Description	By	Chk	App
00	08/08	INFORMATION	NP	NP	KT

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CIVIL · STRUCTURAL · WATER & GEOTECHNICAL SPECIALISTS

CLIENT
WICKLOW COUNTY COUNCIL

PROJECT
AVOCA RIVER (ARKLOW) FLOOD RELIEF SCHEME

DRAWING TITLE
PROPOSED SITE INVESTIGATION SCOPE

STATUS
FOR INFORMATION

Date: 30.03.18	Scale: 1/2000	Drawn: NM	Chk: KT	App: KT
Project No: PH00886/01	Drg. No: 892			Rev: 00

APPENDIX 2 – Window Sampling Records

Ground Investigations Ireland Ltd
www.gii.ie

Site Arklow Marsh - Option 2			**Number** WS02
Machine : Tec op 10 **Method :** Drive-in Windowless Sampler	**Dimensions**	**Ground Level (mOD)** 0.57	**Client** Byrne Looby Partners	**Job Number** 8975-08-19
	Location 723659.1 E 674174.9 N	**Dates** 13/09/2019	**Project Contractor** Ground Investigations Ireland	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.35)	Soft dark brown fibrous PEAT with grass rootlets		
0.35-0.70	B			0.22	0.35	Soft to firm brown mottled red organic SILT with rootlets		
					(0.35)			
				-0.13	0.70	Soft dark brown silty PEAT with rootlets		
					(0.30)			
				-0.43	1.00	Soft dark brown pseudo fibrous spongy PEAT		
					(1.00)			
2.00-3.00	B			-1.43	2.00	Bluish grey slightly gravelly slightly clayey fine to coarse SAND with rootlets		
					(1.00)			
				-2.43	3.00	Complete at 3.00m		

Remarks
0.00-1.00m BGL 90% recovery
1.00-2.00m BGL 100% recovery
2.00-3.00m BGL 70% recovery

Scale (approx)	Logged By
1:25	AB

Figure No. 8975-08-19.WS02

Ground Investigations Ireland Ltd
www.gii.ie

Site Arklow Marsh - Option 2			**Number** WS04
Machine : Tec op 10 **Method :** Drive-in Windowless Sampler	**Dimensions**	**Ground Level (mOD)** 0.80	**Client** Byrne Looby Partners	**Job Number** 8975-08-19
	Location 723971.1 E 674153.7 N	**Dates** 13/09/2019	**Project Contractor** Ground Investigations Ireland	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.40)	Soft brown slightly gravelly organic TOPSOIL with rootlets		
				0.40	0.40	Soft to firm grey mottled red slightly sandy very gravelly SILT with wood and grass rootlets		
					(0.40)			
				-0.01	0.80	Soft light brown slightly sandy SILT with rootlets and wood fragments		
0.90-1.50	B				(0.70)			
				-0.71	1.50	Soft dark brown pseudo fibrous damp spongy PEAT		
					(0.40)			
				-1.11	1.90	Bluish grey slightly gravelly very clayey fine to coarse SAND with rootlets		
2.00-3.00	B				(1.10)			
				-2.21	3.00	Complete at 3.00m		

Remarks
0.00-1.00m BGL 70% recovery
1.00-2.00m BGL 100% recovery
2.00-3.00m BGL 65% recovery
2.00-3.00m very wet

Scale (approx)	Logged By
1:25	AB

Figure No. 8975-08-19.WS04

Ground Investigations Ireland Ltd
www.gii.ie

Site Arklow Marsh - Option 2			**Number** WS05
Machine : Tec op 10 **Method :** Drive-in Windowless Sampler	**Dimensions**	**Ground Level (mOD)** 0.65	**Client** Byrne Looby Partners	**Job Number** 8975-08-19
	Location 724528.6 E 673834.2 N	**Dates** 13/09/2019	**Project Contractor** Ground Investigations Ireland	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.60)	Soft brown slightly sandy slightly gravelly SILT with rootlets		
0.60-1.00	B			0.05	0.60			
					(0.40)	Very soft brown spongy fibrous PEAT with large wood fragments		
				-0.35	1.00			
					(0.50)	Soft grey slightly sandy SILT with rootlets and wood fragments		
1.50-3.00	B			-0.85	1.50			
					(1.50)	Bluish grey slightly gravelly very clayey fine to coarse SAND with rootlets		
				-2.35	3.00			
						Complete at 3.00m		

Remarks
0.00-1.00m BGL 50% recovery
1.00-2.00m BGL 100% recovery
2.00-3.00m BGL 80% recovery

Scale (approx)	Logged By
1:25	AB

Figure No. 8975-08-19.WS05

Ground Investigations Ireland Ltd
www.gii.ie

Site Arklow Marsh - Option 2			**Number** WS07
Machine : Tec op 10 **Method :** Drive-in Windowless Sampler	**Dimensions**	**Ground Level (mOD)** 0.47	**Client** Byrne Looby Partners	**Job Number** 8975-08-19
	Location 724413.1 E 673854.4 N	**Dates** 13/09/2019	**Project Contractor** Ground Investigations Ireland	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(1.00)	Very soft dark brown fibrous PEAT with rootlets		
				-0.53	1.00			
					(0.60)	Brownish grey gravelly very clayey fine to coarse SAND with grass rootlets		
				-1.13	1.60			
2.00-3.00	B				(1.40)	Firm brownish grey slightly sandy SILT with rootlets		
				-2.53	3.00			
						Complete at 3.00m		

Remarks
0.00-1.00m BGL 30% recovery
1.00-2.00m BGL 70% recovery
2.00-3.00m BGL 100% recovery

Scale (approx)	Logged By
1:25	AB

Figure No. 8975-08-19.WS07

Ground Investigations Ireland Ltd
www.gii.ie

Site Arklow Marsh - Option 2			**Number** WS08
Machine : Tec op 10 **Method :** Drive-in Windowless Sampler	**Dimensions**	**Ground Level (mOD)** 0.44	**Client** Byrne Looby Partners	**Job Number** 8975-08-19
	Location 724385.4 E 673763.9 N	**Dates** 13/09/2019	**Project Contractor** Ground Investigations Ireland	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
					(0.65)	Very soft dark brown fibrous spongy PEAT with rootlets			
				-0.21	0.65	Soft brownish grey slightly sandy SILT with rootlets			
1.00-1.70	B				(1.05)				
				-1.26	1.70	Bluish grey slightly gravelly clayey fine to medium SAND with occasional rootlets			
2.00-3.00	B				(1.30)				
				-2.56	3.00	Complete at 3.00m			

Remarks
0.00-1.00m BGL 75% recovery
1.00-2.00m BGL 90% recovery
2.00-3.00m BGL 80% recovery
Standpipe installed, 50mm slotted from 3.00 to 1.00m BGL, sealed from 1.00m BGL to GL with cement benthonite seal with raised covers

Scale (approx)	Logged By
1:25	AB

Figure No. 8975-08-19.WS08

Ground Investigations Ireland Ltd
www.gii.ie

Site Arklow Marsh - Option 2			**Number** WS09
Machine : Tec op 10 **Method :** Drive-in Windowless Sampler	**Dimensions**	**Ground Level (mOD)** 0.67	**Client** Byrne Looby Partners	**Job Number** 8975-08-19
	Location 724237.4 E 673948.9 N	**Dates** 13/09/2019	**Project Contractor** Ground Investigations Ireland	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
					(0.20)	Soft brown TOPSOIL with grass rootlets			
0.20-1.00	B			0.47	0.20	Soft to firm brown mottled red SILT with grass rootlets			
					(0.75)				
1.00-1.70	B			-0.28	0.95	Soft dark brown organic SILT with wood and grass rootlets			
					(0.75)				
2.00-3.00	B			-1.03	1.70	Grey slightly gravelly clayey fine to medium SAND with grass rootlets			
					(1.30)				
				-2.33	3.00	Complete at 3.00m			

Remarks
0.00-1.00m BGL 85% recovery
1.00-2.00m BGL 100% recovery
2.00-3.00m BGL 100% recovery
Standpipe installed, 50mm slotted from 3.00 to 1.00m BGL, sealed from 1.00m BGL to GL with cement benthonite seal with raised covers

Scale (approx)	Logged By
1:25	AB

Figure No. 8975-08-19.WS09

Ground Investigations Ireland Ltd
www.gii.ie

Site Arklow Marsh - Option 2			**Number** WS10
Machine : Tec op 10 **Method :** Drive-in Windowless Sampler	**Dimensions**	**Ground Level (mOD)** 0.85	**Client** Byrne Looby Partners	**Job Number** 8975-08-19
	Location 723603.1 E 674055.3 N	**Dates** 13/09/2019	**Project Contractor** Ground Investigations Ireland	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
					(0.25)	Soft brown TOPSOIL with grass rootlets			
				0.60	0.25				
					(0.35)	Brown mottled red clayey fine to medium SAND with rootlets			
0.60-1.00	B			0.25	0.60				
					(0.40)	Firm to stiff brown mottled red slightly sandy SILT with grass rootlets			
1.00-1.70	B			-0.15	1.00				
					(0.85)	Firm brownish grey slightly sandy slightly gravelly SILT with rootlets			
				-1.00	1.85				
2.00-3.00	B					Grey slightly gravelly clayey fine to coarse SAND with rootlets			
					(1.15)				
				-2.15	3.00				
						Complete at 3.00m			

Remarks
0.00-1.00m BGL 100% recovery
1.00-2.00m BGL 85% recovery
2.00-3.00m BGL 60% recovery
Standpipe installed, 50mm slotted from 3.00 to 1.00m BGL, sealed from 1.00m BGL to GL with cement benthonite seal with raised covers

Scale (approx)	Logged By
1:25	AB

Figure No. 8975-08-19.WS10

Ground Investigations Ireland Ltd
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Site Arklow Marsh - Option 2			**Number** WS11
Machine : Tec op 10 **Method :** Drive-in Windowless Sampler	**Dimensions**	**Ground Level (mOD)** 0.67	**Client** Byrne Looby Partners	**Job Number** 8975-08-19
	Location 724137.7 E 673810.3 N	**Dates** 13/09/2019	**Project Contractor** Ground Investigations Ireland	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.15)	Soft brown very organic TOPSOIL with wood fragments		
0.15-0.85	B			0.52	0.15	Firm grey mottled red organic SILT with rootlets		
					(0.70)			
				-0.18	0.85	Very soft brown pseudo fibrous spongy PEAT with rootlets		
1.00-1.50	B				(0.65)			
				-0.83	1.50	Grey gravelly clayey fine to coarse SAND witrh rootlets		
					(1.50)			
				-2.33	3.00	Complete at 3.00m		

Remarks
0.00-1.00m BGL 90% recovery
1.00-2.00m BGL 70% recovery
2.00-3.00m BGL 100% recovery
2.00-3.00m BGL very wet

Scale (approx)	Logged By
1:25	AB

Figure No. 8975-08-19.WS11

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Site Arklow Marsh - Option 2			**Number** WS12
Machine : Tec op 10 **Method :** Drive-in Windowless Sampler	**Dimensions**	**Ground Level (mOD)** 0.51	**Client** Byrne Looby Partners	**Job Number** 8975-08-19
	Location 723892 E 673974.1 N	**Dates** 13/09/2019	**Project Contractor** Ground Investigations Ireland	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.20)	Soft rown very sandy gravelly TOPSOIL with many grass rootlets		
0.20-0.90	B			0.31	0.20	Firm brown mottled red very organic SILT with wood fragments		
					(0.70)			
0.90-1.80	B			-0.40	0.90	Soft spongy pseudo fibrous PEAT with grass rootlets		
					(0.90)			
2.00-3.00	B			-1.30	1.80	Grey gravelly clayey very organic fine to coarse SAND with rootlets		
					(2.20)			
				-3.50	4.00	Complete at 4.00m		

Remarks
0.00-1.00m BGL 97% recovery
1.00-2.00m BGL 97% recovery
2.00-3.00m BGL 90% recovery
3.00-4.00m BGL 50% recovery

Scale (approx)	Logged By
1:25	AB

Figure No. 8975-08-19.WS12

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Site Arklow Marsh - Option 2			**Number** WS13
Machine : Tec op 10 **Method :** Drive-in Windowless Sampler	**Dimensions**	**Ground Level (mOD)** 0.76	**Client** Byrne Looby Partners	**Job Number** 8975-08-19
	Location 723938.3 E 673869.5 N	**Dates** 13/09/2019	**Project Contractor** Ground Investigations Ireland	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
				0.56	(0.20) 0.20	Very soft brown fibrous spongy PEAT with grass rootlets			
0.10-1.00	B					Firm grey mottled red SILT with grass rootlets			
				-0.24	(0.80) 1.00				
1.00-1.70	B					Soft to firm brown organic slightly sandy SILT with rootlets			
				-0.94	(0.70) 1.70				
2.00-3.00	B					Grey gravelly clayey fine to coarse SAND with grass rootlets			
				-2.24	(1.30) 3.00				
						Complete at 3.00m			

Remarks
0.00-1.00m BGL 100% recovery
1.00-2.00m BGL 90% recovery
2.00-3.00m BGL 65% recovery
Standpipe installed, 50mm slotted from 3.00 to 1.00m BGL, sealed from 1.00m BGL to GL with cement benthonite seal with raised covers

Scale (approx)	Logged By
1:25	AB

Figure No. 8975-08-19.WS13

Ground Investigations Ireland Ltd
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Site Arklow Marsh - Option 2			**Number** WS14
Machine : Tec op 10 **Method :** Drive-in Windowless Sampler	**Dimensions**	**Ground Level (mOD)** 0.66	**Client** Byrne Looby Partners	**Job Number** 8975-08-19
	Location 723803 E 674117.9 N	**Dates** 13/09/2019	**Project Contractor** Ground Investigations Ireland	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water	Instr
					(0.40)	Firm grey mottled red organic SILT with grass rootlets			
				0.26	0.40	Very soft brown spongy pseudo fibrous PEAT with grass and wood rootlets			
1.00-2.00	B				(1.40)				
				-1.14	1.80	Very soft brown silty pseudo fibrous PEAT with grass and wood rootlets			
2.00-3.00	B				(1.20)				
				-2.34	3.00	Complete at 3.00m			

Remarks
0.00-1.00m BGL 55% recovery
1.00-2.00m BGL 100% recovery
2.00-3.00m BGL 100% recovery
Standpipe installed, 50mm slotted from 3.00 to 1.00m BGL, sealed from 1.00m BGL to GL with cement benthonite seal with raised covers

Scale (approx)	Logged By
1:25	AB

Figure No. 8975-08-19.WS14

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Site Arklow Marsh - Option 2			**Number** WS15
Machine : Tec op 10 **Method :** Drive-in Windowless Sampler	**Dimensions**	**Ground Level (mOD)** 0.84	**Client** Byrne Looby Partners	**Job Number** 8975-08-19
	Location 723721.6 E 673948.1 N	**Dates** 13/09/2019	**Project Contractor** Ground Investigations Ireland	**Sheet** 1/1

Depth (m)	Sample / Tests	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
					(0.30)	Soft brown organic TOPSOIL with rootlets		
0.30-1.00	B			0.54	0.30	Firm brown mottled red slightrly sandy organic SILT with grass rootlets		
					(0.90)			
				-0.36	1.20	Soft dark brown spongy pseudo fibrous PEAT with wood fragments		
					(0.50)			
				-0.86	1.70	Grey gravelly fine to coarse SAND with occasional rootlets		
					(1.30)			
				-2.16	3.00	Complete at 3.00m		

Remarks
0.00-1.00m BGL 100% recovery
1.00-2.00m BGL 95% recovery
2.00-3.00m BGL 85% recovery

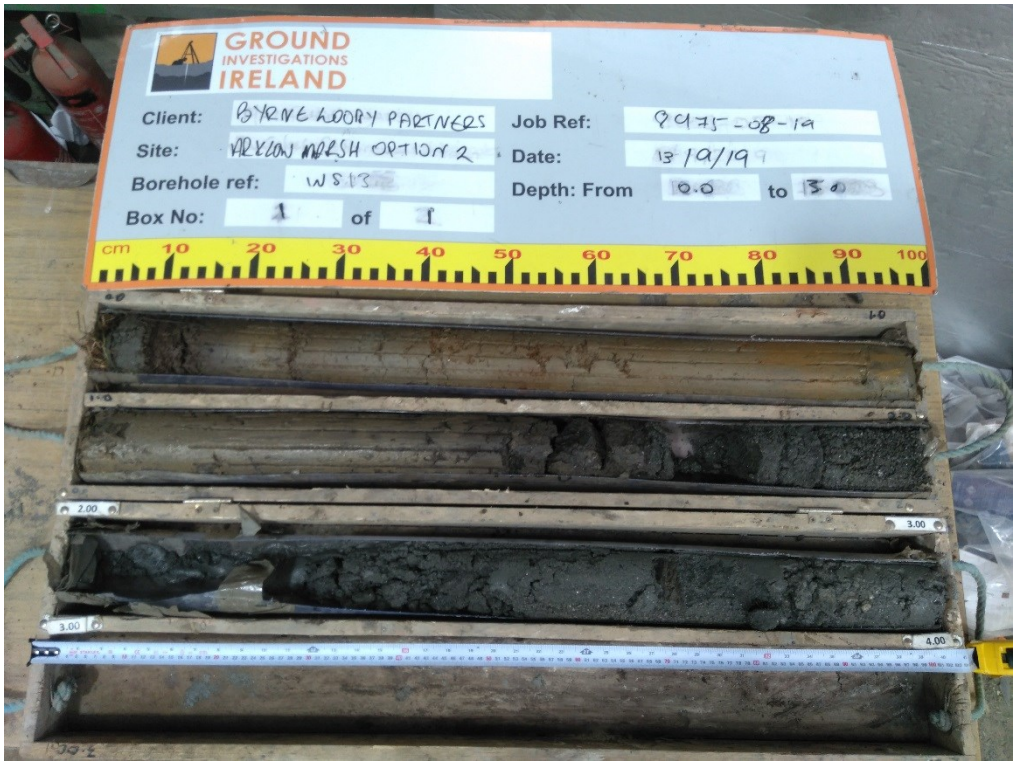
Scale (approx)	Logged By
1:25	AB

Figure No. 8975-08-19.WS15

Arklow Marsh Option 2 WS Photos

WS12

WS13



WS14

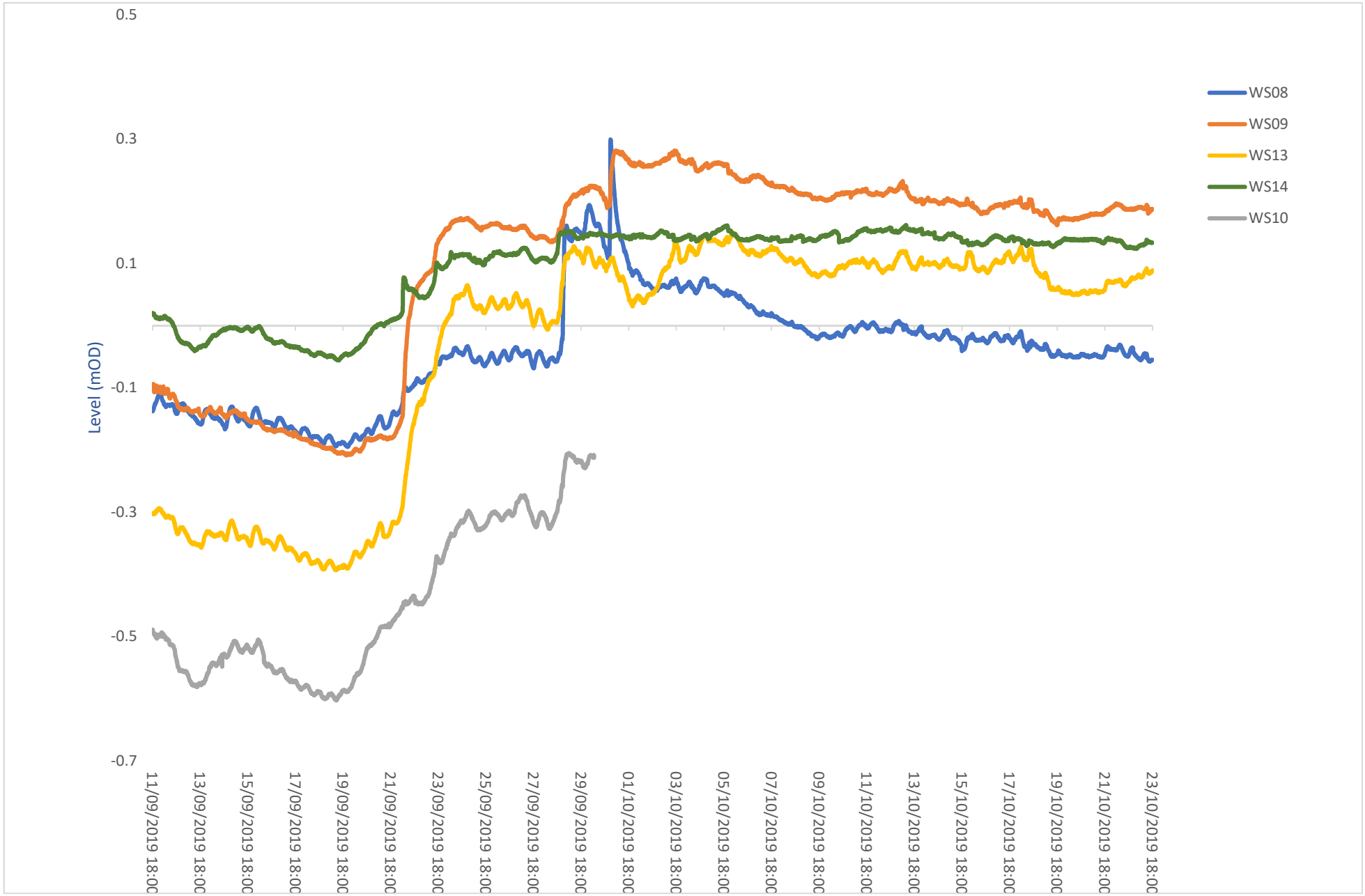

GROUND
INVESTIGATIONS
IRELAND
Client: BYRNE LOOBY PARTNERS
Job Ref: 9475-08-19
Site: ARKLOW MARSH OPTION 2
Date: 16/9/19
Borehole ref: WS14
Depth: From 0.0 to 3.0
Box No: 1 of 1
cm 10 20 30 40 50 60 70 80 90 100
2.00
3.00
3.00
4.00

WS15


GROUND
INVESTIGATIONS
IRELAND
Client: BYRNE LOOBY PARTNERS
Job Ref: 9475-08-19
Site: ARKLOW MARSH OPTION 2
Date: 16/9/19
Borehole ref: WS15
Depth: From 0.0 to 3.0
Box No: 1 of 1
cm 10 20 30 40 50 60 70 80 90 100
2.00
3.00
3.00
4.00

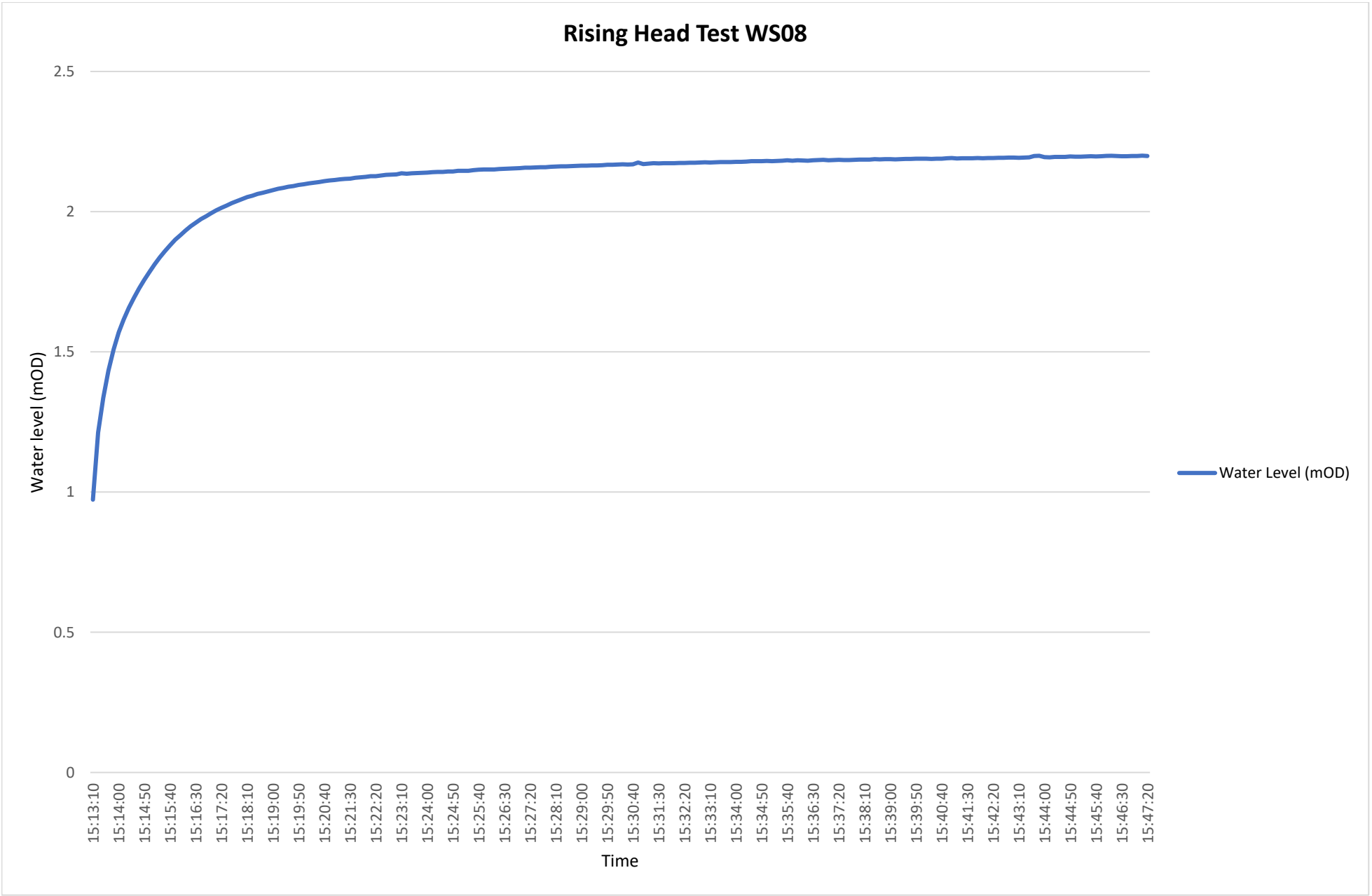
APPENDIX 3 – Groundwater Monitoring

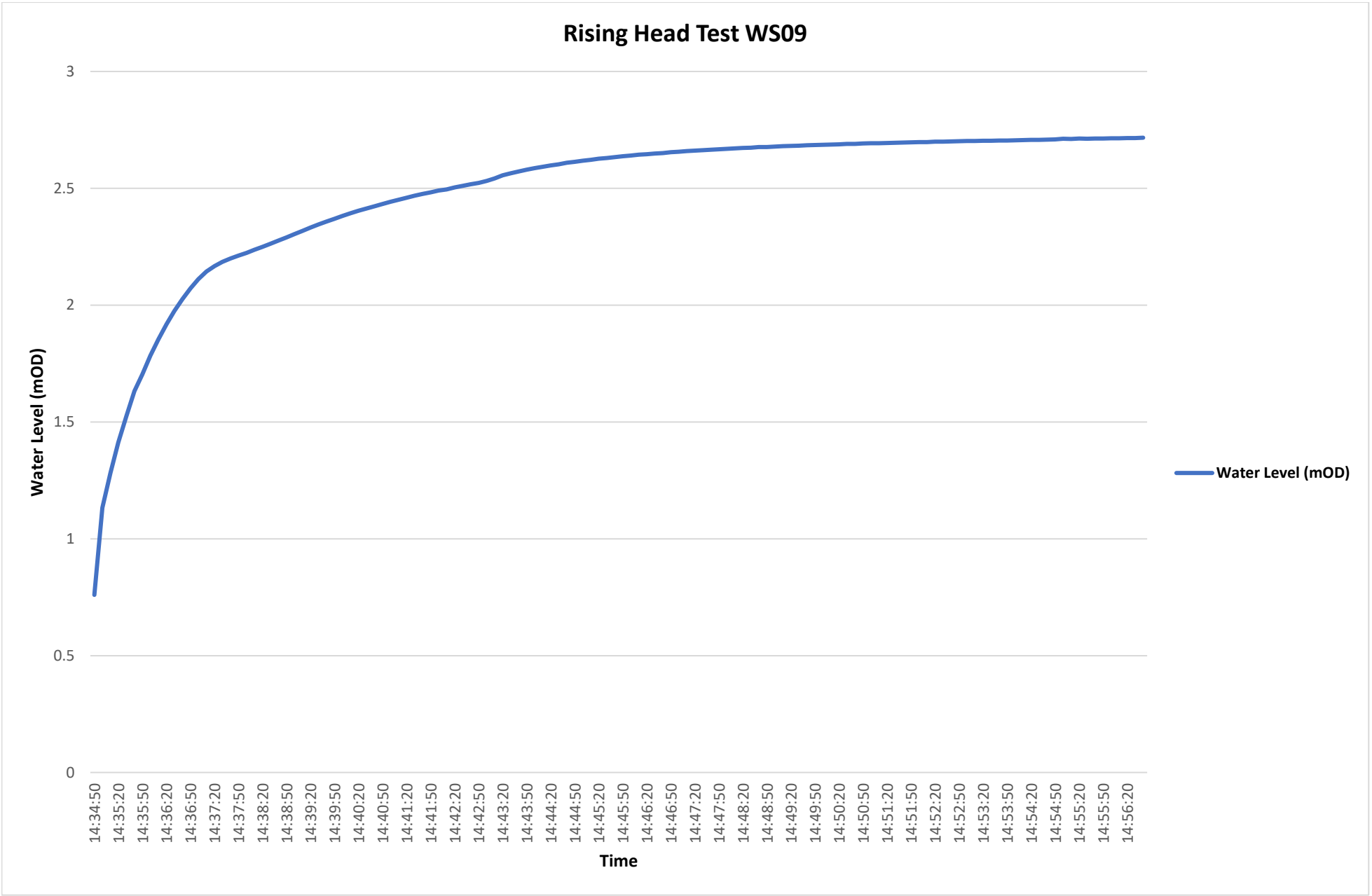
Arklow Marsh Groundwater Montioring



Note: Data Logger for WS10 interfered with and removed from standpipe on 30/09/2019

APPENDIX 4 – Rising Head Tests


Rising Head Test WS08
2.5
2
1.5
1
0.5
0
Water level (mOD)
15:13:10
15:14:00
15:14:50
15:15:40
15:16:30
15:17:20
15:18:10
15:19:00
15:19:50
15:20:40
15:21:30
15:22:20
15:23:10
15:24:00
15:24:50
15:25:40
15:26:30
15:27:20
15:28:10
15:29:00
15:29:50
15:30:40
15:31:30
15:32:20
15:33:10
15:34:00
15:34:50
15:35:40
15:36:30
15:37:20
15:38:10
15:39:00
15:39:50
15:40:40
15:41:30
15:42:20
15:43:10
15:44:00
15:44:50
15:45:40
15:46:30
15:47:20
Time
Water Level (mOD)


Rising Head Test WS09
Water Level (mOD)
3
2.5
2
1.5
1
0.5
0
14:34:50
14:35:20
14:35:50
14:36:20
14:36:50
14:37:20
14:37:50
14:38:20
14:38:50
14:39:20
14:39:50
14:40:20
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14:41:20
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14:42:20
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14:44:20
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14:46:20
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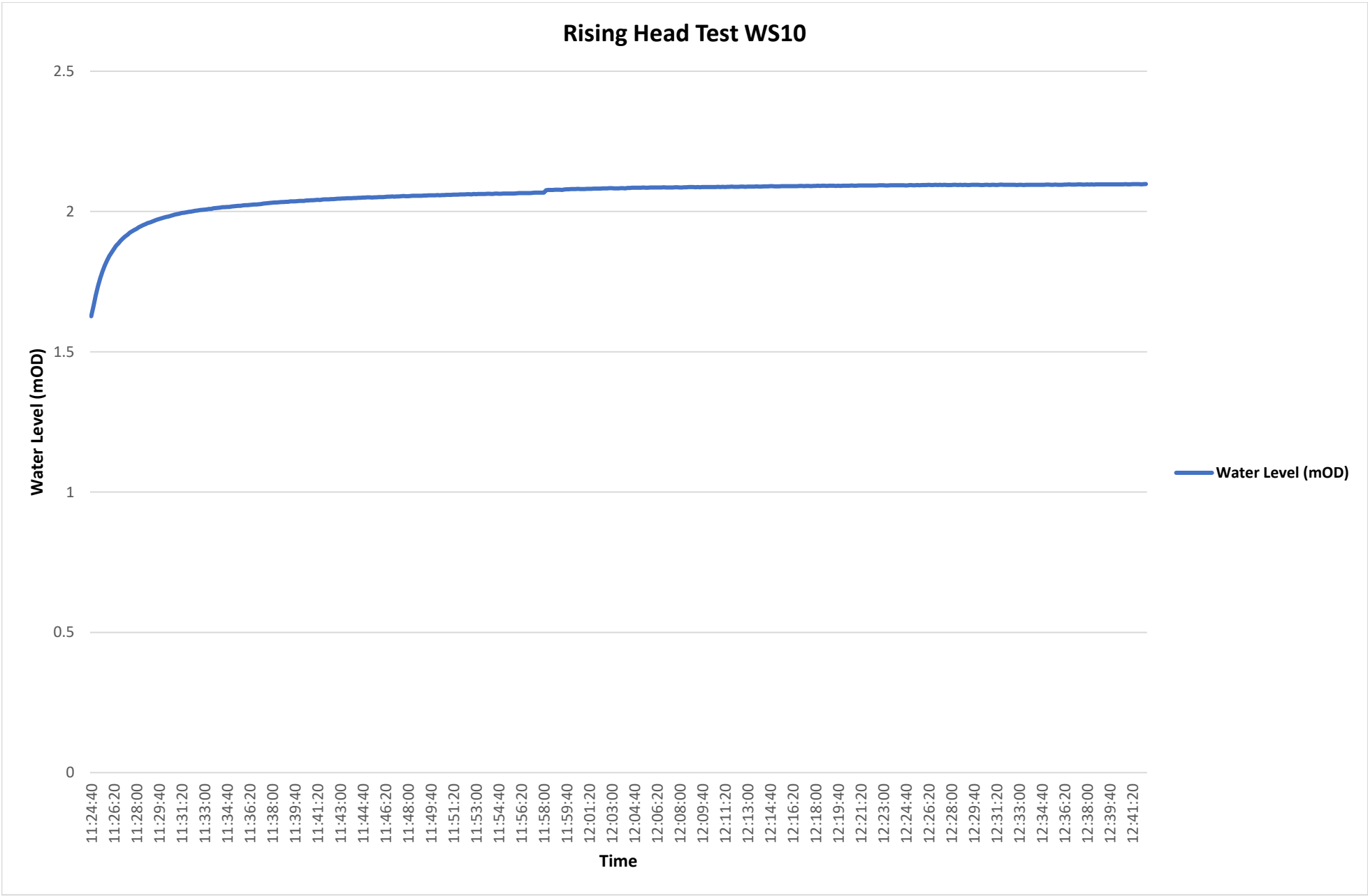
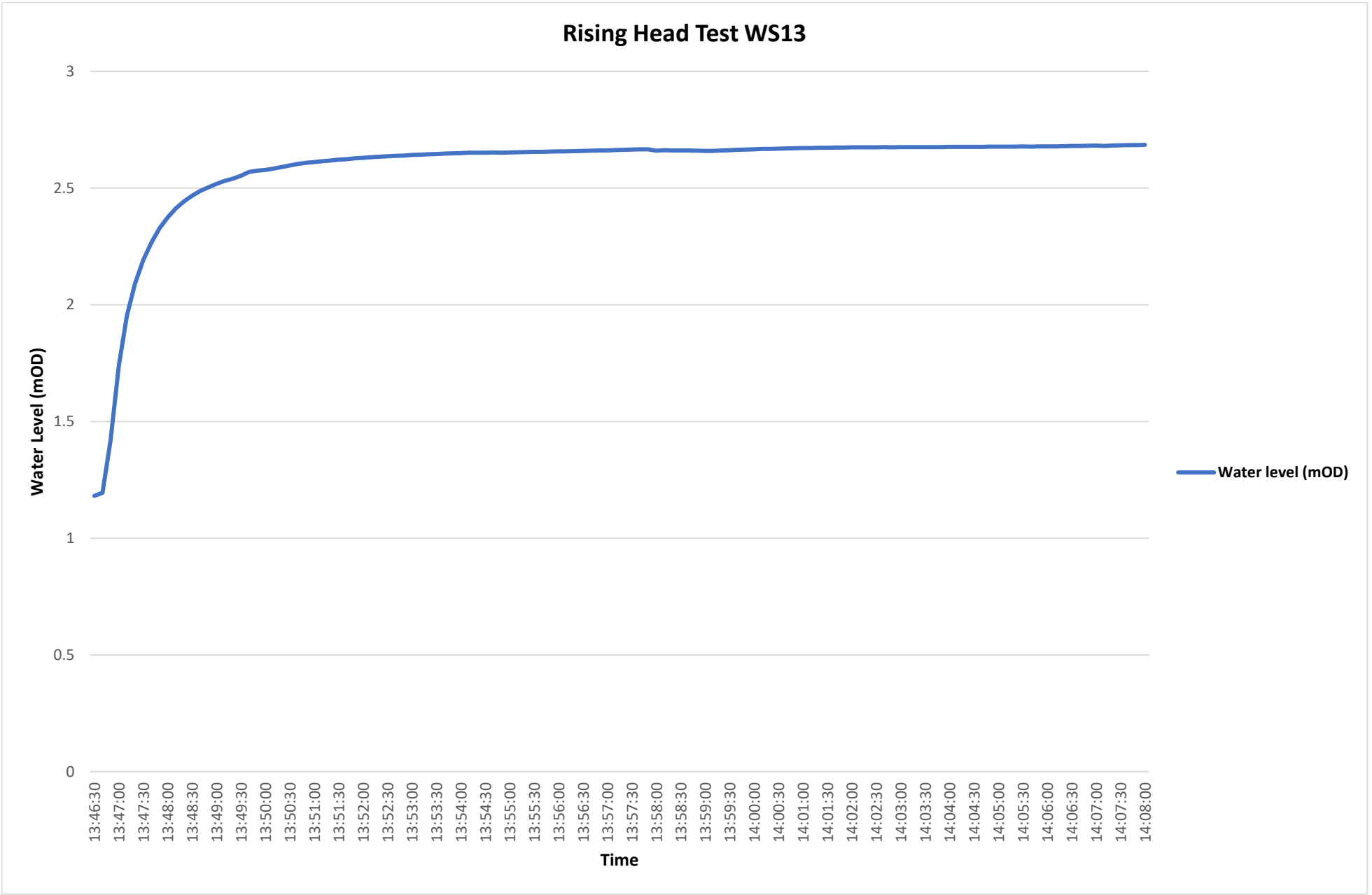
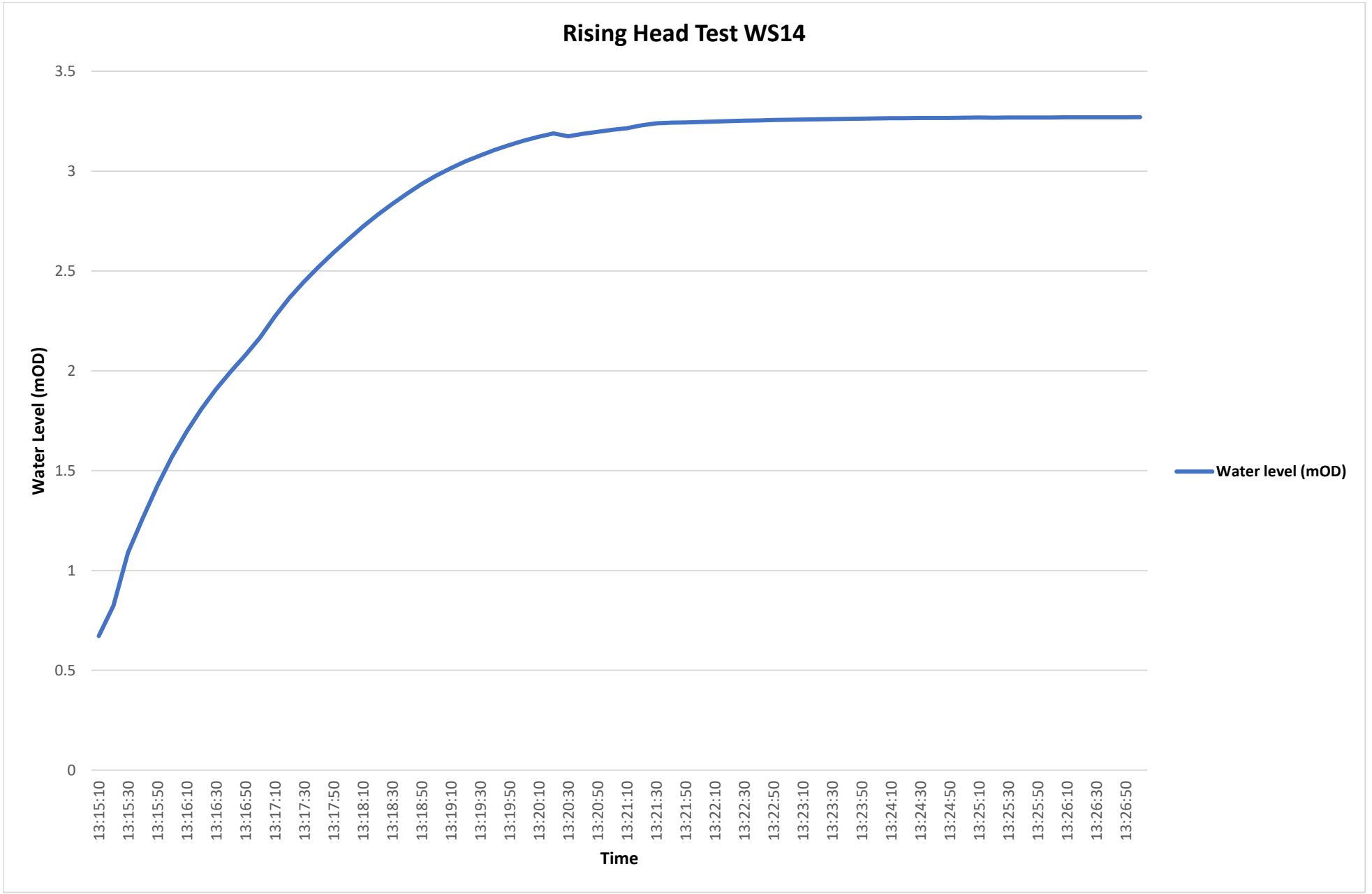
14:52:20
14:52:50
14:53:20
14:53:50
14:54:20
14:54:50
14:55:20
14:55:50
14:56:20
Time
Water Level (mOD)


Rising Head Test WS10
2.5
2
1.5
1
0.5
0
Water Level (mOD)
11:24:40
11:26:20
11:28:00
11:29:40
11:31:20
11:33:00
11:34:40
11:36:20
11:38:00
11:39:40
11:41:20
11:43:00
11:44:40
11:46:20
11:48:00
11:49:40
11:51:20
11:53:00
11:54:40
11:56:20
11:58:00
11:59:40
12:01:20
12:03:00
12:04:40
12:06:20
12:08:00
12:09:40
12:11:20
12:13:00
12:14:40
12:16:20
12:18:00
12:19:40
12:21:20
12:23:00
12:24:40
12:26:20
12:28:00
12:29:40
12:31:20
12:33:00
12:34:40
12:36:20
12:38:00
12:39:40
12:41:20
Time
Water Level (mOD)


Rising Head Test WS13
Water Level (mOD)
3
2.5
2
1.5
1
0.5
0
13:46:30
13:47:00
13:47:30
13:48:00
13:48:30
13:49:00
13:49:30
13:50:00
13:50:30
13:51:00
13:51:30
13:52:00
13:52:30
13:53:00
13:53:30
13:54:00
13:54:30
13:55:00
13:55:30
13:56:00
13:56:30
13:57:00
13:57:30
13:58:00
13:58:30
13:59:00
13:59:30
14:00:00
14:00:30
14:01:00
14:01:30
14:02:00
14:02:30
14:03:00
14:03:30
14:04:00
14:04:30
14:05:00
14:05:30
14:06:00
14:06:30
14:07:00
14:07:30
14:08:00
Time
Water level (mOD)


Rising Head Test WS14
3.5
3
2.5
2
1.5
1
0.5
0
Water Level (mOD)
13:15:10
13:15:30
13:15:50
13:16:10
13:16:30
13:16:50
13:17:10
13:17:30
13:17:50
13:18:10
13:18:30
13:18:50
13:19:10
13:19:30
13:19:50
13:20:10
13:20:30
13:20:50
13:21:10
13:21:30
13:21:50
13:22:10
13:22:30
13:22:50
13:23:10
13:23:30
13:23:50
13:24:10
13:24:30
13:24:50
13:25:10
13:25:30
13:25:50
13:26:10
13:26:30
13:26:50
Time
Water level (mOD)

APPENDIX 5 – Permeability Tests

RISING HEAD TEST

Window Sample No.	**WS08**	**Job Name**	**Arklow Marsh**
Filter Zone		**Standpipe Details:**	
Depth from (m bgl)	1.00	Height above Ground Level	n/a
Depth to (m bgl)	3.00	Depth (m below top of SP)	n/a
Length of Filter (m)	2.00	Depth (mbgl)	n/a
Hole Diameter (m)	0.15	Diameter (m)	n/a
CSA of Filter Zone (m2)	0.018		
		Water Level Prior to Start of Test (Ws)	
		Metres below top of SP	n/a
Test No. Test 1		Metres (mOD)	0.9729

Time (mins)	Water Level (W) Metres (mOD)	Head H (W-Ws)	H/H0
00:00	2.1985	1.2256	1.000
00:10	2.1997	1.2268	1.001
00:20	2.1983	1.2254	1.000
00:30	2.1985	1.2256	1.000
00:40	2.1980	1.2251	1.000
00:50	2.1978	1.2249	0.999
01:00	2.1985	1.2256	1.000
01:10	2.1991	1.2262	1.000
01:20	2.1989	1.226	1.000
01:30	2.1975	1.2246	0.999
01:40	2.1973	1.2244	0.999
01:50	2.1975	1.2246	0.999
02:00	2.1966	1.2237	0.998
02:10	2.1961	1.2232	0.998
02:20	2.1958	1.2229	0.998
02:30	2.1966	1.2237	0.998
02:40	2.1952	1.2223	0.997
02:50	2.1953	1.2224	0.997
03:00	2.1955	1.2226	0.998
03:10	2.1937	1.2208	0.996
03:20	2.1942	1.2213	0.996
03:30	2.1993	1.2264	1.001
03:40	2.1986	1.2257	1.000
03:50	2.1935	1.2206	0.996
04:00	2.1928	1.2199	0.995
04:10	2.1923	1.2194	0.995

Ho
1.2256

Time	Water Level (W)	Head H	
(mins)	Metres (mOD)	(W-Ws)	H/H0
04:20	2.1928	1.2199	0.995
04:30	2.1927	1.2198	0.995
04:40	2.1920	1.2191	0.995
04:50	2.1921	1.2192	0.995
05:00	2.1914	1.2185	0.994
05:10	2.1910	1.2181	0.994
05:20	2.1908	1.2179	0.994
05:30	2.1911	1.2182	0.994
05:40	2.1902	1.2173	0.993
05:50	2.1904	1.2175	0.993
06:00	2.1908	1.2179	0.994
06:10	2.1897	1.2168	0.993
06:20	2.1914	1.2185	0.994
06:30	2.1904	1.2175	0.993
06:40	2.1891	1.2162	0.992
06:50	2.1890	1.2161	0.992
07:00	2.1884	1.2155	0.992
07:10	2.1888	1.2159	0.992
07:20	2.1888	1.2159	0.992
07:30	2.1887	1.2158	0.992
07:40	2.1879	1.215	0.991
07:50	2.1883	1.2154	0.992
08:00	2.1876	1.2147	0.991
08:10	2.1866	1.2137	0.990
08:20	2.1871	1.2142	0.991
08:30	2.1874	1.2145	0.991
08:40	2.1865	1.2136	0.990
08:50	2.1871	1.2142	0.991
09:00	2.1857	1.2128	0.990
09:10	2.1856	1.2127	0.989
09:20	2.1856	1.2127	0.989
09:30	2.1849	1.212	0.989
09:40	2.1845	1.2116	0.989
09:50	2.1843	1.2114	0.988
10:00	2.1850	1.2121	0.989
10:10	2.1845	1.2116	0.989
10:20	2.1837	1.2108	0.988
10:30	2.1849	1.212	0.989
10:40	2.1838	1.2109	0.988
10:50	2.1830	1.2101	0.987
11:00	2.1821	1.2092	0.987
11:10	2.1822	1.2093	0.987

Time	Water Level (W)	Head H	
(mins)	Metres (mOD)	(W-Ws)	H/H0
11:20	2.1831	1.2102	0.987
11:30	2.1817	1.2088	0.986
11:40	2.1835	1.2106	0.988
11:50	2.1817	1.2088	0.986
12:00	2.1806	1.2077	0.985
12:10	2.1803	1.2074	0.985
12:20	2.1812	1.2083	0.986
12:30	2.1798	1.2069	0.985
12:40	2.1802	1.2073	0.985
12:50	2.1799	1.207	0.985
13:00	2.1787	1.2058	0.984
13:10	2.1776	1.2047	0.983
13:20	2.1774	1.2045	0.983
13:30	2.1773	1.2044	0.983
13:40	2.1766	1.2037	0.982
13:50	2.1772	1.2043	0.983
14:00	2.1764	1.2035	0.982
14:10	2.1754	1.2025	0.981
14:20	2.1764	1.2035	0.982
14:30	2.1753	1.2024	0.981
14:40	2.1744	1.2015	0.980
14:50	2.1746	1.2017	0.980
15:00	2.1735	1.2006	0.980
15:10	2.1735	1.2006	0.980
15:20	2.1726	1.1997	0.979
15:30	2.1732	1.2003	0.979
15:40	2.1727	1.1998	0.979
15:50	2.1722	1.1993	0.979
16:00	2.1729	1.2	0.979
16:10	2.1712	1.1983	0.978
16:20	2.1695	1.1966	0.976
16:30	2.1750	1.2021	0.981
16:40	2.1693	1.1964	0.976
16:50	2.1681	1.1952	0.975
17:00	2.1686	1.1957	0.976
17:10	2.1683	1.1954	0.975
17:20	2.1677	1.1948	0.975
17:30	2.1674	1.1945	0.975
17:40	2.1657	1.1928	0.973
17:50	2.1653	1.1924	0.973
18:00	2.1650	1.1921	0.973
18:10	2.1644	1.1915	0.972

Time	Water Level (W)	Head H	
(mins)	Metres (mOD)	(W-Ws)	H/H0
18:20	2.1645	1.1916	0.972
18:30	2.1635	1.1906	0.971
18:40	2.1622	1.1893	0.970
18:50	2.1621	1.1892	0.970
19:00	2.1616	1.1887	0.970
19:10	2.1613	1.1884	0.970
19:20	2.1600	1.1871	0.969
19:30	2.1589	1.186	0.968
19:40	2.1586	1.1857	0.967
19:50	2.1577	1.1848	0.967
20:00	2.1571	1.1842	0.966
20:10	2.1568	1.1839	0.966
20:20	2.1556	1.1827	0.965
20:30	2.1547	1.1818	0.964
20:40	2.1536	1.1807	0.963
20:50	2.1533	1.1804	0.963
21:00	2.1524	1.1795	0.962
21:10	2.1509	1.178	0.961
21:20	2.1504	1.1775	0.961
21:30	2.1506	1.1777	0.961
21:40	2.1500	1.1771	0.960
21:50	2.1482	1.1753	0.959
22:00	2.1461	1.1732	0.957
22:10	2.1460	1.1731	0.957
22:20	2.1457	1.1728	0.957
22:30	2.1436	1.1707	0.955
22:40	2.1430	1.1701	0.955
22:50	2.1420	1.1691	0.954
23:00	2.1420	1.1691	0.954
23:10	2.1410	1.1681	0.953
23:20	2.1395	1.1666	0.952
23:30	2.1383	1.1654	0.951
23:40	2.1374	1.1645	0.950
23:50	2.1369	1.164	0.950
24:00	2.1357	1.1628	0.949
24:10	2.1373	1.1644	0.950
24:20	2.1333	1.1604	0.947
24:30	2.1318	1.1589	0.946
24:40	2.1312	1.1583	0.945
24:50	2.1290	1.1561	0.943
25:00	2.1269	1.154	0.942
25:10	2.1264	1.1535	0.941

Time	Water Level (W)	Head H	
(mins)	Metres (mOD)	(W-Ws)	H/H0
25:20	2.1242	1.1513	0.939
25:30	2.1225	1.1496	0.938
25:40	2.1208	1.1479	0.937
25:50	2.1180	1.1451	0.934
26:00	2.1168	1.1439	0.933
26:10	2.1157	1.1428	0.932
26:20	2.1130	1.1401	0.930
26:30	2.1114	1.1385	0.929
26:40	2.1088	1.1359	0.927
26:50	2.1057	1.1328	0.924
27:00	2.1032	1.1303	0.922
27:10	2.1007	1.1278	0.920
27:20	2.0979	1.125	0.918
27:30	2.0950	1.1221	0.916
27:40	2.0916	1.1187	0.913
27:50	2.0886	1.1157	0.910
28:00	2.0847	1.1118	0.907
28:10	2.0817	1.1088	0.905
28:20	2.0767	1.1038	0.901
28:30	2.0721	1.0992	0.897
28:40	2.0675	1.0946	0.893
28:50	2.0630	1.0901	0.889
29:00	2.0566	1.0837	0.884
29:10	2.0518	1.0789	0.880
29:20	2.0446	1.0717	0.874
29:30	2.0375	1.0646	0.869
29:40	2.0302	1.0573	0.863
29:50	2.0214	1.0485	0.855
30:00	2.0137	1.0408	0.849
30:10	2.0046	1.0317	0.842
30:20	1.9948	1.0219	0.834
30:30	1.9831	1.0102	0.824
30:40	1.9736	1.0007	0.816
30:50	1.9611	0.9882	0.806
31:00	1.9481	0.9752	0.796
31:10	1.9326	0.9597	0.783
31:20	1.9164	0.9435	0.770
31:30	1.8998	0.9269	0.756
31:40	1.8804	0.9075	0.740
31:50	1.8595	0.8866	0.723
32:00	1.8370	0.8641	0.705
32:10	1.8123	0.8394	0.685

Time	Water Level (W)	Head H	
(mins)	Metres (mOD)	(W-Ws)	H/H0
32:20	1.7847	0.8118	0.662
32:30	1.7569	0.784	0.640
32:40	1.7268	0.7539	0.615
32:50	1.6930	0.7201	0.588
33:00	1.6569	0.684	0.558
33:10	1.6154	0.6425	0.524
33:20	1.5695	0.5966	0.487
33:30	1.5079	0.535	0.437
33:40	1.4328	0.4599	0.375
33:50	1.3366	0.3637	0.297
34:00	1.2119	0.239	0.195
34:10	0.9729	0	0.000

Intake Factor (F)		**Basic Time Factor**	
L	2.00	H/Ho	0.37
L/D	13.3	T (mins)	**33.5** at H/Ho = 0.37
F	3.83	from graph	

Intake Factor (F): Impervious bottom: BS5930 Case d) - Case b)

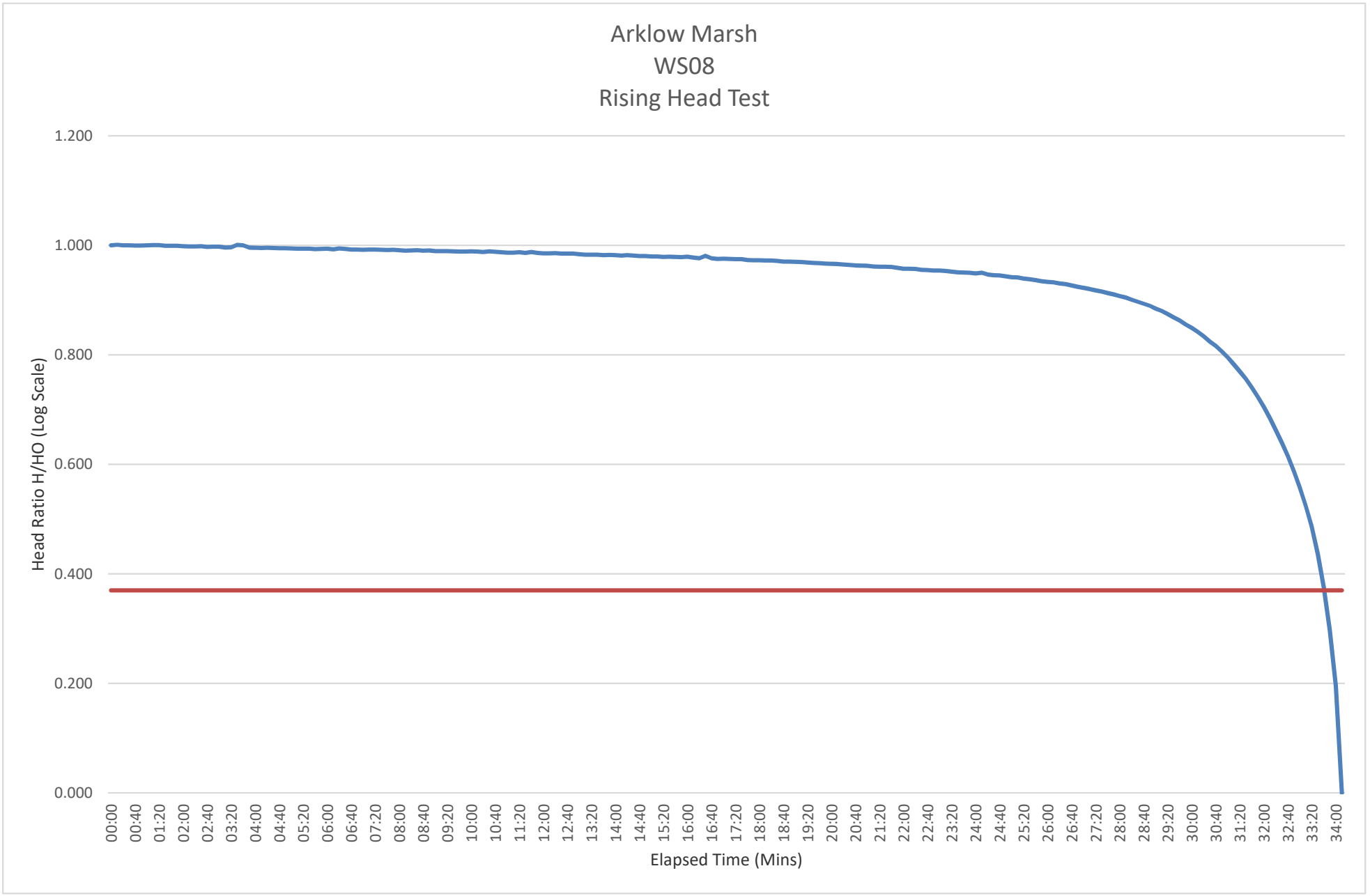
Case d) F = (2*Pi*L) / Ln (L/D + SQRT((1 + (L/D)*(L/D)))

Permeability

Note: Diameter of filter zone used in calculation of area in permeability calculation below;

k = A / (F x T) **1.38E-04** m/min

2.30E-06 m/sec


Arklow Marsh
WS08
Rising Head Test
1.200
1.000
0.800
0.600
0.400
0.200
0.000
Head Ratio H/HO (Log Scale)
00:00
00:40
01:20
02:00
02:40
03:20
04:00
04:40
05:20
06:00
06:40
07:20
08:00
08:40
09:20
10:00
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12:00
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15:20
16:00
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22:00
22:40
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24:00
24:40
25:20
26:00
26:40
27:20
28:00
28:40
29:20
30:00
30:40
31:20
32:00
32:40
33:20
34:00
Elapsed Time (Mins)

RISING HEAD TEST

Window Sample No.	**WS09**	**Job Name**	**Arklow Marsh**
Filter Zone		**Standpipe Details:**	
Depth from (m bgl)	1.00	Height above Ground Level	n/a
Depth to (m bgl)	3.00	Depth (m below top of SP)	n/a
Length of Filter (m)	2.00	Depth (mbgl)	n/a
Hole Diameter (m)	0.15	Diameter (m)	n/a
CSA of Filter Zone (m2)	0.018		
		Water Level Prior to Start of Test (Ws)	
		Metres below top of SP	n/a
Test No. Test 1		Metres (mOD)	0.76

Time (mins)	Water Level (W) Metres (mOD)	Head H (W-Ws)	H/H0
00:00	2.7165	1.9565	1.000
00:10	2.7153	1.9553	0.999
00:20	2.7147	1.9547	0.999
00:30	2.7136	1.9536	0.999
00:40	2.7140	1.954	0.999
00:50	2.7133	1.9533	0.998
01:00	2.7126	1.9526	0.998
01:10	2.7122	1.9522	0.998
01:20	2.7127	1.9527	0.998
01:30	2.7116	1.9516	0.997
01:40	2.7124	1.9524	0.998
01:50	2.7092	1.9492	0.996
02:00	2.7081	1.9481	0.996
02:10	2.7070	1.947	0.995
02:20	2.7071	1.9471	0.995
02:30	2.7064	1.9464	0.995
02:40	2.7053	1.9453	0.994
02:50	2.7049	1.9449	0.994
03:00	2.7046	1.9446	0.994
03:10	2.7037	1.9437	0.993
03:20	2.7038	1.9438	0.994
03:30	2.7027	1.9427	0.993
03:40	2.7021	1.9421	0.993
03:50	2.7013	1.9413	0.992
04:00	2.7006	1.9406	0.992
04:10	2.6997	1.9397	0.991

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1.9565

Time	Water Level (W)	Head H	
(mins)	Metres (mOD)	(W-Ws)	H/H0
04:20	2.6994	1.9394	0.991
04:30	2.6978	1.9378	0.990
04:40	2.6977	1.9377	0.990
04:50	2.6970	1.937	0.990
05:00	2.6957	1.9357	0.989
05:10	2.6953	1.9353	0.989
05:20	2.6941	1.9341	0.989
05:30	2.6934	1.9334	0.988
05:40	2.6925	1.9325	0.988
05:50	2.6917	1.9317	0.987
06:00	2.6905	1.9305	0.987
06:10	2.6896	1.9296	0.986
06:20	2.6884	1.9284	0.986
06:30	2.6876	1.9276	0.985
06:40	2.6860	1.926	0.984
06:50	2.6850	1.925	0.984
07:00	2.6839	1.9239	0.983
07:10	2.6826	1.9226	0.983
07:20	2.6813	1.9213	0.982
07:30	2.6801	1.9201	0.981
07:40	2.6783	1.9183	0.980
07:50	2.6765	1.9165	0.980
08:00	2.6762	1.9162	0.979
08:10	2.6742	1.9142	0.978
08:20	2.6728	1.9128	0.978
08:30	2.6709	1.9109	0.977
08:40	2.6687	1.9087	0.976
08:50	2.6674	1.9074	0.975
09:00	2.6650	1.905	0.974
09:10	2.6632	1.9032	0.973
09:20	2.6615	1.9015	0.972
09:30	2.6591	1.8991	0.971
09:40	2.6565	1.8965	0.969
09:50	2.6541	1.8941	0.968
10:00	2.6511	1.8911	0.967
10:10	2.6490	1.889	0.965
10:20	2.6463	1.8863	0.964
10:30	2.6440	1.884	0.963
10:40	2.6399	1.8799	0.961
10:50	2.6368	1.8768	0.959
11:00	2.6335	1.8735	0.958
11:10	2.6300	1.87	0.956

Time	Water Level (W)	Head H	
(mins)	Metres (mOD)	(W-Ws)	H/H0
11:20	2.6267	1.8667	0.954
11:30	2.6223	1.8623	0.952
11:40	2.6180	1.858	0.950
11:50	2.6131	1.8531	0.947
12:00	2.6090	1.849	0.945
12:10	2.6031	1.8431	0.942
12:20	2.5980	1.838	0.939
12:30	2.5921	1.8321	0.936
12:40	2.5859	1.8259	0.933
12:50	2.5793	1.8193	0.930
13:00	2.5721	1.8121	0.926
13:10	2.5641	1.8041	0.922
13:20	2.5554	1.7954	0.918
13:30	2.5425	1.7825	0.911
13:40	2.5315	1.7715	0.905
13:50	2.5234	1.7634	0.901
14:00	2.5176	1.7576	0.898
14:10	2.5104	1.7504	0.895
14:20	2.5036	1.7436	0.891
14:30	2.4956	1.7356	0.887
14:40	2.4900	1.73	0.884
14:50	2.4831	1.7231	0.881
15:00	2.4757	1.7157	0.877
15:10	2.4681	1.7081	0.873
15:20	2.4601	1.7001	0.869
15:30	2.4508	1.6908	0.864
15:40	2.4428	1.6828	0.860
15:50	2.4325	1.6725	0.855
16:00	2.4231	1.6631	0.850
16:10	2.4134	1.6534	0.845
16:20	2.4037	1.6437	0.840
16:30	2.3931	1.6331	0.835
16:40	2.3816	1.6216	0.829
16:50	2.3693	1.6093	0.823
17:00	2.3576	1.5976	0.817
17:10	2.3450	1.585	0.810
17:20	2.3317	1.5717	0.803
17:30	2.3180	1.558	0.796
17:40	2.3039	1.5439	0.789
17:50	2.2898	1.5298	0.782
18:00	2.2765	1.5165	0.775
18:10	2.2628	1.5028	0.768

Time	Water Level (W)	Head H	
(mins)	Metres (mOD)	(W-Ws)	H/H0
18:20	2.2498	1.4898	0.761
18:30	2.2368	1.4768	0.755
18:40	2.2233	1.4633	0.748
18:50	2.2119	1.4519	0.742
19:00	2.1998	1.4398	0.736
19:10	2.1848	1.4248	0.728
19:20	2.1673	1.4073	0.719
19:30	2.1443	1.3843	0.708
19:40	2.1116	1.3516	0.691
19:50	2.0718	1.3118	0.670
20:00	2.0260	1.266	0.647
20:10	1.9746	1.2146	0.621
20:20	1.9185	1.1585	0.592
20:30	1.8544	1.0944	0.559
20:40	1.7835	1.0235	0.523
20:50	1.7035	0.9435	0.482
21:00	1.6319	0.8719	0.446
21:10	1.5252	0.7652	0.391
21:20	1.4129	0.6529	0.334
21:30	1.2820	0.522	0.267
21:40	1.1335	0.3735	0.191
21:50	0.7600	0	0.000

Intake Factor (F)		**Basic Time Factor**	
L	2.00	H/Ho	0.37
L/D	13.3	T (mins)	**21.25** at H/Ho = 0.37
F	3.83	from graph	

Intake Factor (F): Impervious bottom: BS5930 Case d) - Case b)

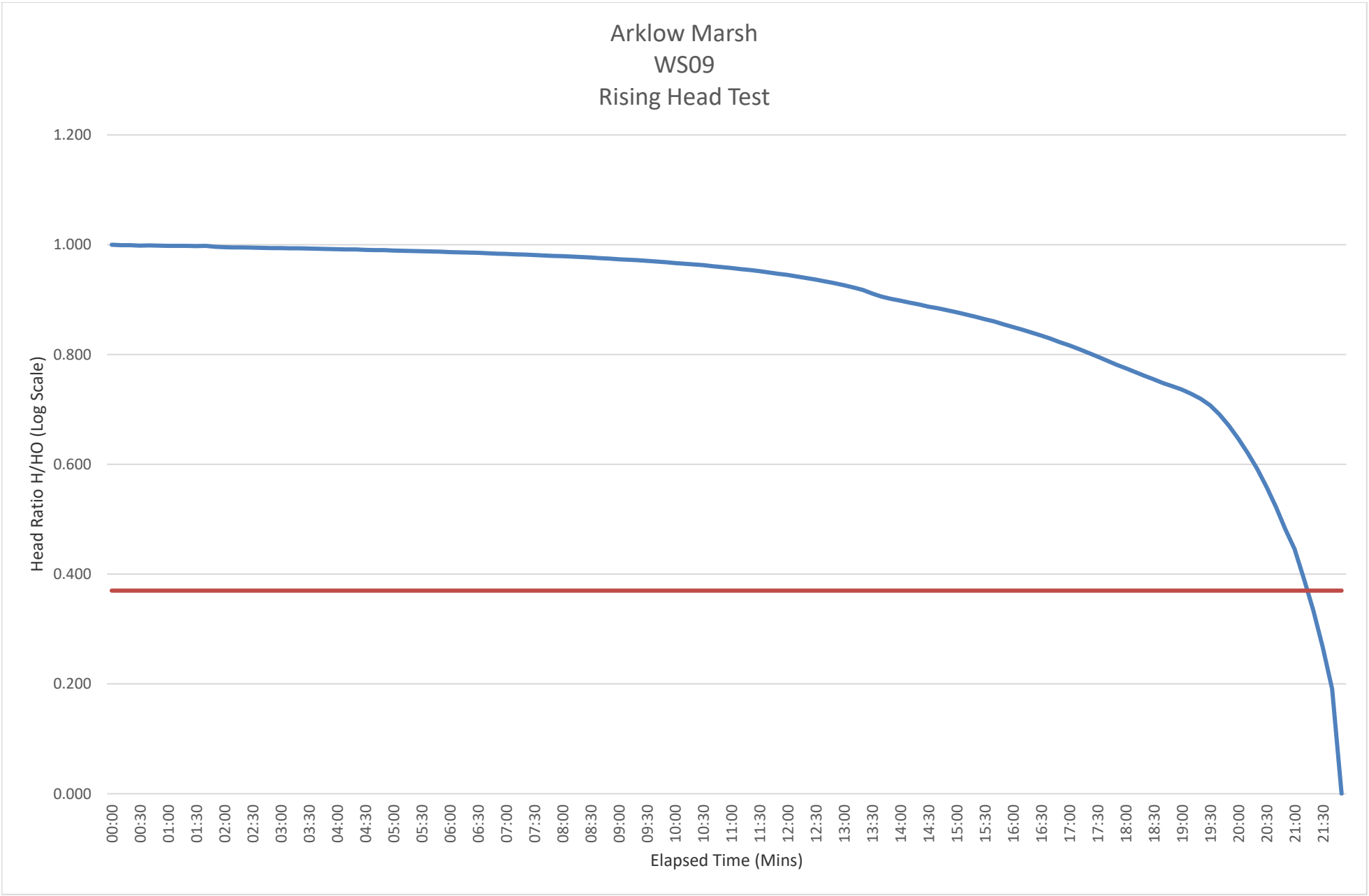
Case d) F = (2*Pi*L) / Ln (L/D + SQRT((1 + (L/D)*(L/D)))

Permeability

Note: Diameter of filter zone used in calculation of area in permeability calculation below;

k = A / (F x T) **2.17E-04** m/min

3.62E-06 m/sec


Arklow Marsh
WS09
Rising Head Test
1.200
1.000
0.800
0.600
0.400
0.200
0.000
Head Ratio H/HO (Log Scale)
00:00
00:30
01:00
01:30
02:00
02:30
03:00
03:30
04:00
04:30
05:00
05:30
06:00
06:30
07:00
07:30
08:00
08:30
09:00
09:30
10:00
10:30
11:00
11:30
12:00
12:30
13:00
13:30
14:00
14:30
15:00
15:30
16:00
16:30
17:00
17:30
18:00
18:30
19:00
19:30
20:00
20:30
21:00
21:30
Elapsed Time (Mins)

RISING HEAD TEST

Window Sample No.	**WS10**	**Job Name**	**Arklow Marsh**
Filter Zone		**Standpipe Details:**	
Depth from (m bgl)	1.00	Height above Ground Level	n/a
Depth to (m bgl)	3.00	Depth (m below top of SP)	n/a
Length of Filter (m)	2.00	Depth (mbgl)	n/a
Hole Diameter (m)	0.15	Diameter (m)	n/a
CSA of Filter Zone (m2)	0.018		
		Water Level Prior to Start of Test (Ws)	
		Metres below top of SP	n/a
Test No. Test 1		Metres (mOD)	1.627

Ho
0.4712

Time (mins)	Water Level (W) Metres (mOD)	Head H (W-Ws)	H/H0
00:00:00	2.0980	0.4712	1.0000
00:00:10	2.0973	0.4705	0.9985
00:00:20	2.0971	0.4703	0.9981
00:00:30	2.0976	0.4708	0.9992
00:00:40	2.0975	0.4707	0.9989
00:00:50	2.0974	0.4706	0.9987
00:01:00	2.0978	0.4710	0.9996
00:01:10	2.0969	0.4701	0.9977
00:01:20	2.0971	0.4703	0.9981
00:01:30	2.0979	0.4711	0.9998
00:01:40	2.0972	0.4704	0.9983
00:01:50	2.0970	0.4702	0.9979
00:02:00	2.0971	0.4703	0.9981
00:02:10	2.0971	0.4703	0.9981
00:02:20	2.0969	0.4701	0.9977
00:02:30	2.0969	0.4701	0.9977
00:02:40	2.0968	0.4700	0.9975
00:02:50	2.0970	0.4702	0.9979
00:03:00	2.0968	0.4700	0.9975
00:03:10	2.0970	0.4702	0.9979
00:03:20	2.0968	0.4700	0.9975
00:03:30	2.0968	0.4700	0.9975
00:03:40	2.0966	0.4698	0.9970
00:03:50	2.0964	0.4696	0.9966
00:04:00	2.0967	0.4699	0.9972
00:04:10	2.0958	0.4690	0.9953

Ho
0.4712

Time	Water Level (W)	Head H	
(mins)	Metres (mOD)	(W-Ws)	H/H0
00:04:20	2.0965	0.4697	0.9968
00:04:30	2.0961	0.4693	0.9960
00:04:40	2.0961	0.4693	0.9960
00:04:50	2.0965	0.4697	0.9968
00:05:00	2.0965	0.4697	0.9968
00:05:10	2.0962	0.4694	0.9962
00:05:20	2.0960	0.4692	0.9958
00:05:30	2.0958	0.4690	0.9953
00:05:40	2.0967	0.4699	0.9972
00:05:50	2.0958	0.4690	0.9953
00:06:00	2.0960	0.4692	0.9958
00:06:10	2.0956	0.4688	0.9949
00:06:20	2.0955	0.4687	0.9947
00:06:30	2.0953	0.4685	0.9943
00:06:40	2.0957	0.4689	0.9951
00:06:50	2.0952	0.4684	0.9941
00:07:00	2.0956	0.4688	0.9949
00:07:10	2.0957	0.4689	0.9951
00:07:20	2.0957	0.4689	0.9951
00:07:30	2.0949	0.4681	0.9934
00:07:40	2.0953	0.4685	0.9943
00:07:50	2.0953	0.4685	0.9943
00:08:00	2.0954	0.4686	0.9945
00:08:10	2.0954	0.4686	0.9945
00:08:20	2.0949	0.4681	0.9934
00:08:30	2.0950	0.4682	0.9936
00:08:40	2.0954	0.4686	0.9945
00:08:50	2.0953	0.4685	0.9943
00:09:00	2.0946	0.4678	0.9928
00:09:10	2.0952	0.4684	0.9941
00:09:20	2.0951	0.4683	0.9938
00:09:30	2.0948	0.4680	0.9932
00:09:40	2.0952	0.4684	0.9941
00:09:50	2.0949	0.4681	0.9934
00:10:00	2.0951	0.4683	0.9938
00:10:10	2.0951	0.4683	0.9938
00:10:20	2.0950	0.4682	0.9936
00:10:30	2.0952	0.4684	0.9941
00:10:40	2.0957	0.4689	0.9951
00:10:50	2.0951	0.4683	0.9938
00:11:00	2.0943	0.4675	0.9921
00:11:10	2.0952	0.4684	0.9941

Ho
0.4712

Time	Water Level (W)	Head H	
(mins)	Metres (mOD)	(W-Ws)	H/H0
00:11:20	2.0952	0.4684	0.9941
00:11:30	2.0946	0.4678	0.9928
00:11:40	2.0952	0.4684	0.9941
00:11:50	2.0952	0.4684	0.9941
00:12:00	2.0947	0.4679	0.9930
00:12:10	2.0947	0.4679	0.9930
00:12:20	2.0951	0.4683	0.9938
00:12:30	2.0950	0.4682	0.9936
00:12:40	2.0956	0.4688	0.9949
00:12:50	2.0956	0.4688	0.9949
00:13:00	2.0946	0.4678	0.9928
00:13:10	2.0944	0.4676	0.9924
00:13:20	2.0950	0.4682	0.9936
00:13:30	2.0948	0.4680	0.9932
00:13:40	2.0950	0.4682	0.9936
00:13:50	2.0944	0.4676	0.9924
00:14:00	2.0949	0.4681	0.9934
00:14:10	2.0950	0.4682	0.9936
00:14:20	2.0942	0.4674	0.9919
00:14:30	2.0941	0.4673	0.9917
00:14:40	2.0945	0.4677	0.9926
00:14:50	2.0950	0.4682	0.9936
00:15:00	2.0948	0.4680	0.9932
00:15:10	2.0950	0.4682	0.9936
00:15:20	2.0943	0.4675	0.9921
00:15:30	2.0954	0.4686	0.9945
00:15:40	2.0943	0.4675	0.9921
00:15:50	2.0942	0.4674	0.9919
00:16:00	2.0949	0.4681	0.9934
00:16:10	2.0941	0.4673	0.9917
00:16:20	2.0945	0.4677	0.9926
00:16:30	2.0941	0.4673	0.9917
00:16:40	2.0936	0.4668	0.9907
00:16:50	2.0941	0.4673	0.9917
00:17:00	2.0934	0.4666	0.9902
00:17:10	2.0939	0.4671	0.9913
00:17:20	2.0943	0.4675	0.9921
00:17:30	2.0940	0.4672	0.9915
00:17:40	2.0932	0.4664	0.9898
00:17:50	2.0940	0.4672	0.9915
00:18:00	2.0940	0.4672	0.9915
00:18:10	2.0938	0.4670	0.9911

Ho
0.4712

Time	Water Level (W)	Head H	
(mins)	Metres (mOD)	(W-Ws)	H/H0
00:18:20	2.0937	0.4669	0.9909
00:18:30	2.0934	0.4666	0.9902
00:18:40	2.0937	0.4669	0.9909
00:18:50	2.0934	0.4666	0.9902
00:19:00	2.0931	0.4663	0.9896
00:19:10	2.0928	0.4660	0.9890
00:19:20	2.0936	0.4668	0.9907
00:19:30	2.0933	0.4665	0.9900
00:19:40	2.0935	0.4667	0.9904
00:19:50	2.0930	0.4662	0.9894
00:20:00	2.0930	0.4662	0.9894
00:20:10	2.0931	0.4663	0.9896
00:20:20	2.0930	0.4662	0.9894
00:20:30	2.0930	0.4662	0.9894
00:20:40	2.0925	0.4657	0.9883
00:20:50	2.0929	0.4661	0.9892
00:21:00	2.0925	0.4657	0.9883
00:21:10	2.0926	0.4658	0.9885
00:21:20	2.0921	0.4653	0.9875
00:21:30	2.0923	0.4655	0.9879
00:21:40	2.0926	0.4658	0.9885
00:21:50	2.0922	0.4654	0.9877
00:22:00	2.0921	0.4653	0.9875
00:22:10	2.0917	0.4649	0.9866
00:22:20	2.0918	0.4650	0.9868
00:22:30	2.0912	0.4644	0.9856
00:22:40	2.0920	0.4652	0.9873
00:22:50	2.0916	0.4648	0.9864
00:23:00	2.0917	0.4649	0.9866
00:23:10	2.0921	0.4653	0.9875
00:23:20	2.0919	0.4651	0.9871
00:23:30	2.0915	0.4647	0.9862
00:23:40	2.0917	0.4649	0.9866
00:23:50	2.0919	0.4651	0.9871
00:24:00	2.0915	0.4647	0.9862
00:24:10	2.0917	0.4649	0.9866
00:24:20	2.0914	0.4646	0.9860
00:24:30	2.0910	0.4642	0.9851
00:24:40	2.0908	0.4640	0.9847
00:24:50	2.0909	0.4641	0.9849
00:25:00	2.0910	0.4642	0.9851
00:25:10	2.0906	0.4638	0.9843

Ho
0.4712

Time	Water Level (W)	Head H	
(mins)	Metres (mOD)	(W-Ws)	H/H0
00:25:20	2.0909	0.4641	0.9849
00:25:30	2.0910	0.4642	0.9851
00:25:40	2.0906	0.4638	0.9843
00:25:50	2.0905	0.4637	0.9841
00:26:00	2.0902	0.4634	0.9834
00:26:10	2.0903	0.4635	0.9837
00:26:20	2.0903	0.4635	0.9837
00:26:30	2.0901	0.4633	0.9832
00:26:40	2.0902	0.4634	0.9834
00:26:50	2.0902	0.4634	0.9834
00:27:00	2.0895	0.4627	0.9820
00:27:10	2.0899	0.4631	0.9828
00:27:20	2.0896	0.4628	0.9822
00:27:30	2.0901	0.4633	0.9832
00:27:40	2.0903	0.4635	0.9837
00:27:50	2.0898	0.4630	0.9826
00:28:00	2.0895	0.4627	0.9820
00:28:10	2.0898	0.4630	0.9826
00:28:20	2.0892	0.4624	0.9813
00:28:30	2.0890	0.4622	0.9809
00:28:40	2.0895	0.4627	0.9820
00:28:50	2.0891	0.4623	0.9811
00:29:00	2.0888	0.4620	0.9805
00:29:10	2.0890	0.4622	0.9809
00:29:20	2.0890	0.4622	0.9809
00:29:30	2.0883	0.4615	0.9794
00:29:40	2.0889	0.4621	0.9807
00:29:50	2.0887	0.4619	0.9803
00:30:00	2.0883	0.4615	0.9794
00:30:10	2.0883	0.4615	0.9794
00:30:20	2.0884	0.4616	0.9796
00:30:30	2.0887	0.4619	0.9803
00:30:40	2.0879	0.4611	0.9786
00:30:50	2.0881	0.4613	0.9790
00:31:00	2.0872	0.4604	0.9771
00:31:10	2.0879	0.4611	0.9786
00:31:20	2.0873	0.4605	0.9773
00:31:30	2.0877	0.4609	0.9781
00:31:40	2.0874	0.4606	0.9775
00:31:50	2.0872	0.4604	0.9771
00:32:00	2.0874	0.4606	0.9775
00:32:10	2.0872	0.4604	0.9771

Ho
0.4712

Time	Water Level (W)	Head H	
(mins)	Metres (mOD)	(W-Ws)	H/H0
00:32:20	2.0872	0.4604	0.9771
00:32:30	2.0875	0.4607	0.9777
00:32:40	2.0874	0.4606	0.9775
00:32:50	2.0865	0.4597	0.9756
00:33:00	2.0870	0.4602	0.9767
00:33:10	2.0868	0.4600	0.9762
00:33:20	2.0869	0.4601	0.9764
00:33:30	2.0869	0.4601	0.9764
00:33:40	2.0873	0.4605	0.9773
00:33:50	2.0867	0.4599	0.9760
00:34:00	2.0866	0.4598	0.9758
00:34:10	2.0859	0.4591	0.9743
00:34:20	2.0860	0.4592	0.9745
00:34:30	2.0868	0.4600	0.9762
00:34:40	2.0865	0.4597	0.9756
00:34:50	2.0858	0.4590	0.9741
00:35:00	2.0860	0.4592	0.9745
00:35:10	2.0859	0.4591	0.9743
00:35:20	2.0855	0.4587	0.9735
00:35:30	2.0861	0.4593	0.9747
00:35:40	2.0855	0.4587	0.9735
00:35:50	2.0854	0.4586	0.9733
00:36:00	2.0857	0.4589	0.9739
00:36:10	2.0855	0.4587	0.9735
00:36:20	2.0853	0.4585	0.9730
00:36:30	2.0853	0.4585	0.9730
00:36:40	2.0846	0.4578	0.9716
00:36:50	2.0852	0.4584	0.9728
00:37:00	2.0853	0.4585	0.9730
00:37:10	2.0850	0.4582	0.9724
00:37:20	2.0846	0.4578	0.9716
00:37:30	2.0850	0.4582	0.9724
00:37:40	2.0848	0.4580	0.9720
00:37:50	2.0846	0.4578	0.9716
00:38:00	2.0838	0.4570	0.9699
00:38:10	2.0838	0.4570	0.9699
00:38:20	2.0824	0.4556	0.9669
00:38:30	2.0835	0.4567	0.9692
00:38:40	2.0835	0.4567	0.9692
00:38:50	2.0828	0.4560	0.9677
00:39:00	2.0827	0.4559	0.9675
00:39:10	2.0825	0.4557	0.9671

Ho
0.4712

Time	Water Level (W)	Head H	
(mins)	Metres (mOD)	(W-Ws)	H/H0
00:39:20	2.0832	0.4564	0.9686
00:39:30	2.0830	0.4562	0.9682
00:39:40	2.0824	0.4556	0.9669
00:39:50	2.0828	0.4560	0.9677
00:40:00	2.0822	0.4554	0.9665
00:40:10	2.0820	0.4552	0.9660
00:40:20	2.0815	0.4547	0.9650
00:40:30	2.0814	0.4546	0.9648
00:40:40	2.0813	0.4545	0.9646
00:40:50	2.0811	0.4543	0.9641
00:41:00	2.0809	0.4541	0.9637
00:41:10	2.0809	0.4541	0.9637
00:41:20	2.0804	0.4536	0.9626
00:41:30	2.0802	0.4534	0.9622
00:41:40	2.0802	0.4534	0.9622
00:41:50	2.0807	0.4539	0.9633
00:42:00	2.0800	0.4532	0.9618
00:42:10	2.0801	0.4533	0.9620
00:42:20	2.0797	0.4529	0.9612
00:42:30	2.0794	0.4526	0.9605
00:42:40	2.0793	0.4525	0.9603
00:42:50	2.0781	0.4513	0.9578
00:43:00	2.0772	0.4504	0.9559
00:43:10	2.0779	0.4511	0.9573
00:43:20	2.0774	0.4506	0.9563
00:43:30	2.0773	0.4505	0.9561
00:43:40	2.0769	0.4501	0.9552
00:43:50	2.0769	0.4501	0.9552
00:44:00	2.0766	0.4498	0.9546
00:44:10	2.0759	0.4491	0.9531
00:44:20	2.0673	0.4405	0.9348
00:44:30	2.0670	0.4402	0.9342
00:44:40	2.0672	0.4404	0.9346
00:44:50	2.0672	0.4404	0.9346
00:45:00	2.0670	0.4402	0.9342
00:45:10	2.0668	0.4400	0.9338
00:45:20	2.0659	0.4391	0.9319
00:45:30	2.0654	0.4386	0.9308
00:45:40	2.0658	0.4390	0.9317
00:45:50	2.0657	0.4389	0.9315
00:46:00	2.0655	0.4387	0.9310
00:46:10	2.0656	0.4388	0.9312

Ho
0.4712

Time	Water Level (W)	Head H	
(mins)	Metres (mOD)	(W-Ws)	H/H0
00:46:20	2.0648	0.4380	0.9295
00:46:30	2.0644	0.4376	0.9287
00:46:40	2.0642	0.4374	0.9283
00:46:50	2.0645	0.4377	0.9289
00:47:00	2.0644	0.4376	0.9287
00:47:10	2.0642	0.4374	0.9283
00:47:20	2.0638	0.4370	0.9274
00:47:30	2.0634	0.4366	0.9266
00:47:40	2.0635	0.4367	0.9268
00:47:50	2.0638	0.4370	0.9274
00:48:00	2.0637	0.4369	0.9272
00:48:10	2.0629	0.4361	0.9255
00:48:20	2.0632	0.4364	0.9261
00:48:30	2.0632	0.4364	0.9261
00:48:40	2.0629	0.4361	0.9255
00:48:50	2.0623	0.4355	0.9242
00:49:00	2.0625	0.4357	0.9247
00:49:10	2.0622	0.4354	0.9240
00:49:20	2.0617	0.4349	0.9230
00:49:30	2.0623	0.4355	0.9242
00:49:40	2.0613	0.4345	0.9221
00:49:50	2.0617	0.4349	0.9230
00:50:00	2.0614	0.4346	0.9223
00:50:10	2.0611	0.4343	0.9217
00:50:20	2.0607	0.4339	0.9208
00:50:30	2.0607	0.4339	0.9208
00:50:40	2.0603	0.4335	0.9200
00:50:50	2.0603	0.4335	0.9200
00:51:00	2.0598	0.4330	0.9189
00:51:10	2.0595	0.4327	0.9183
00:51:20	2.0593	0.4325	0.9179
00:51:30	2.0591	0.4323	0.9174
00:51:40	2.0586	0.4318	0.9164
00:51:50	2.0589	0.4321	0.9170
00:52:00	2.0579	0.4311	0.9149
00:52:10	2.0583	0.4315	0.9157
00:52:20	2.0577	0.4309	0.9145
00:52:30	2.0575	0.4307	0.9140
00:52:40	2.0576	0.4308	0.9143
00:52:50	2.0574	0.4306	0.9138
00:53:00	2.0571	0.4303	0.9132
00:53:10	2.0569	0.4301	0.9128

Ho
0.4712

Time	Water Level (W)	Head H	
(mins)	Metres (mOD)	(W-Ws)	H/H0
00:53:20	2.0561	0.4293	0.9111
00:53:30	2.0562	0.4294	0.9113
00:53:40	2.0564	0.4296	0.9117
00:53:50	2.0558	0.4290	0.9104
00:54:00	2.0559	0.4291	0.9107
00:54:10	2.0555	0.4287	0.9098
00:54:20	2.0547	0.4279	0.9081
00:54:30	2.0549	0.4281	0.9085
00:54:40	2.0551	0.4283	0.9090
00:54:50	2.0542	0.4274	0.9070
00:55:00	2.0538	0.4270	0.9062
00:55:10	2.0540	0.4272	0.9066
00:55:20	2.0529	0.4261	0.9043
00:55:30	2.0536	0.4268	0.9058
00:55:40	2.0529	0.4261	0.9043
00:55:50	2.0527	0.4259	0.9039
00:56:00	2.0523	0.4255	0.9030
00:56:10	2.0517	0.4249	0.9017
00:56:20	2.0514	0.4246	0.9011
00:56:30	2.0514	0.4246	0.9011
00:56:40	2.0508	0.4240	0.8998
00:56:50	2.0509	0.4241	0.9000
00:57:00	2.0501	0.4233	0.8983
00:57:10	2.0503	0.4235	0.8988
00:57:20	2.0504	0.4236	0.8990
00:57:30	2.0500	0.4232	0.8981
00:57:40	2.0496	0.4228	0.8973
00:57:50	2.0493	0.4225	0.8966
00:58:00	2.0486	0.4218	0.8952
00:58:10	2.0484	0.4216	0.8947
00:58:20	2.0481	0.4213	0.8941
00:58:30	2.0475	0.4207	0.8928
00:58:40	2.0476	0.4208	0.8930
00:58:50	2.0475	0.4207	0.8928
00:59:00	2.0462	0.4194	0.8901
00:59:10	2.0464	0.4196	0.8905
00:59:20	2.0461	0.4193	0.8899
00:59:30	2.0457	0.4189	0.8890
00:59:40	2.0450	0.4182	0.8875
00:59:50	2.0441	0.4173	0.8856
01:00:00	2.0441	0.4173	0.8856
01:00:10	2.0432	0.4164	0.8837

Ho
0.4712

Time	Water Level (W)	Head H	
(mins)	Metres (mOD)	(W-Ws)	H/H0
01:00:20	2.0433	0.4165	0.8839
01:00:30	2.0434	0.4166	0.8841
01:00:40	2.0425	0.4157	0.8822
01:00:50	2.0412	0.4144	0.8795
01:01:00	2.0415	0.4147	0.8801
01:01:10	2.0412	0.4144	0.8795
01:01:20	2.0406	0.4138	0.8782
01:01:30	2.0400	0.4132	0.8769
01:01:40	2.0398	0.4130	0.8765
01:01:50	2.0391	0.4123	0.8750
01:02:00	2.0380	0.4112	0.8727
01:02:10	2.0380	0.4112	0.8727
01:02:20	2.0375	0.4107	0.8716
01:02:30	2.0373	0.4105	0.8712
01:02:40	2.0362	0.4094	0.8688
01:02:50	2.0365	0.4097	0.8695
01:03:00	2.0362	0.4094	0.8688
01:03:10	2.0350	0.4082	0.8663
01:03:20	2.0345	0.4077	0.8652
01:03:30	2.0341	0.4073	0.8644
01:03:40	2.0342	0.4074	0.8646
01:03:50	2.0331	0.4063	0.8623
01:04:00	2.0325	0.4057	0.8610
01:04:10	2.0320	0.4052	0.8599
01:04:20	2.0314	0.4046	0.8587
01:04:30	2.0309	0.4041	0.8576
01:04:40	2.0299	0.4031	0.8555
01:04:50	2.0290	0.4022	0.8536
01:05:00	2.0279	0.4011	0.8512
01:05:10	2.0264	0.3996	0.8480
01:05:20	2.0261	0.3993	0.8474
01:05:30	2.0254	0.3986	0.8459
01:05:40	2.0248	0.3980	0.8447
01:05:50	2.0241	0.3973	0.8432
01:06:00	2.0235	0.3967	0.8419
01:06:10	2.0227	0.3959	0.8402
01:06:20	2.0229	0.3961	0.8406
01:06:30	2.0215	0.3947	0.8376
01:06:40	2.0204	0.3936	0.8353
01:06:50	2.0200	0.3932	0.8345
01:07:00	2.0198	0.393	0.8340
01:07:10	2.0185	0.3917	0.8313

Ho
0.4712

Time	Water Level (W)	Head H	
(mins)	Metres (mOD)	(W-Ws)	H/H0
01:07:20	2.0183	0.3915	0.8309
01:07:30	2.0167	0.3899	0.8275
01:07:40	2.0162	0.3894	0.8264
01:07:50	2.0157	0.3889	0.8253
01:08:00	2.0152	0.3884	0.8243
01:08:10	2.0141	0.3873	0.8219
01:08:20	2.0128	0.386	0.8192
01:08:30	2.0120	0.3852	0.8175
01:08:40	2.0115	0.3847	0.8164
01:08:50	2.0095	0.3827	0.8122
01:09:00	2.0092	0.3824	0.8115
01:09:10	2.0076	0.3808	0.8081
01:09:20	2.0070	0.3802	0.8069
01:09:30	2.0059	0.3791	0.8045
01:09:40	2.0049	0.3781	0.8024
01:09:50	2.0038	0.377	0.8001
01:10:00	2.0024	0.3756	0.7971
01:10:10	2.0014	0.3746	0.7950
01:10:20	1.9999	0.3731	0.7918
01:10:30	1.9984	0.3716	0.7886
01:10:40	1.9972	0.3704	0.7861
01:10:50	1.9954	0.3686	0.7823
01:11:00	1.9950	0.3682	0.7814
01:11:10	1.9927	0.3659	0.7765
01:11:20	1.9907	0.3639	0.7723
01:11:30	1.9891	0.3623	0.7689
01:11:40	1.9867	0.3599	0.7638
01:11:50	1.9846	0.3578	0.7593
01:12:00	1.9824	0.3556	0.7547
01:12:10	1.9806	0.3538	0.7508
01:12:20	1.9780	0.3512	0.7453
01:12:30	1.9757	0.3489	0.7404
01:12:40	1.9731	0.3463	0.7349
01:12:50	1.9705	0.3437	0.7294
01:13:00	1.9676	0.3408	0.7233
01:13:10	1.9649	0.3381	0.7175
01:13:20	1.9612	0.3344	0.7097
01:13:30	1.9590	0.3322	0.7050
01:13:40	1.9546	0.3278	0.6957
01:13:50	1.9516	0.3248	0.6893
01:14:00	1.9476	0.3208	0.6808
01:14:10	1.9436	0.3168	0.6723

Ho
0.4712

Time	Water Level (W)	Head H	
(mins)	Metres (mOD)	(W-Ws)	H/H0
01:14:20	1.9385	0.3117	0.6615
01:14:30	1.9341	0.3073	0.6522
01:14:40	1.9295	0.3027	0.6424
01:14:50	1.9244	0.2976	0.6316
01:15:00	1.9170	0.2902	0.6159
01:15:10	1.9115	0.2847	0.6042
01:15:20	1.9036	0.2768	0.5874
01:15:30	1.8959	0.2691	0.5711
01:15:40	1.8866	0.2598	0.5514
01:15:50	1.8788	0.252	0.5348
01:16:00	1.8665	0.2397	0.5087
01:16:10	1.8549	0.2281	0.4841
01:16:20	1.8410	0.2142	0.4546
01:16:30	1.8252	0.1984	0.4211
01:16:40	1.8079	0.1811	0.3843
01:16:50	1.7868	0.16	0.3396
01:17:00	1.7631	0.1363	0.2893
01:17:10	1.7346	0.1078	0.2288
01:17:20	1.7023	0.0755	0.1602
01:17:30	1.6643	0.0375	0.0796
01:17:40	1.6268	0.0000	0.0000

Intake Factor (F)

L	2.00
L/D	13.3
F	3.83

Basic Time Factor

H/Ho	0.37
T (mins)	**76.6** at H/Ho = 0.37
from graph	

Intake Factor (F): Impervious bottom: BS5930 Case d) - Case b)

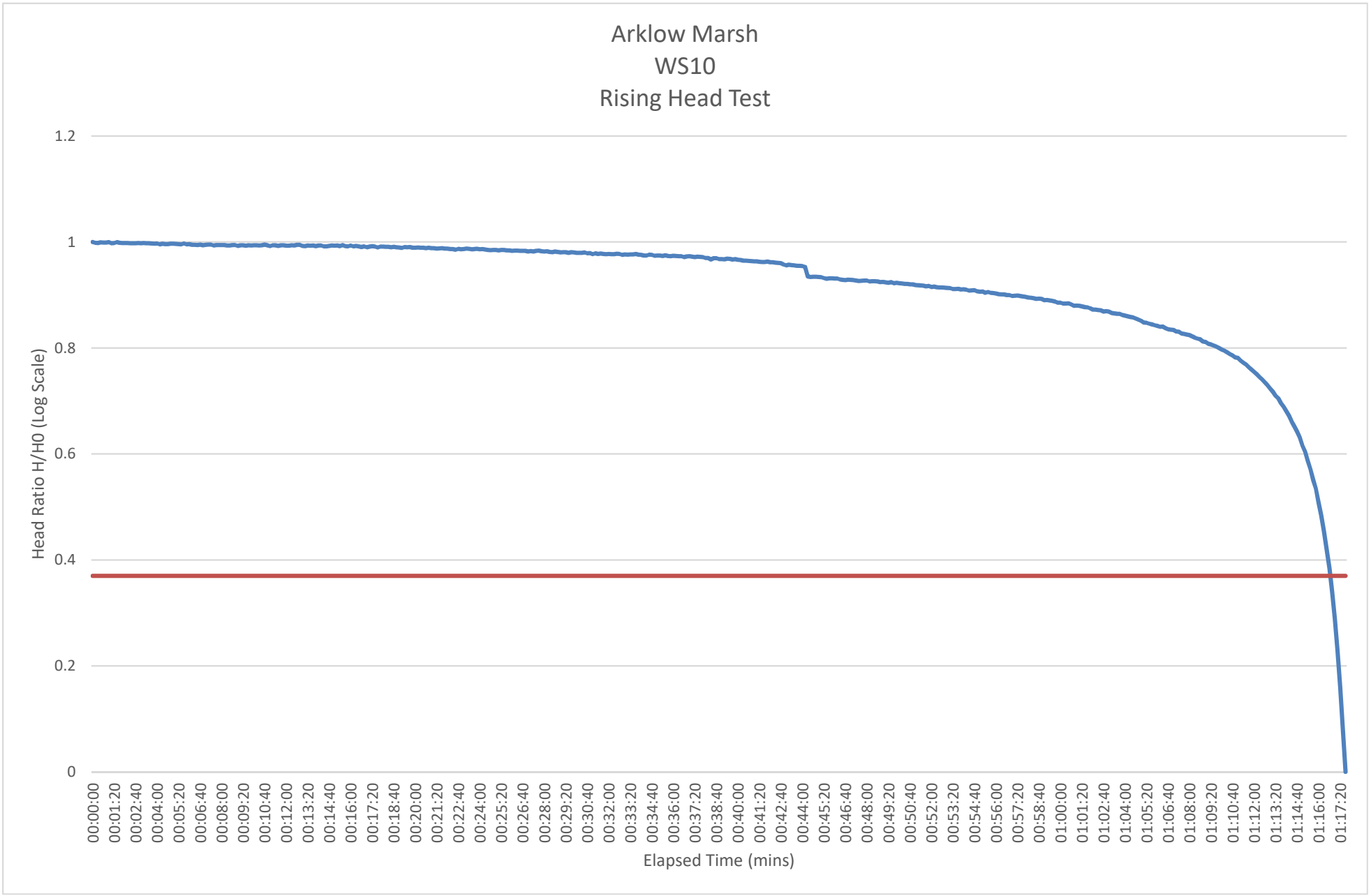
Case d) F = (2*Pi*L) / Ln (L/D + SQRT((1 + (L/D)*(L/D)))

Permeability

Note: Diameter of filter zone used in calculation of area in permeability calculation below;

k = A / (F x T) **6.03E-05** m/min

1.01E-06 m/sec


Arklow Marsh
WS10
Rising Head Test
Head Ratio H/H0 (Log Scale)
1.2
1
0.8
0.6
0.4
0.2
0
00:00:00
00:01:20
00:02:40
00:04:00
00:05:20
00:06:40
00:08:00
00:09:20
00:10:40
00:12:00
00:13:20
00:14:40
00:16:00
00:17:20
00:18:40
00:20:00
00:21:20
00:22:40
00:24:00
00:25:20
00:26:40
00:28:00
00:29:20
00:30:40
00:32:00
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00:34:40
00:36:00
00:37:20
00:38:40
00:40:00
00:41:20
00:42:40
00:44:00
00:45:20
00:46:40
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00:50:40
00:52:00
00:53:20
00:54:40
00:56:00
00:57:20
00:58:40
01:00:00
01:01:20
01:02:40
01:04:00
01:05:20
01:06:40
01:08:00
01:09:20
01:10:40
01:12:00
01:13:20
01:14:40
01:16:00
01:17:20
Elapsed Time (mins)

RISING HEAD TEST

Window Sample No.	**WS13**	**Job Name**	**Arklow Marsh**
Filter Zone		**Standpipe Details:**	
Depth from (m bgl)	1.00	Height above Ground Level	n/a
Depth to (m bgl)	3.00	Depth (m below top of SP)	n/a
Length of Filter (m)	2.00	Depth (mbgl)	n/a
Hole Diameter (m)	0.15	Diameter (m)	n/a
CSA of Filter Zone (m2)	0.018		
		Water Level Prior to Start of Test (Ws)	
		Metres below top of SP	n/a
Test No. Test 1		Metres (mOD)	1.181

Ho
1.5040

Time (mins)	Water Level (W) Metres (mOD)	Head H (W-Ws)	H/H0
00:00	2.6853	1.5040	1.0000
00:10	2.6840	1.5027	0.9991
00:20	2.6841	1.5028	0.9992
00:30	2.6832	1.5019	0.9986
00:40	2.6823	1.5010	0.9980
00:50	2.6809	1.4996	0.9971
01:00	2.6819	1.5006	0.9977
01:10	2.6811	1.4998	0.9972
01:20	2.6805	1.4992	0.9968
01:30	2.6801	1.4988	0.9965
01:40	2.6796	1.4983	0.9962
01:50	2.6789	1.4976	0.9957
02:00	2.6789	1.4976	0.9957
02:10	2.6784	1.4971	0.9954
02:20	2.6777	1.4964	0.9949
02:30	2.6781	1.4968	0.9952
02:40	2.6776	1.4963	0.9949
02:50	2.6774	1.4961	0.9947
03:00	2.6772	1.4959	0.9946
03:10	2.6772	1.4959	0.9946
03:20	2.6769	1.4956	0.9944
03:30	2.6768	1.4955	0.9943
03:40	2.6770	1.4957	0.9945
03:50	2.6763	1.4950	0.9940
04:00	2.6766	1.4953	0.9942
04:10	2.6761	1.4948	0.9939

Ho
1.5040

Time (mins)	Water Level (W) Metres (mOD)	Head H (W-Ws)	H/H0
04:20	2.6759	1.4946	0.9938
04:30	2.6755	1.4942	0.9935
04:40	2.6759	1.4946	0.9938
04:50	2.6760	1.4947	0.9938
05:00	2.6752	1.4939	0.9933
05:10	2.6748	1.4935	0.9930
05:20	2.6758	1.4945	0.9937
05:30	2.6750	1.4937	0.9932
05:40	2.6743	1.4930	0.9927
05:50	2.6743	1.4930	0.9927
06:00	2.6743	1.4930	0.9927
06:10	2.6741	1.4928	0.9926
06:20	2.6733	1.4920	0.9920
06:30	2.6730	1.4917	0.9918
06:40	2.6726	1.4913	0.9916
06:50	2.6721	1.4908	0.9912
07:00	2.6722	1.4909	0.9913
07:10	2.6711	1.4898	0.9906
07:20	2.6702	1.4889	0.9900
07:30	2.6694	1.4881	0.9894
07:40	2.6684	1.4871	0.9888
07:50	2.6680	1.4867	0.9885
08:00	2.6660	1.4847	0.9872
08:10	2.6647	1.4834	0.9863
08:20	2.6642	1.4829	0.9860
08:30	2.6626	1.4813	0.9849
08:40	2.6613	1.4800	0.9840
08:50	2.6598	1.4785	0.9830
09:00	2.6590	1.4777	0.9825
09:10	2.6606	1.4793	0.9836
09:20	2.6613	1.4800	0.9840
09:30	2.6614	1.4801	0.9841
09:40	2.6615	1.4802	0.9842
09:50	2.6619	1.4806	0.9844
10:00	2.6607	1.4794	0.9836
10:10	2.6660	1.4847	0.9872
10:20	2.6658	1.4845	0.9870
10:30	2.6653	1.4840	0.9867
10:40	2.6638	1.4825	0.9857
10:50	2.6633	1.4820	0.9854
11:00	2.6617	1.4804	0.9843
11:10	2.6610	1.4797	0.9838

Ho
1.5040

Time (mins)	Water Level (W) Metres (mOD)	Head H (W-Ws)	H/H0
11:20	2.6602	1.4789	0.9833
11:30	2.6595	1.4782	0.9828
11:40	2.6584	1.4771	0.9821
11:50	2.6578	1.4765	0.9817
12:00	2.6574	1.4761	0.9814
12:10	2.6565	1.4752	0.9809
12:20	2.6556	1.4743	0.9803
12:30	2.6555	1.4742	0.9802
12:40	2.6542	1.4729	0.9793
12:50	2.6535	1.4722	0.9789
13:00	2.6529	1.4716	0.9785
13:10	2.6516	1.4703	0.9776
13:20	2.6523	1.4710	0.9781
13:30	2.6519	1.4706	0.9778
13:40	2.6517	1.4704	0.9777
13:50	2.6515	1.4702	0.9775
14:00	2.6499	1.4686	0.9765
14:10	2.6485	1.4672	0.9755
14:20	2.6475	1.4662	0.9749
14:30	2.6456	1.4643	0.9736
14:40	2.6447	1.4634	0.9730
14:50	2.6430	1.4617	0.9719
15:00	2.6416	1.4603	0.9709
15:10	2.6396	1.4583	0.9696
15:20	2.6378	1.4565	0.9684
15:30	2.6359	1.4546	0.9672
15:40	2.6340	1.4527	0.9659
15:50	2.6324	1.4511	0.9648
16:00	2.6292	1.4479	0.9627
16:10	2.6272	1.4459	0.9614
16:20	2.6241	1.4428	0.9593
16:30	2.6221	1.4408	0.9580
16:40	2.6184	1.4371	0.9555
16:50	2.6148	1.4335	0.9531
17:00	2.6117	1.4304	0.9511
17:10	2.6081	1.4268	0.9487
17:20	2.6033	1.4220	0.9455
17:30	2.5968	1.4155	0.9412
17:40	2.5899	1.4086	0.9366
17:50	2.5836	1.4023	0.9324
18:00	2.5776	1.3963	0.9284
18:10	2.5748	1.3935	0.9265

Ho
1.5040

Time	Water Level (W)	Head H	
(mins)	Metres (mOD)	(W-Ws)	H/H0
18:20	2.5687	1.3874	0.9225
18:30	2.5527	1.3714	0.9118
18:40	2.5404	1.3591	0.9037
18:50	2.5305	1.3492	0.8971
19:00	2.5186	1.3373	0.8892
19:10	2.5032	1.3219	0.8789
19:20	2.4874	1.3061	0.8684
19:30	2.4670	1.2857	0.8549
19:40	2.4425	1.2612	0.8386
19:50	2.4127	1.2314	0.8188
20:00	2.3746	1.1933	0.7934
20:10	2.3276	1.1463	0.7622
20:20	2.2654	1.0841	0.7208
20:30	2.1917	1.0104	0.6718
20:40	2.0904	0.9091	0.6045
20:50	1.9542	0.7729	0.5139
21:00	1.7397	0.5584	0.3713
21:10	1.4193	0.2380	0.1582
21:20	1.1947	0.0134	0.0089
21:30	1.1813	0.0000	0.0000

Intake Factor (F)

L	2.00	H/Ho	0.37
L/D	13.3	T (mins)	**21** at H/Ho = 0.37
F	3.83	from graph	

Intake Factor (F): Impervious bottom: BS5930 Case d) - Case b)

Case d) F = (2*Pi*L) / Ln (L/D + SQRT((1 + (L/D)*(L/D)))

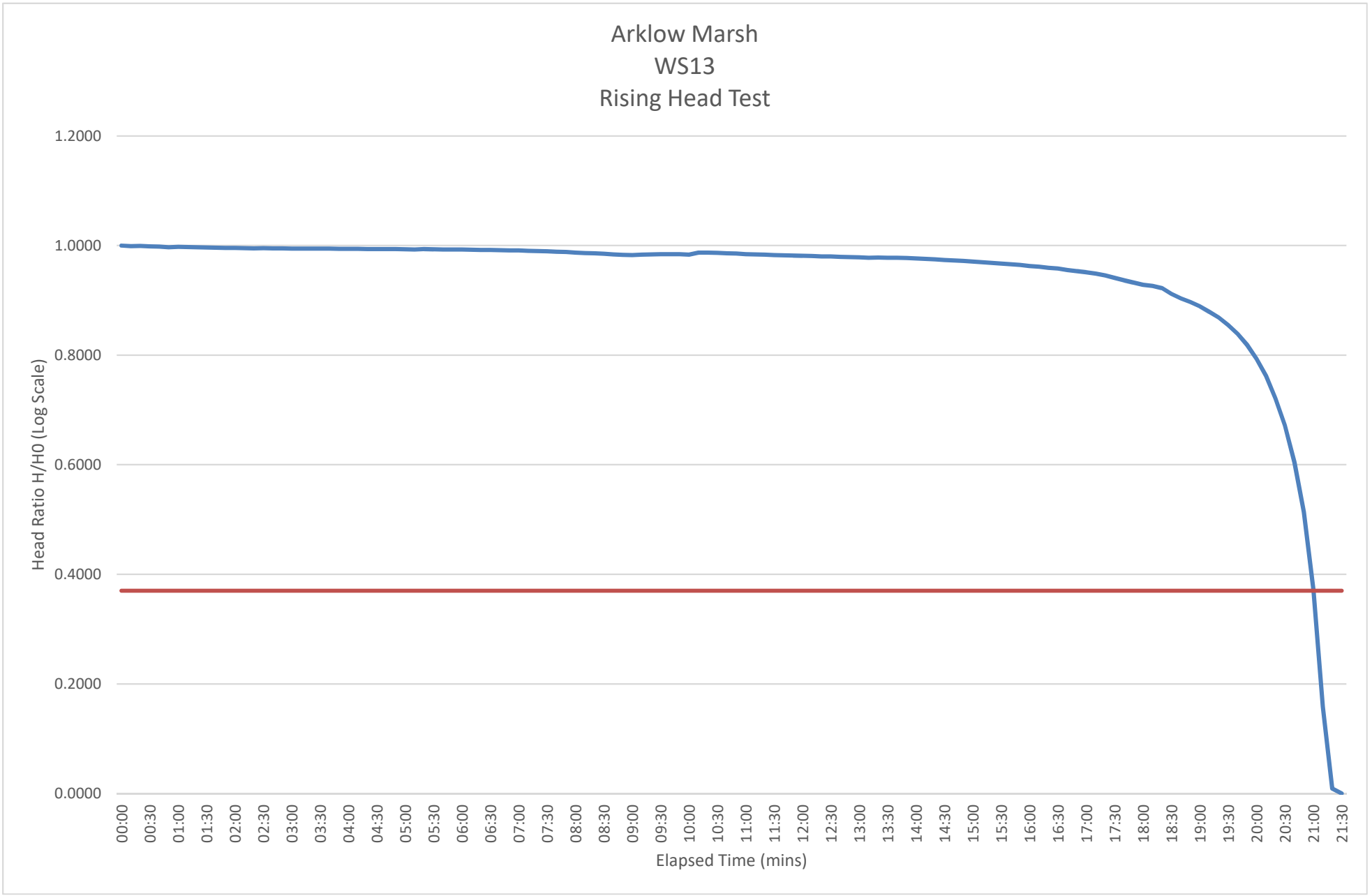
Basic Time Factor

Permeability

Note: Diameter of filter zone used in calculation of area in permeability calculation below;

k = A / (F x T) **2.20E-04** m/min

3.67E-06 m/sec


Arklow Marsh
WS13
Rising Head Test
Head Ratio H/H0 (Log Scale)
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0000
00:00
00:30
01:00
01:30
02:00
02:30
03:00
03:30
04:00
04:30
05:00
05:30
06:00
06:30
07:00
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11:00
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13:30
14:00
14:30
15:00
15:30
16:00
16:30
17:00
17:30
18:00
18:30
19:00
19:30
20:00
20:30
21:00
21:30
Elapsed Time (mins)

RISING HEAD TEST

Window Sample No.	**WS14**	**Job Name**	**Arklow Marsh**
Filter Zone		**Standpipe Details:**	
Depth from (m bgl)	1.00	Height above Ground Level	n/a
Depth to (m bgl)	3.00	Depth (m below top of SP)	n/a
Length of Filter (m)	2.00	Depth (mbgl)	n/a
Hole Diameter (m)	0.15	Diameter (m)	n/a
CSA of Filter Zone (m2)	0.018		
		Water Level Prior to Start of Test (Ws)	
		Metres below top of SP	n/a
Test No. Test 1		Metres (mOD)	0.6715

Ho
2.5986

Time (mins)	Water Level (W) Metres (mOD)	Head H (W-Ws)	H/H0
00:00	3.2701	2.5986	1.0000
00:10	3.2697	2.5982	0.9998
00:20	3.2699	2.5984	0.9999
00:30	3.2694	2.5979	0.9997
00:40	3.2691	2.5976	0.9996
00:50	3.2694	2.5979	0.9997
01:00	3.2685	2.5970	0.9994
01:10	3.2686	2.5971	0.9994
01:20	3.2683	2.5968	0.9993
01:30	3.2683	2.5968	0.9993
01:40	3.2677	2.5962	0.9991
01:50	3.2678	2.5963	0.9991
02:00	3.2669	2.5954	0.9988
02:10	3.2665	2.5950	0.9986
02:20	3.2664	2.5949	0.9986
02:30	3.2662	2.5947	0.9985
02:40	3.2652	2.5937	0.9981
02:50	3.2645	2.5930	0.9978
03:00	3.2635	2.5920	0.9975
03:10	3.263	2.5915	0.9973
03:20	3.2618	2.5903	0.9968
03:30	3.2603	2.5888	0.9962
03:40	3.2593	2.5878	0.9958
03:50	3.2582	2.5867	0.9954
04:00	3.2573	2.5858	0.9951
04:10	3.2557	2.5842	0.9945

Ho
2.5986

Time (mins)	Water Level (W) Metres (mOD)	Head H (W-Ws)	H/H0
04:20	3.2538	2.5823	0.9937
04:30	3.2523	2.5808	0.9932
04:40	3.2501	2.5786	0.9923
04:50	3.2482	2.5767	0.9916
05:00	3.2463	2.5748	0.9908
05:10	3.2442	2.5727	0.9900
05:20	3.2424	2.5709	0.9893
05:30	3.2397	2.5682	0.9883
05:40	3.229	2.5575	0.9842
05:50	3.2145	2.5430	0.9786
06:00	3.2063	2.5348	0.9754
06:10	3.1963	2.5248	0.9716
06:20	3.1864	2.5149	0.9678
06:30	3.1737	2.5022	0.9629
06:40	3.1889	2.5174	0.9688
06:50	3.1722	2.5007	0.9623
07:00	3.1525	2.4810	0.9547
07:10	3.1301	2.4586	0.9461
07:20	3.1062	2.4347	0.9369
07:30	3.0784	2.4069	0.9262
07:40	3.0486	2.3771	0.9148
07:50	3.0146	2.3431	0.9017
08:00	2.9772	2.3057	0.8873
08:10	2.9344	2.2629	0.8708
08:20	2.8864	2.2149	0.8523
08:30	2.8347	2.1632	0.8324
08:40	2.7798	2.1083	0.8113
08:50	2.7214	2.0499	0.7888
09:00	2.6569	1.9854	0.7640
09:10	2.5907	1.9192	0.7386
09:20	2.5214	1.8499	0.7119
09:30	2.4459	1.7744	0.6828
09:40	2.365	1.6935	0.6517
09:50	2.2716	1.6001	0.6158
10:00	2.1659	1.4944	0.5751
10:10	2.0794	1.4079	0.5418
10:20	1.9962	1.3247	0.5098
10:30	1.9073	1.2358	0.4756
10:40	1.8087	1.1372	0.4376
10:50	1.6964	1.0249	0.3944
11:00	1.5695	0.8980	0.3456
11:10	1.4252	0.7537	0.2900

Time	Water Level (W)	Head H	
(mins)	Metres (mOD)	(W-Ws)	H/H0
11:20	1.2613	0.5898	0.2270
11:30	1.089	0.4175	0.1607
11:40	0.8232	0.1517	0.0584
11:50	0.6715	0.0000	0.0000

Ho
2.5986

Intake Factor (F)

L	2.00	H/Ho	0.37
L/D	13.3	T (mins)	**10.9** at H/Ho = 0.37
F	3.83	from graph	

Intake Factor (F): Impervious bottom: BS5930 Case d) - Case b)

Case d) F = (2*Pi*L) / Ln (L/D + SQRT((1 + (L/D)*(L/D)))

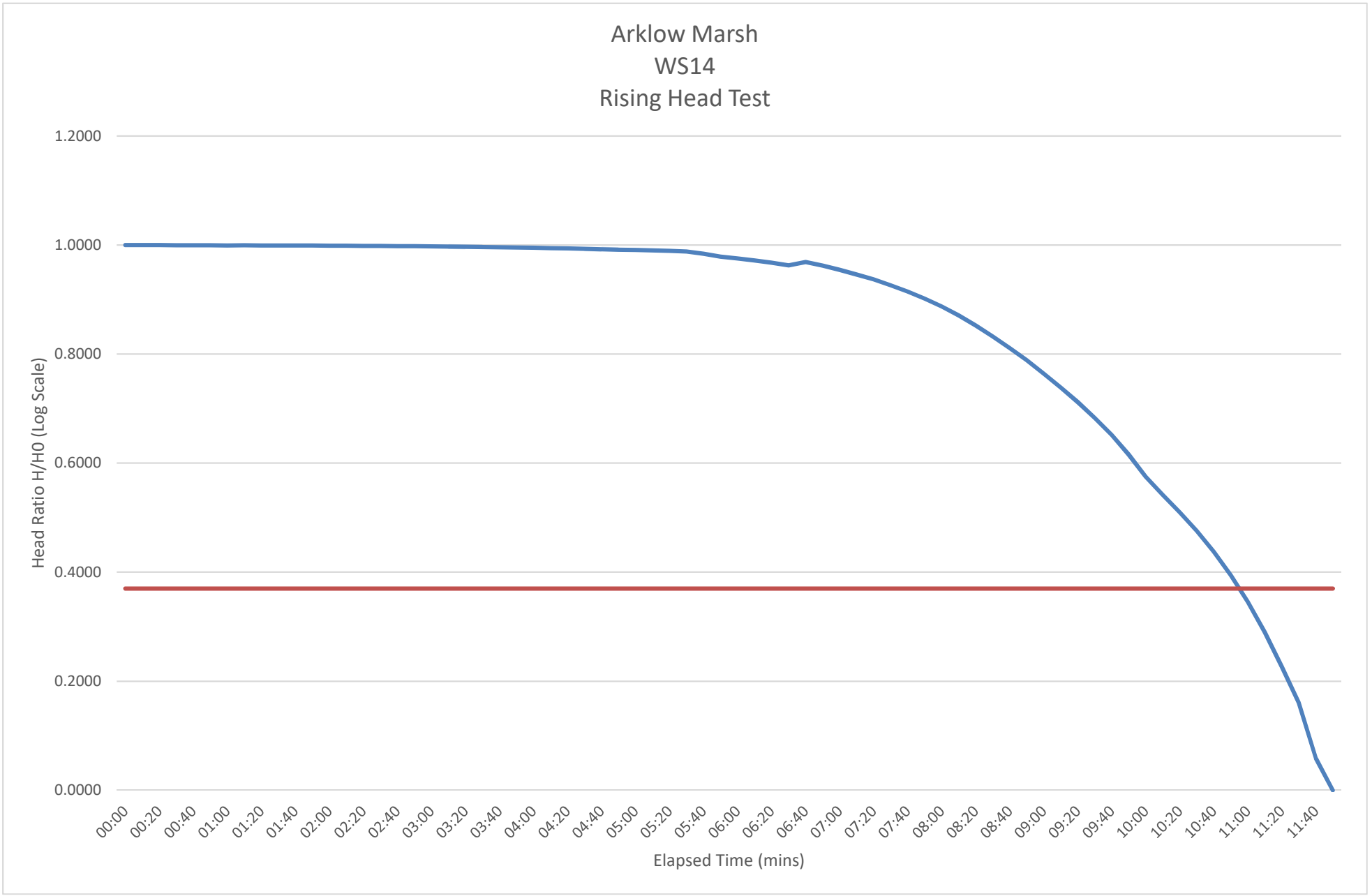
Basic Time Factor

Permeability

Note: Diameter of filter zone used in calculation of area in permeability calculation below;

k = A / (F x T) **4.24E-04** m/min

7.06E-06 m/sec


Arklow Marsh
WS14
Rising Head Test
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0000
Head Ratio H/H0 (Log Scale)
00:00
00:20
00:40
01:00
01:20
01:40
02:00
02:20
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03:40
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07:00
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07:40
08:00
08:20
08:40
09:00
09:20
09:40
10:00
10:20
10:40
11:00
11:20
11:40
Elapsed Time (mins)

Appendix 6 - Laboratory Testing

Element Materials Technology
Unit 3 Deeside Point
Zone 3
Deeside Industrial Park
Deeside
CH5 2UA

P: +44 (0) 1244 833780
F: +44 (0) 1244 833781
W: www.element.com

Ground Investigations Ireland
Catherinestown House
Hazelhatch Road
Newcastle
Co. Dublin
Ireland

Attention :	Stephen McLoughlan
Date :	22nd October, 2019
Your reference :	8975-08-19
Our reference :	Test Report 19/16601 Batch 1
Location :	Arklow Marsh
Date samples received :	10th October, 2019
Status :	Final report
Issue :	1

Five samples were received for analysis on 10th October, 2019 of which five were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Authorised By:

Bruce Leslie
Project Manager

Element Materials Technology

Client Name: Ground Investigations Ireland
Reference: 8975-08-19
Location: Arklow Marsh
Contact: Stephen McLoughlan
EMT Job No: 19/16601

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

EMT Sample No.	1	2	3	4	5							
Sample ID	WS05	WS09	WS11	WS12	WS14							
Depth	0.60-1.00	1.00-1.70	1.00-1.50	0.90-1.80	1.00-2.00							
COC No / misc												
Containers	T	T	T	T	T							
Sample Date	07/10/2019	07/10/2019	07/10/2019	07/10/2019	07/10/2019							
Sample Type	Soil	Soil	Soil	Soil	Soil							
Batch Number	1	1	1	1	1							
Date of Receipt	10/10/2019	10/10/2019	10/10/2019	10/10/2019	10/10/2019							
Organic Matter	9.6	11.6	17.1	16.9	19.1						<0.2	%	TM21/PM24

Please see attached notes for all abbreviations and acronyms

Client Name: Ground Investigations Ireland
Reference: 8975-08-19
Location: Arklow Marsh
Contact: Stephen McLoughlan

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Analysis	Reason
No deviating sample report results for job 19/16601						

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating.
Only analyses which are accredited are recorded as deviating if set criteria are not met.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

EMT Job No.: 19/16601

SOILS

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

Measurement Uncertainty

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
>>	Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher, this result is not accredited.
*	Analysis subcontracted to an Element Materials Technology approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

EMT Job No: 19/16601

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM21	Modified BS 7755-3:1995, ISO10694:1995 Determination of Total Organic Carbon or Total Carbon by combustion in an Eltra TOC furnace/analyser in the presence of oxygen. The CO2 generated is quantified using infra-red detection. Organic Matter (SOM) calculated as per EA MCERTS Chemical Testing of Soil, March 2012 v4.	PM24	Dried and ground solid samples are washed with hydrochloric acid, then rinsed with deionised water to remove the mineral carbon before TOC analysis.			AD	Yes

NMTL Ltd

Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5

Sieve Size mm	% Passing
125.000	100.0
75.000	100.0
63.000	100.0
50.000	100.0
37.500	100.0
28.000	100.0
20.000	100.0
14.000	100.0
10.000	99.5
6.300	97.7
5.000	96.6
3.350	94.9
2.000	89.6
1.180	75.1
0.600	37.8
0.425	25.5
0.300	18.3
0.212	14.5
0.150	12.2
0.063	8.6

Percentage Particle Size

Clay	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulder
		Silt			Sand			Gravel			
		8.6			81.0			10.4		0.0	0.0

Sample Description	Dark grey silty gravelly SAND.			Project No.	NMTL 3057
				BH/TP No.	WS02
Project	Arklow Marsh-Option 2		GII PROJECT ID: 8975-08-19	Sample No.	B
Operator Tzr	Checked Nc	Approved Bc	Date sample tested 16/10/2019	Depth	2.0-3.0m

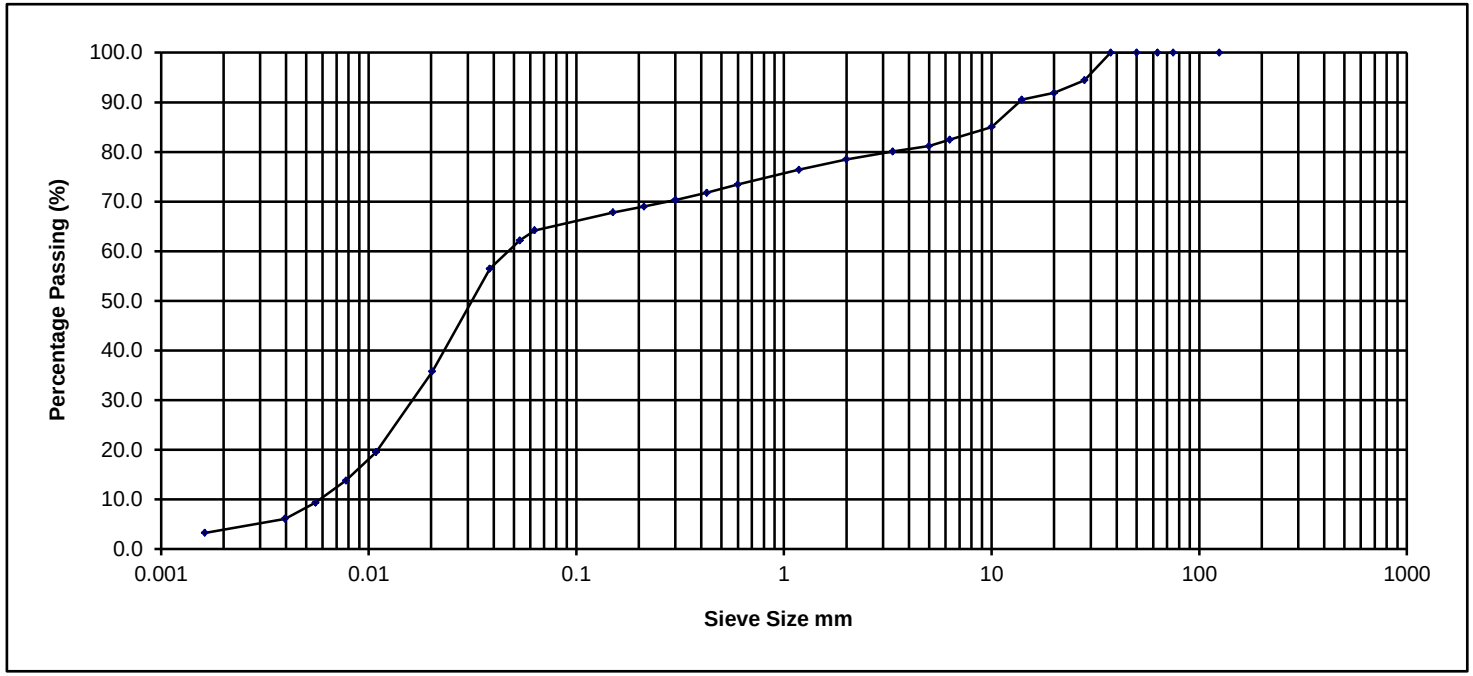
NMTL Ltd

NMTL Ltd

Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5

Sieve Size mm	% Passing
125.000	100.0
75.000	100.0
63.000	100.0
50.000	100.0
37.500	100.0
28.000	94.4
20.000	91.9
14.000	90.5
10.000	85.0
6.300	82.5
5.000	81.2
3.350	80.1
2.000	78.5
1.180	76.4
0.600	73.4
0.425	71.8
0.300	70.3
0.212	69.0
0.150	67.8
0.063	64.2
0.053	62.2
0.038	56.5
0.020	35.8
0.011	19.5
0.008	13.8
0.006	9.3
0.004	6.1
0.002	3.3



Percentage Particle Size

Clay	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulder
		Silt			Sand			Gravel			
3.3		61.0			14.3			21.5		0.0	0.0

Sample Description	Brown/green grey slightly sandy slightly gravelly clayey SILT.					Project No.	NMTL 3057
						BH/TP No.	WS04
Project	Arklow Marsh-Option 2				GII PROJECT ID: 8975-08-19	Sample No.	B
Operator	Tzr	Checked	Nc	Approved	Bc	Depth	0.90-1.50m
				Date sample tested	16/10/2019		

NMTL Ltd

Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5

Sieve Size mm	% Passing
125.000	100.0
75.000	100.0
63.000	100.0
50.000	100.0
37.500	100.0
28.000	100.0
20.000	97.9
14.000	97.9
10.000	97.9
6.300	97.3
5.000	97.2
3.350	96.8
2.000	96.1
1.180	93.3
0.600	84.5
0.425	79.5
0.300	69.1
0.212	53.4
0.150	36.3
0.063	16.7

Percentage Particle Size

Clay	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulder
		Silt			Sand			Gravel			
		16.7			79.4			3.9		0.0	0.0

Sample Description	Dark grey slightly gravelly silty SAND.					Project No.	NMTL 3057
						BH/TP No.	WS04
Project	Arklow Marsh-Option 2			GII PROJECT ID: 8975-08-19		Sample No.	B
Operator	Tzr	Checked	Nc	Approved	Bc	Date sample tested	16/10/2019	Depth	2.0-3.0m

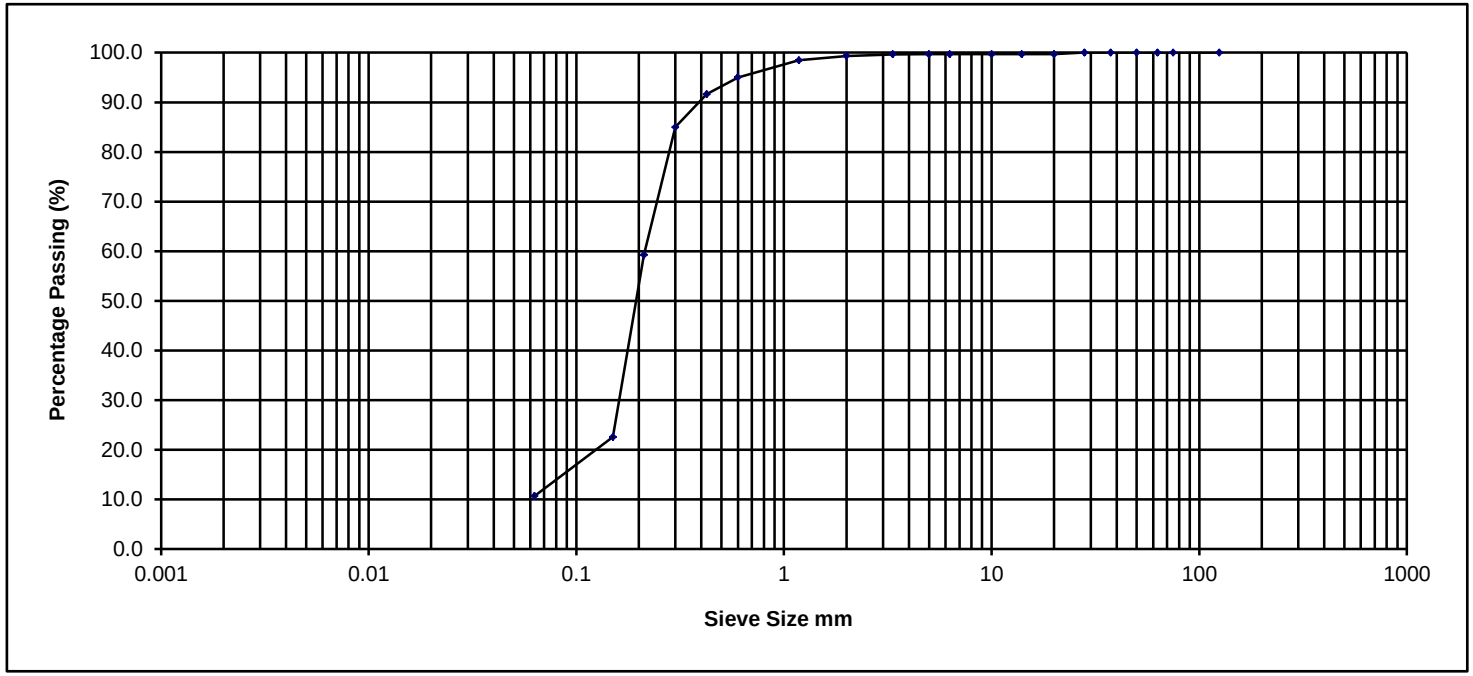
NM TL Ltd

NMTL Ltd

Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5

Sieve Size mm	% Passing
125.000	100.0
75.000	100.0
63.000	100.0
50.000	100.0
37.500	100.0
28.000	100.0
20.000	99.7
14.000	99.7
10.000	99.7
6.300	99.7
5.000	99.7
3.350	99.7
2.000	99.3
1.180	98.5
0.600	95.0
0.425	91.6
0.300	85.0
0.212	59.3
0.150	22.6
0.063	10.7



Percentage Particle Size

Clay	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulder
		Silt			Sand			Gravel			
		10.7			88.6			0.7		0.0	0.0

Sample Description	Dark grey silty SAND.					Project No.	NMTL 3057
						BH/TP No.	WS05
Project	Arklow Marsh-Option 2			GII PROJECT ID: 8975-08-19		Sample No.	B
Operator	Tzr	Checked	Nc	Approved	Bc	Date sample tested	16/10/2019	Depth	1.50-3.00m

NM TL Ltd

NMTL Ltd

Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5

Sieve Size mm	% Passing
125.000	100.0
75.000	100.0
63.000	100.0
50.000	100.0
37.500	100.0
28.000	100.0
20.000	100.0
14.000	100.0
10.000	100.0
6.300	100.0
5.000	99.4
3.350	99.2
2.000	98.2
1.180	96.3
0.600	92.9
0.425	90.8
0.300	86.6
0.212	69.8
0.150	48.0
0.063	25.6

Percentage Particle Size

Clay	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulder
		Silt			Sand			Gravel			
		25.6			72.6			1.8		0.0	0.0

Sample Description	Dark grey slightly gravell clayey/silty SAND.					Project No.	NMTL 3057
						BH/TP No.	WS07
Project	Arklow Marsh-Option 2			GII PROJECT ID: 8975-08-19		Sample No.	B
Operator	Tzr	Checked	Nc	Approved	Bc	Date sample tested	16/10/2019	Depth	2.0-3.0m

NM TL Ltd

NMTL Ltd

Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5

Sieve Size mm	% Passing
125.000	100.0
75.000	100.0
63.000	100.0
50.000	100.0
37.500	100.0
28.000	100.0
20.000	99.3
14.000	99.3
10.000	99.3
6.300	99.0
5.000	98.6
3.350	98.2
2.000	96.7
1.180	94.2
0.600	88.3
0.425	84.3
0.300	80.1
0.212	72.8
0.150	65.8
0.063	43.6
0.056	40.6
0.041	30.4
0.021	17.2
0.011	9.2
0.008	7.0
0.006	4.8
0.004	2.9
0.002	1.8

Percentage Particle Size

Clay	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulder
		Silt			Sand			Gravel			
1.8		41.7			53.1			3.3		0.0	0.0

Sample Description	Dark grey slightly gravelly silty SAND.					Project No.	NMTL 3057
						BH/TP No.	WS08
Project	Arklow Marsh-Option 2			GII PROJECT ID: 8975-08-19		Sample No.	B
Operator	Tzr	Checked	Nc	Approved	Bc	Date sample tested	17/10/2019
						Depth	1.0-1.70m

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Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5

Sieve Size mm	% Passing
125.000	100.0
75.000	100.0
63.000	100.0
50.000	100.0
37.500	100.0
28.000	100.0
20.000	100.0
14.000	100.0
10.000	100.0
6.300	100.0
5.000	100.0
3.350	99.8
2.000	99.8
1.180	99.5
0.600	98.9
0.425	98.2
0.300	93.2
0.212	50.3
0.150	6.0
0.063	0.9

Percentage Particle Size

Clay	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulder
		Silt			Sand			Gravel			
		0.9			98.9			0.2		0.0	0.0

Sample Description	Grey fine to coarse SAND.					Project No.	NMTL 3057
						BH/TP No.	WS08
Project	Arklow Marsh-Option 2			GII PROJECT ID: 8975-08-19		Sample No.	B
Operator	Tzr	Checked	Nc	Approved	Bc	Date sample tested	16/10/2019	Depth	2.0-3.0m

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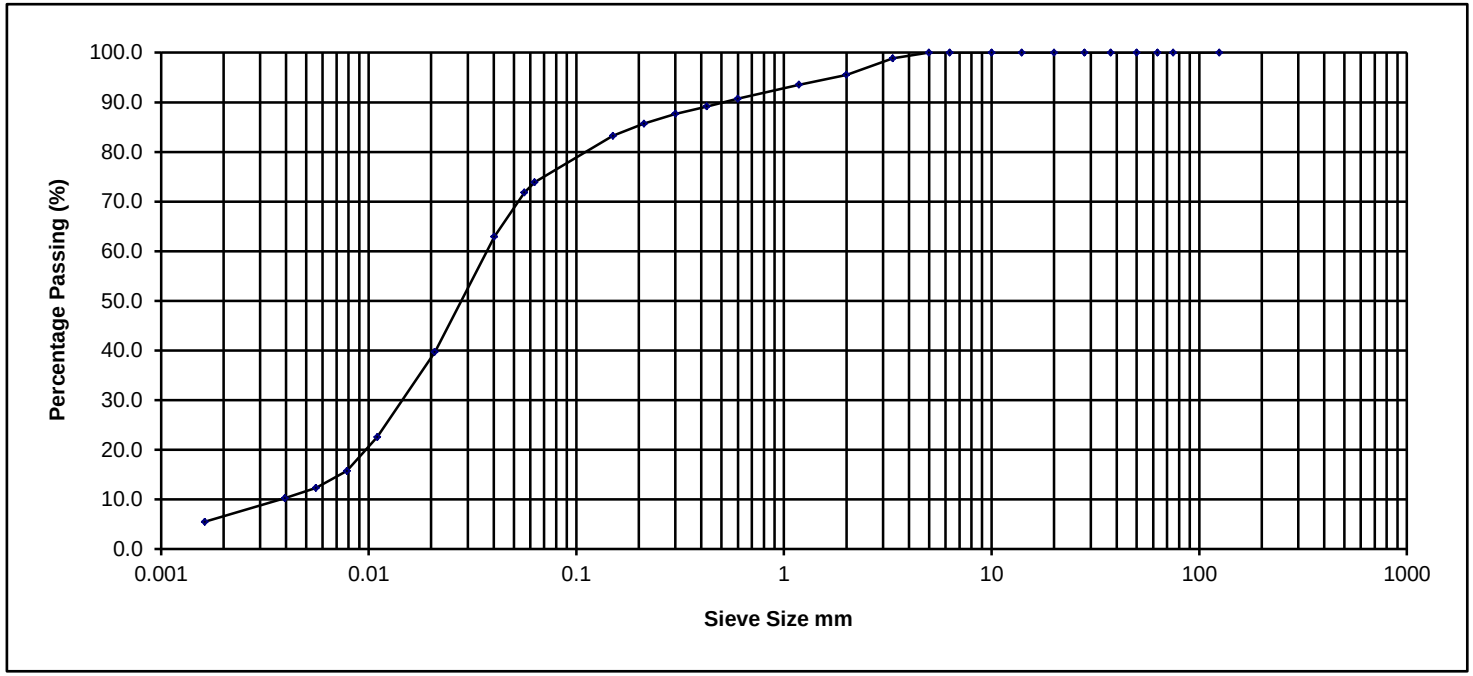
Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5

Sieve Size mm	% Passing
125.000	100.0
75.000	100.0
63.000	100.0
50.000	100.0
37.500	100.0
28.000	100.0
20.000	100.0
14.000	100.0
10.000	100.0
6.300	100.0
5.000	100.0
3.350	98.9
2.000	95.5
1.180	93.5
0.600	90.7
0.425	89.1
0.300	87.7
0.212	85.7
0.150	83.2
0.063	73.9
0.056	71.8
0.040	63.0
0.021	39.7
0.011	22.6
0.008	15.7
0.006	12.3
0.004	10.3
0.002	5.5



Percentage Particle Size

Clay	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulder
		Silt			Sand			Gravel			
5.5		68.4			21.6			4.5		0.0	0.0

Sample Description	Dark brown slightly gravelly slightly sandy clayey SILT.					Project No.	NMTL 3057
						BH/TP No.	WS09
Project	Arklow Marsh-Option 2			GII PROJECT ID: 8975-08-19		Sample No.	B
Operator	Tzr	Checked	Nc	Approved	Bc	Date sample tested	17/10/2019	Depth	1.0-1.70m

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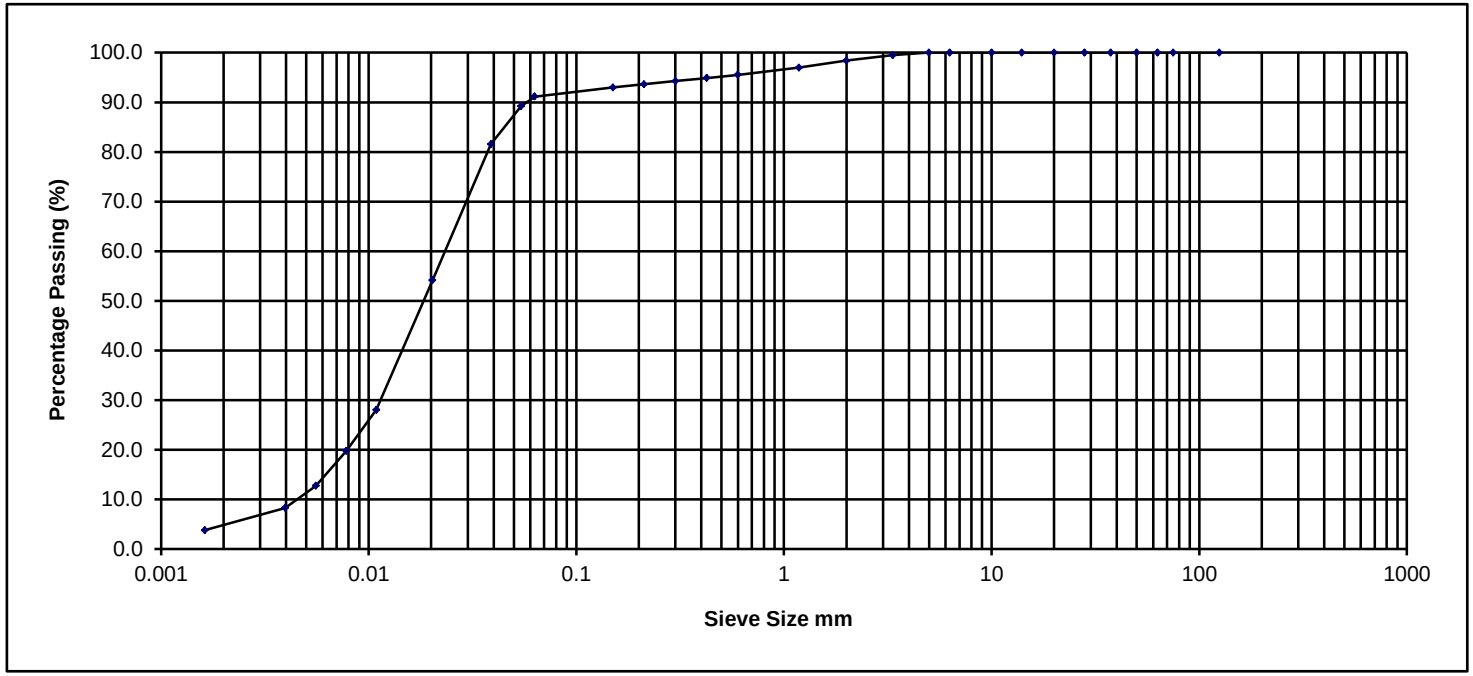
Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5

Sieve Size mm	% Passing
125.000	100.0
75.000	100.0
63.000	100.0
50.000	100.0
37.500	100.0
28.000	100.0
20.000	100.0
14.000	100.0
10.000	100.0
6.300	100.0
5.000	100.0
3.350	99.5
2.000	98.4
1.180	97.0
0.600	95.5
0.425	94.9
0.300	94.3
0.212	93.6
0.150	93.0
0.063	91.1
0.054	89.2
0.039	81.6
0.020	54.2
0.011	28.0
0.008	19.8
0.006	12.7
0.004	8.3
0.002	3.8



Percentage Particle Size

Clay	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulder
		Silt			Sand			Gravel			
3.8		87.3			7.3			1.6		0.0	0.0

Sample Description	Dark brown slightly gravelly sandy clayey SILT.					Project No.	NMTL 3057
						BH/TP No.	WS10
Project	Arklow Marsh-Option 2			GII PROJECT ID: 8975-08-19		Sample No.	B
Operator	Tzr	Checked	Nc	Approved	Bc	Date sample tested	17/10/2019	Depth	1.0-1.70m

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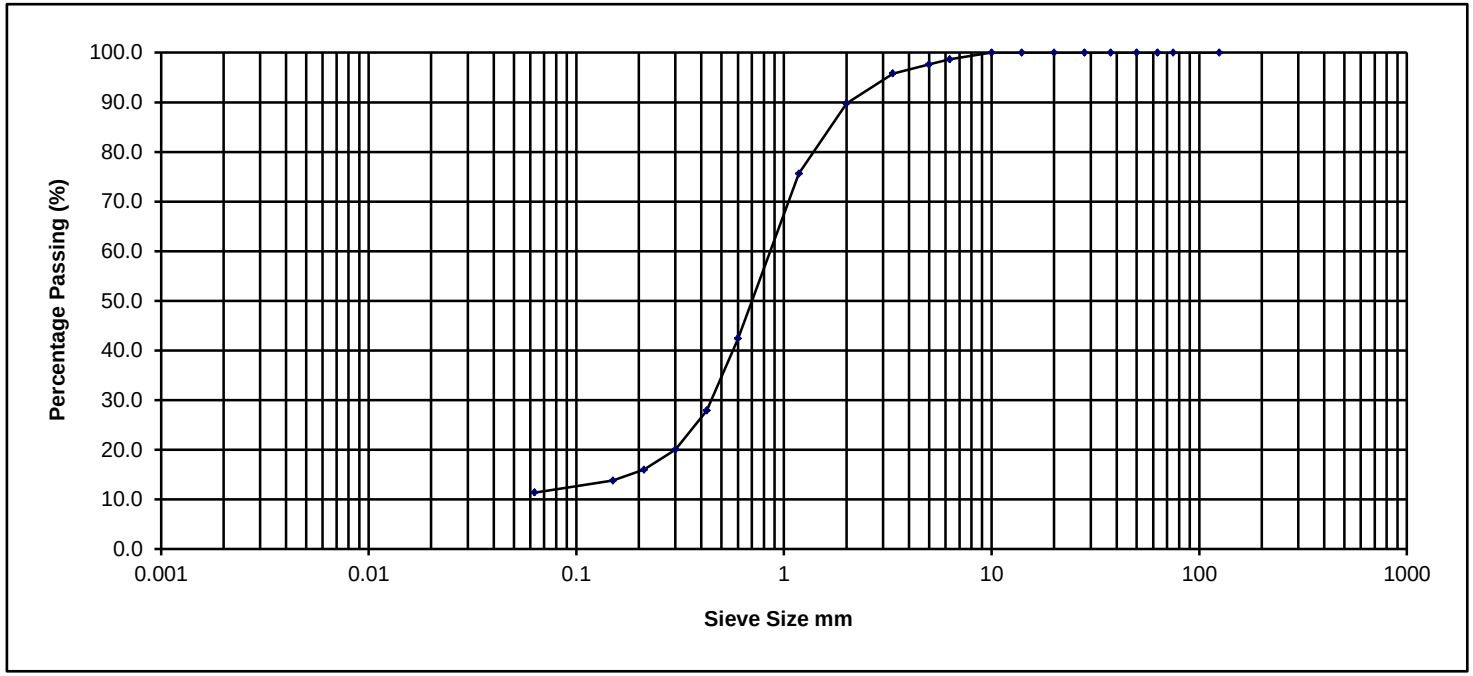
Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5

Sieve Size mm	% Passing
125.000	100.0
75.000	100.0
63.000	100.0
50.000	100.0
37.500	100.0
28.000	100.0
20.000	100.0
14.000	100.0
10.000	100.0
6.300	98.7
5.000	97.6
3.350	95.8
2.000	89.8
1.180	75.6
0.600	42.4
0.425	27.9
0.300	20.0
0.212	16.0
0.150	13.8
0.063	11.4



Percentage Particle Size

Clay	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulder
		Silt			Sand			Gravel			
		11.4			78.4			10.2		0.0	0.0

Sample Description	Dark grey slightly gravelly silty SAND.					Project No.	NMTL 3057
						BH/TP No.	WS10
Project	Arklow Marsh-Option 2			GII PROJECT ID: 8975-08-19		Sample No.	B
Operator	Tzr	Checked	Nc	Approved	Bc	Date sample tested	17/10/2019	Depth	2.0-3.0m

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Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5

Sieve Size mm	% Passing
125.000	100.0
75.000	100.0
63.000	100.0
50.000	100.0
37.500	100.0
28.000	100.0
20.000	100.0
14.000	100.0
10.000	100.0
6.300	99.8
5.000	99.7
3.350	99.4
2.000	98.2
1.180	94.4
0.600	78.5
0.425	65.8
0.300	50.9
0.212	37.5
0.150	26.0
0.063	13.2

Percentage Particle Size

Clay	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulder
		Silt			Sand			Gravel			
		13.2			85.0			1.8		0.0	0.0

Sample Description	Dark grey slightly gravelly silty CLAY.					Project No.	NMTL 3057
						BH/TP No.	WS12
Project	Arklow Marsh-Option 2			GII PROJECT ID: 8975-08-19		Sample No.	B
Operator	Tzr	Checked	Nc	Approved	Bc	Date sample tested	17/10/2019	Depth	2.0-3.0m

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Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5

Sieve Size mm	% Passing
125.000	100.0
75.000	100.0
63.000	100.0
50.000	100.0
37.500	100.0
28.000	100.0
20.000	100.0
14.000	100.0
10.000	100.0
6.300	100.0
5.000	100.0
3.350	99.8
2.000	99.2
1.180	98.7
0.600	98.0
0.425	97.5
0.300	96.9
0.212	95.7
0.150	90.3
0.063	69.6
0.056	66.0
0.040	57.5
0.021	38.2
0.011	21.2
0.008	15.1
0.006	10.9
0.004	7.3
0.002	3.6

Percentage Particle Size

Clay	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulder
		Silt			Sand			Gravel			
3.6		66.0			29.5			0.8		0.0	0.0

Sample Description	Brown/grey slightly sandy clayey SILT.					Project No.	NMTL 3057
						BH/TP No.	WS13
Project	Arklow Marsh-Option 2			GII PROJECT ID: 8975-08-19		Sample No.	B
Operator	Tzr	Checked	Nc	Approved	Bc	Depth	1.0-1.70m
				Date sample tested	17/10/2019		

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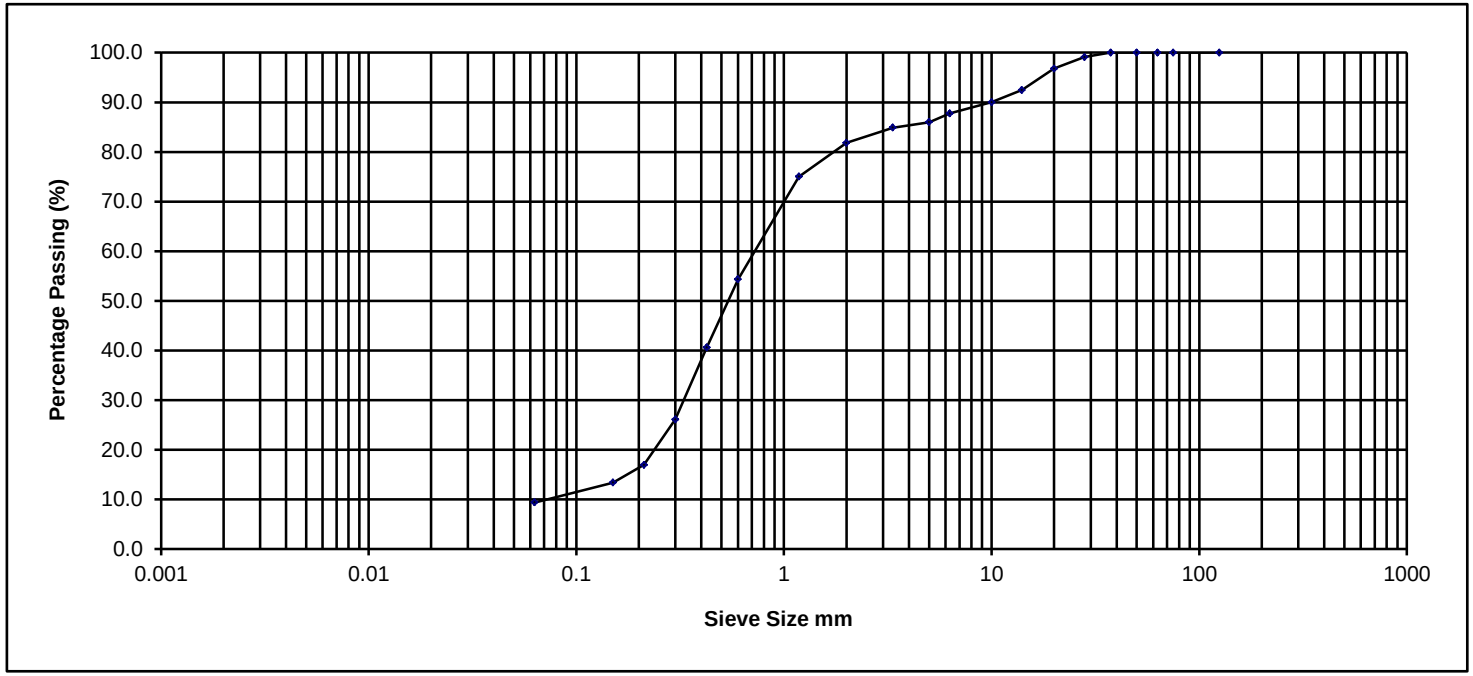
Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5

Sieve Size mm	% Passing
125.000	100.0
75.000	100.0
63.000	100.0
50.000	100.0
37.500	100.0
28.000	99.1
20.000	96.8
14.000	92.5
10.000	90.0
6.300	87.8
5.000	86.0
3.350	84.9
2.000	81.8
1.180	75.0
0.600	54.3
0.425	40.6
0.300	26.1
0.212	17.0
0.150	13.4
0.063	9.4



Percentage Particle Size

Clay	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulder
		Silt			Sand			Gravel			
		9.4			72.4			18.2		0.0	0.0

Sample Description	Dark grey silty gravell fine to coarse SAND.			Project No.	NMTL 3057
				BH/TP No.	WS13
Project	Arklow Marsh-Option 2		GII PROJECT ID: 8975-08-19	Sample No.	B
Operator Tzr	Checked Nc	Approved Bc	Date sample tested 17/10/2019	Depth	2.0-3.0m

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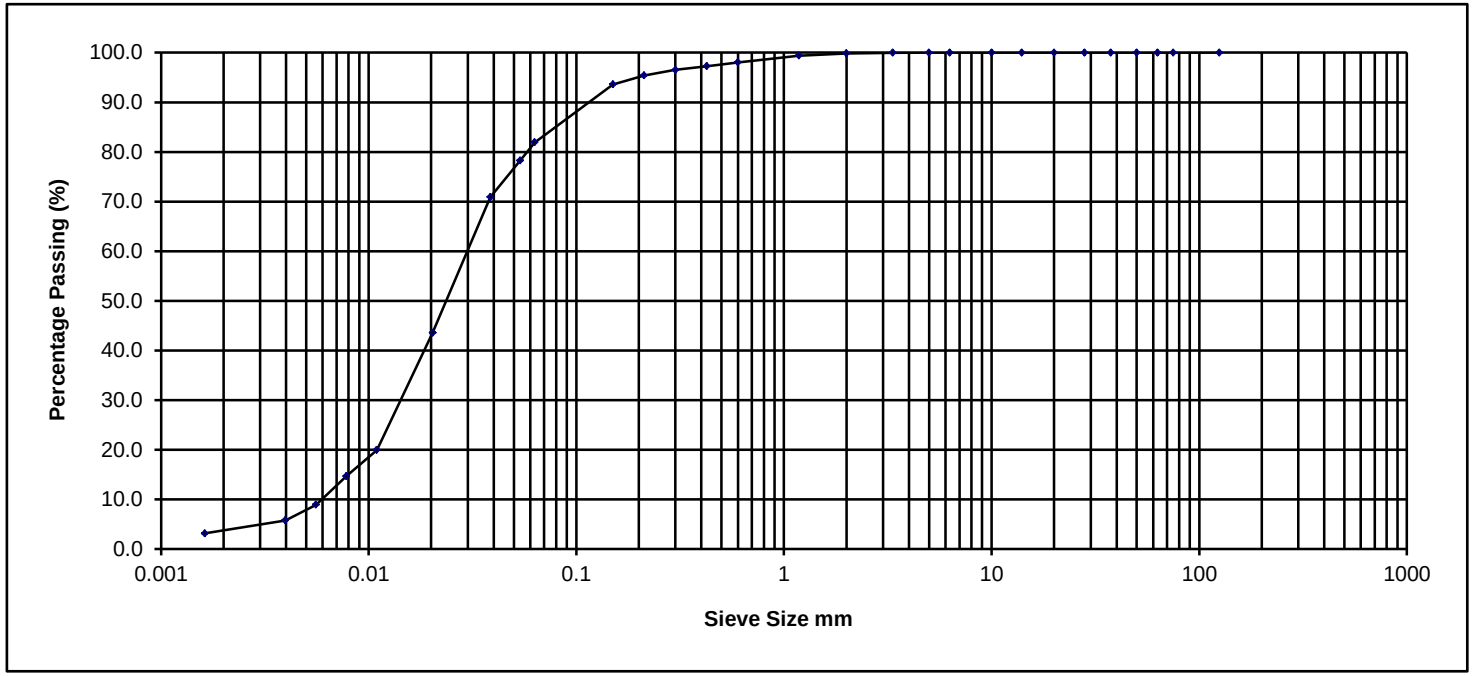
Determination of Particle Size Distribution

BS 1377 : 1990 : Part 2 : Clauses 9.2 & 9.5

Sieve Size mm	% Passing
125.000	100.0
75.000	100.0
63.000	100.0
50.000	100.0
37.500	100.0
28.000	100.0
20.000	100.0
14.000	100.0
10.000	100.0
6.300	100.0
5.000	100.0
3.350	100.0
2.000	99.8
1.180	99.4
0.600	98.0
0.425	97.3
0.300	96.5
0.212	95.4
0.150	93.6
0.063	81.9
0.054	78.2
0.039	70.9
0.020	43.6
0.011	20.0
0.008	14.7
0.006	8.9
0.004	5.8
0.002	3.2



Percentage Particle Size

Clay	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulder
		Silt			Sand			Gravel			
3.2		78.8			17.9			0.2		0.0	0.0

Sample Description	Brown and orange brown slightly sandy clayey SILT.					Project No.	NMTL 3057
						BH/TP No.	WS15
Project	Arklow Marsh-Option 2			GII PROJECT ID: 8975-08-19		Sample No.	B
Operator	Tzr	Checked	Nc	Approved	Bc	Date sample tested	17/10/2019	Depth	0.3-1.0m

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