

Appendix B. Installation of Shallow Monitoring Boreholes 2016

Your Ref:

Our Ref: JR.1964

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14th September 2016

E. & J. W. Glendinning Ltd.,
Glentor,
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DEVON. TQ13 7LF

For the attention of Mr. Barry Wilson

Dear Barry

Proposed Extension to Linhay Quarry
Monitoring Boreholes

Eleven groundwater monitoring standpipes were recently installed in boreholes drilled to the north and east of the proposed Linhay Quarry extension area (see Figure 1). The boreholes were drilled by ADS Drilling Limited between the 1st and 5th August 2016 using a combination of dynamic sampling, rotary coring and rotary open-hole methods. Selected boreholes were logged or monitored by Frederick Sherrell Limited and the results are appended to this letter.

The borehole details are summarised in Table 1 and briefly described in the paragraphs below.

1. **Ground Conditions**

1 – 1. The boreholes typically encountered a surface layer of topsoil approximately 0.4m thick, underlain by overburden soils typically comprising soft to firm brown gravelly clay with cobbles of limestone. Layers of orange-brown slightly clayey gravel and clayey fine sand were recorded in the top 1.2m in Boreholes AF2 and NE8 and traces of umber were recorded in Borehole AF1.

1 – 2. Limestone bedrock was encountered at depths between 2.5m and >19m below ground level (bedrock was not encountered in Boreholes AF1, AF3, AC2 and NE4). Core samples obtained from Borehole AF2 indicate that the intact limestone is slightly weathered and strong to very strong with close to medium spaced fractures. Clay-filled voids and fissures were recorded within the limestone bedrock at 6.2 – 7.0m (AF2), 11.0 – 12.0m (NE6), 9.9 – 10.2m (NE8) and 12.5 – 13.0m (NE8).

Directors:

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1 – 3. The presence of limestone boulders and/or highly fractured limestone with clay pockets was interpreted in Borehole AC2 below 12.5m and in AC3 between 7.0 and 8.5m.

1 – 4. No evidence of groundwater was recorded during drilling of the boreholes and initial monitoring of standpipes on the 5th August 2016 indicated that all the boreholes were dry to the base of the standpipes. (Note : standpipes had not yet been fully installed in Boreholes AF2, AC2 and AC3 at the time of monitoring.)

2. Conclusions

2 – 1. The results of the monitoring borehole investigation have been used to update the plan of interpreted rockhead contours that was included within the Land Stability Risk Assessment report. The updated plan is attached (see Figure 3A).

2 – 2. The monitoring boreholes indicate the following :

- i. evidence of probable solution features within the upper levels of the limestone bedrock at some locations, including infilled voids and fissures
- ii. confirmation of the presence of limestone bedrock at shallow depth to the south-west of Caton village (Borehole NE5)
- iii. confirmation of significant thicknesses of overburden soil to the north-west of Caton village (Boreholes NE6 - 8)
- iv. evidence of deep solution weathering approximately 70m west of Caton Cross (Borehole NE4).
The extent of this zone is not known but it could potentially extend northwards beneath properties within Caton village.
- v. limestone bedrock at approximately 8m depth to the north and south of Alston Cottage (Boreholes AC1 and AC3)
- vi. extensive thickness of soil (>10m) in the vicinity of Alston Farm (Boreholes AF1 and AF3) and to the south-west of Alston Cottage (Borehole AC2)

We trust these notes are sufficient for your present purposes. If you have any queries or require any further information please do not hesitate to contact us.

Yours sincerely
for Frederick Sherrell Ltd

A handwritten signature in black ink, appearing to read 'J Rickeard', with a long, sweeping horizontal stroke extending to the right.

Jeremy Rickeard

Encl. :

Table 1

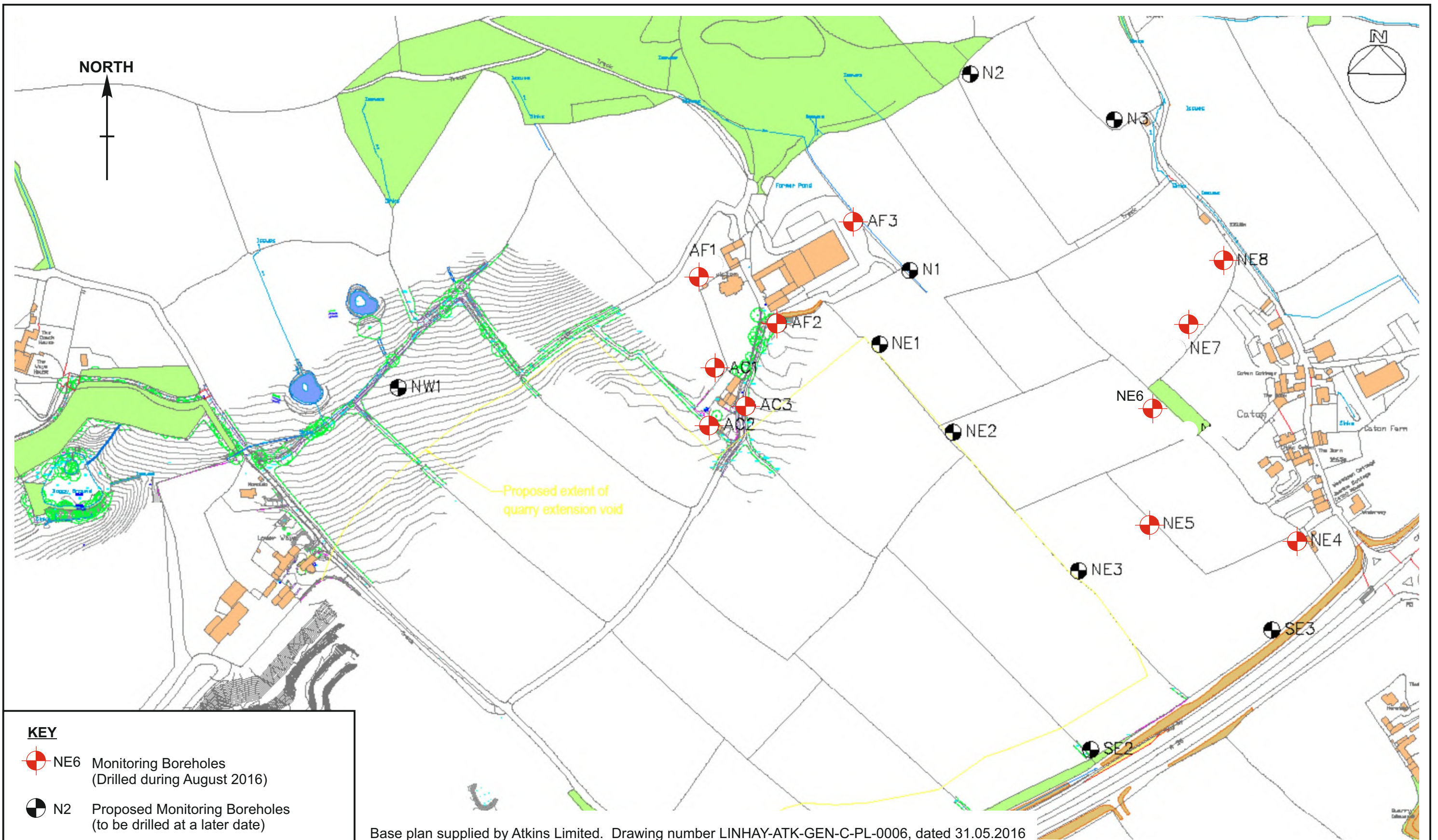
Figures 1 and 3A

Borehole Records : AF1, AF2, AF3, AC1, AC2, NE7, NE8

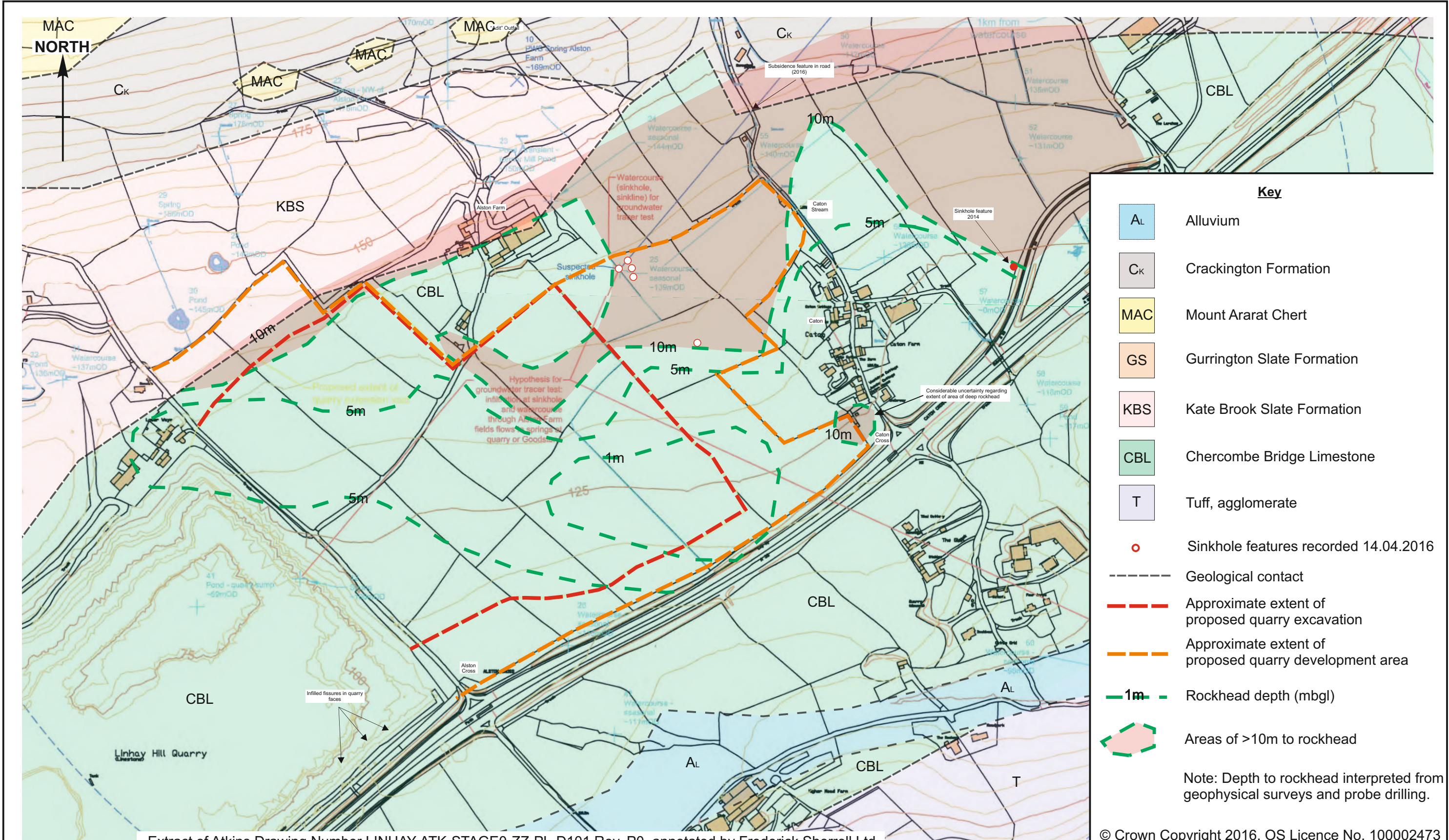
Borehole No.	Total Depth (m bgl)	Depth to Rockhead (m bgl)	Trial Pit Excavated	Open Hole Drilling (m)	Dynamic Sampling (m)	Rotary Coring (m)	Standpipe Depth (m)	Standpipe Diameter (mm)	5/8/2106 Groundwater monitoring (m)
AF1	18	10.5	No	10.5-18.0	GL - 10.5	-	16 (6m slotted)	19	Depth: 14.2m BH : Dry
AF2	8.5	6	No	-	GL - 6.0	6.0 - 8.5	8.5 (3m slotted)	19	
AF3	17.5	None	No	GL - 17.5	-	-	17 6m slotted	19	Depth: 16.58m BH : Damp
AC1	11	8	No	GL - 11.0	-	-	11 (6m slotted)	19	Depth: 10.4m BH : Dry
AC2	16	None	No	GL - 16.0	-	-	12 (6m slotted)	50	
AC3	11.5	8.5	No	GL - 11.5	-	-	11.5 (6m slotted)	19	
NE4	19	None	Yes	19	-	-	17 (6m slotted)	19	Depth: 17.3m BH : Damp
NE5	6	6	Yes	1.0 - 6.0	-	-	6 (3m slotted)	19	Depth: 5.56m BH : Damp
NE6	14	11	Yes	1.0 - 14	-	-	12 (6m slotted)	50	Depth: 12.5m BH : Damp
NE7	17.5	16	Yes	1.0 - 17.5	-	-	17.5 (6m slotted)	19	Depth: 16.88m BH : Damp
NE8	13	10	Yes	1.0 - 13.0	-	-	13 (6m slotted)	19	Depth: 12.5m BH : Dry

All boreholes have standpipes installed to full depth. Standpipes are slotted in bottom 3m to 6m with remainder plain pipe. Proud steel covers installed, set in concrete extending to 1.0m depth with bentonite seal from 1.0 - 2.0m depth and gravel surround from 2.0m to base of hole.

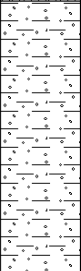
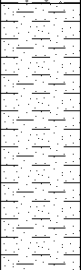
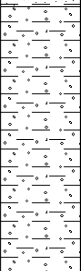
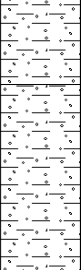
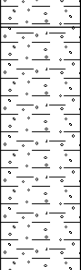
Wooden fence erected around each borehole.

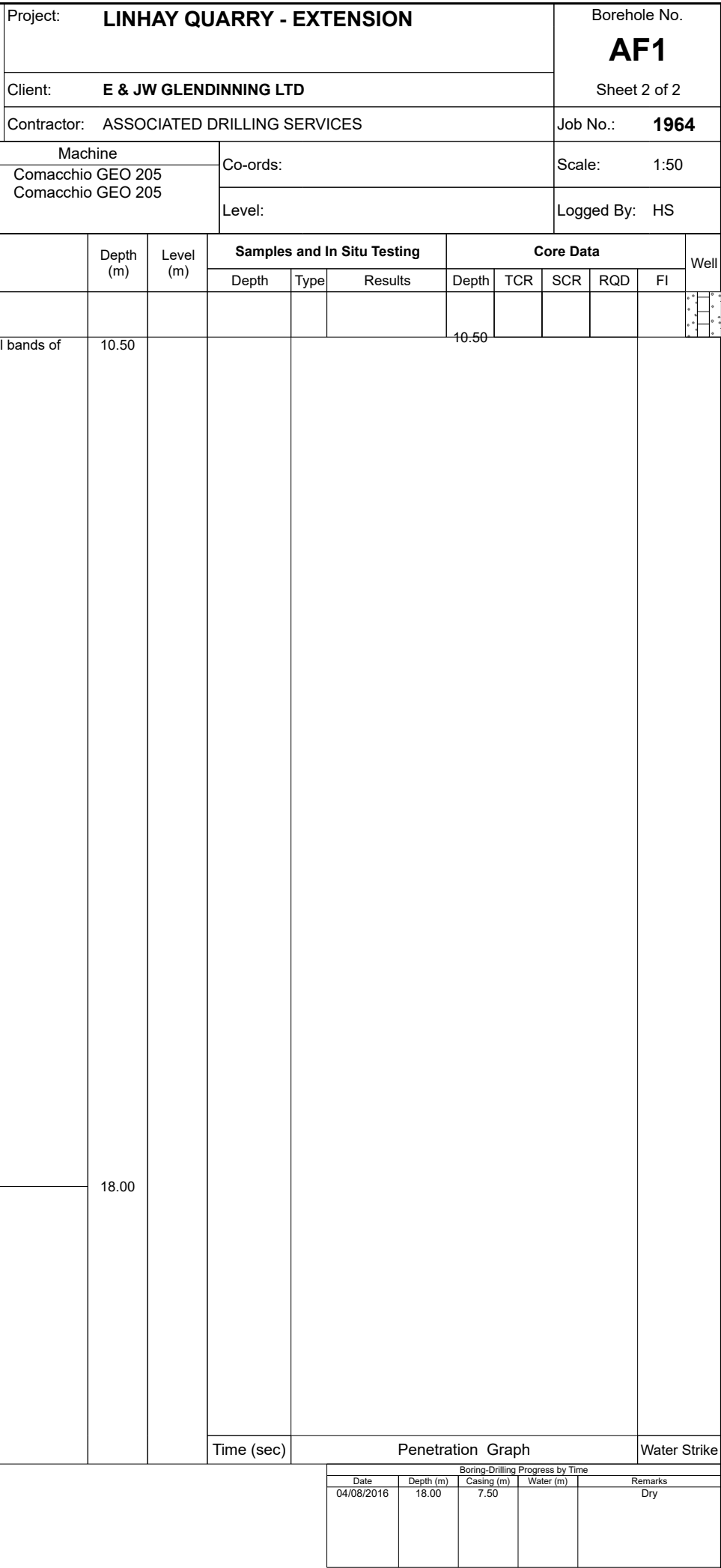


Title	LINHAY QUARRY EXTENSION - WATER MONITORING				Approximate Scale 1:2500@A3		Drawing No. Figure 1	
	BOREHOLE MONITORING PLAN				Drawn HS	Checked JR	Date Aug. 2016	Job Ref. 1964
Client	E & JW GLENDINNING LTD				FREDERICK SHERRELL LTD CONSULTING ENGINEERING GEOLOGISTS AND GEOTECHNICAL ENGINEERS			



Title	LINHAY QUARRY LAND STABILITY RISK ASSESSMENT SITE PLAN SHOWING INTERPRETED ROCKHEAD CONTOURS (UPDATED SEPTEMBER 2016)				Approximate Scale 1:5000@A3		Drawing No. FIGURE 3A	
					Drawn TF	Checked JR	Date Sep. 2016	Job Ref. 1964/F
Client	E. AND J.W GLENDINNING LTD						FREDERICK SHERRELL LTD CONSULTING ENGINEERING GEOLOGISTS AND GEOTECHNICAL ENGINEERS	

 GEOTECHNICAL FSL GEOTECHNICAL FREDERICK SHERRELL LTD				Project: LINHAY QUARRY - EXTENSION				Borehole No. AF1				
				Client: E & JW GLENDINNING LTD				Sheet 1 of 2				
				Contractor: ASSOCIATED DRILLING SERVICES				Job No.: 1964				
Top (m)	Base (m)	Method	Diameter	Machine		Co-ords:		Scale:		1:50		
0.00	10.50	DS	90mm	Comacchio GEO 205								
10.50	18.00	RO	114mm	Comacchio GEO 205		Level:		Logged By:		HS		
Legend	Stratum Description	Depth (m)	Level (m)	Samples and In Situ Testing			Core Data					Well
				Depth	Type	Results	Depth	TCR	SCR	RQD	FI	
	Brown, slightly silty, sandy CLAY with frequent rootlets (TOPSOIL).	0.40					0.00					
	Soft to firm orangish brown, slightly sandy, slightly gravelly CLAY with dark brown umber deposits.						100					
	Soft to firm, pale orangish brown, sandy CLAY with rare cobbles of limestone.	2.20					1.50					
							100					
	Soft dark orangish brown, slightly gravelly CLAY with flecks of red and black gravel.	4.00					3.00					
							100					
	Soft pale orangish brown, slightly sandy, slightly gravelly CLAY with rare cobbles of limestone.	6.30					4.50					
							100					
	Soft dark orangish brown, slightly sandy, slightly gravelly CLAY with rare cobbles of limestone.	7.70					6.00					
							100					
							7.50					
							100					
							9.00					
							100					
Remarks:						Boring-Drilling Progress by Time						
Groundwater not encountered. 19mm diameter standpipe installed to 16.0m.						Date	Depth (m)	Casing (m)	Water (m)	Remarks		
						04/08/2016	18.00	7.50		Dry		



				Project: LINHAY QUARRY - EXTENSION				Borehole No. AF2				
				Client: E & JW GLENDINNING LTD				Sheet 1 of 1				
				Contractor: ASSOCIATED DRILLING SERVICES				Job No.: 1964				
Top (m)	Base (m)	Method	Diameter	Machine			Co-ords:		Scale: 1:50			
0.00 6.00	6.00 8.50	DS RC	90mm 90mm	Comacchio GEO 205 Comacchio GEO 205					Logged By: HS			
Legend	Stratum Description	Depth (m)	Level (m)	Samples and In Situ Testing			Core Data					Well
				Depth	Type	Results	Depth	TCR	SCR	RQD	FI	
	Brown, slightly silty, slightly sandy, gravelly CLAY with frequent rootlets (TOPSOIL).	0.40					0.00					
	Orangish brown, slightly clayey, angular to sub-angular, fine to coarse GRAVEL of limestone.						100					
	Firm, dark orangish brown, slightly gravelly CLAY with occasional cobbles of limestone.	1.20					1.50					
	Soft to firm, mid brown to dark brown, slightly gravelly CLAY.	3.00					3.00					
	3.50m: with rare rootlets.						4.50					
	5.5m: becoming soft.						100					
	Strong to very strong grey LIMESTONE. Slightly weathered. Bedding fractures close to medium spaced, dip 20° to 40° stepped and rough. Joint fractures are stepped and rough, strike perpendicular to bedding. 6.2m - 7.0m: no core recovery (driller records "clay void").	6.00					6.00					
		8.50					7.30					
							92	50	50	4		
	End of Borehole at 8.50m						8.50					
Remarks: Groundwater not encountered. 19mm diameter standpipe installed to 8.5m.							Boring-Drilling Progress by Time					
							Date	Depth (m)	Casing (m)	Water (m)	Remarks	
							05/08/2016	8.50	6.00		Dry	

Depth (m)	Time (s)	Comments
0.0 - 0.5		
0.5 - 1.0		
1.0 - 1.5	20	Brown clay.
1.5 - 2.0	10	
2.0 - 2.5	9	
2.5 - 3.0	16	
3.0 - 3.5	21	No dust returns. Irregular hammering.
3.5 - 4.0	22	
4.0 - 4.5	50	
4.5 - 5.0	10	
5.0 - 5.5	14	
5.5 - 6.0	11	
6.0 - 6.5	92	Limestone boulder
6.5 - 7.0	10	Soft brown clay
7.0 - 7.5	25	
7.5 - 8.0	94	
8.0 - 8.5	127	
8.5 - 9.0	117	Grey limestone. Rockhead at 8.0m. Steady drilling
9.0 - 9.5	92	
9.5 - 10.0	93	
10.0 - 10.5	141	
10.5 - 11.0	86	
11.0 - 11.5		
11.5 - 12.0		
12.0 - 12.5		
12.5 - 13.0		
13.0 - 13.5		
13.5 - 14.0		
14.0 - 14.5		
14.5 - 15.0		
15.0 - 15.5		
15.5 - 16.0		
16.0 - 16.5		
16.5 - 17.0		
17.0 - 17.5		
17.5 - 18.0		
18.0 - 18.5		
18.5 - 19.0		
19.0 - 19.5		
19.5 - 20.0		

BOREHOLE NO.	AC1
DATE	03/08/2016
DRILLING RIG	Comacchio Geo 205
CONTRACTOR	ADS
NOTES	Borehole dry. 19mm diameter standpipe installed to 11m depth.

Depth (m)	Time (s)	Comments
0.0 - 0.5		
0.5 - 1.0		
1.0 - 1.5	38	Reddish-brown dust. Irregular hammering. Probable clay with cobbles of limestone.
1.5 - 2.0	38	
2.0 - 2.5	66	
2.5 - 3.0	103	
3.0 - 3.5	91	
3.5 - 4.0	64	No dust returns. Irregular hammering. Probable clay with cobbles of limestone.
4.0 - 4.5	74	
4.5 - 5.0	75	
5.0 - 5.5	87	
5.5 - 6.0	81	
6.0 - 6.5	158	
6.5 - 7.0	145	
7.0 - 7.5	96	
7.5 - 8.0	23	
8.0 - 8.5	13	
8.5 - 9.0	13	
9.0 - 9.5	14	
9.5 - 10.0	12	No dust returns. No hammering
10.0 - 10.5	12	
10.5 - 11.0	38	
11.0 - 11.5	22	
11.5 - 12.0	24	
12.0 - 12.5	42	
12.5 - 13.0	178	Unsteady drilling with irregular hammering and no dust returns. Probably clay with limestone boulders or fractured limestone with clay bands/pockets (driller records limestone below 12m).
13.0 - 13.5	222	
13.5 - 14.0	184	
14.0 - 14.5	94	
14.5 - 15.0	90	
15.0 - 15.5	186	
15.5 - 16.0	196	
16.0 - 16.5		
16.5 - 17.0		
17.0 - 17.5		
17.5 - 18.0		
18.0 - 18.5		
18.5 - 19.0		
19.0 - 19.5		
19.5 - 20.0		

BOREHOLE NO.	AC2
DATE	03/08/2016
DRILLING RIG	Comacchio Geo 205
CONTRACTOR	ADS
NOTES	Borehole dry. 19mm diameter standpipe installed to 11m depth.

Depth (m)	Time (s)	Comments
0.0 - 0.5		0.0 - 10.0m : driller records soft brown clay with occasional bands of gravel.
0.5 - 1.0		
1.0 - 1.5		
1.5 - 2.0		
2.0 - 2.5		
2.5 - 3.0		
3.0 - 3.5		
3.5 - 4.0		
4.0 - 4.5		
4.5 - 5.0		
5.0 - 5.5		
5.5 - 6.0		
6.0 - 6.5		
6.5 - 7.0		
7.0 - 7.5		
7.5 - 8.0		
8.0 - 8.5		
8.5 - 9.0		
9.0 - 9.5		
9.5 - 10.0		
10.0 - 10.5	30	Brown flush returns. No hammering.
10.5 - 11.0	7	
11.0 - 11.5	13	
11.5 - 12.0	33	No dust returns. Irregular hammering.
12.0 - 12.5	14	
12.5 - 13.0	7	No dust returns. No hammering.
13.0 - 13.5	5	
13.5 - 14.0	6	
14.0 - 14.5	5	
14.5 - 15.0	7	
15.0 - 15.5	7	
15.5 - 16.0	7	
16.0 - 16.5	8	
16.5 - 17.0	9	
17.0 - 17.5	9	
17.5 - 18.0		
18.0 - 18.5		
18.5 - 19.0		
19.0 - 19.5		
19.5 - 20.0		

BOREHOLE NO.	AF3
DATE	03/08/2016
DRILLING RIG	Comacchio Geo 205
CONTRACTOR	ADS
NOTES	Bedrock not encountered. Borehole dry. 19mm diameter standpipe installed to 17m depth.

Depth (m)	Time (s)	Comments
0.0 - 0.5		
0.5 - 1.0		
1.0 - 1.5	27	Reddish-brown dust. Irregular hammering. (Clay with occasional limestone gravel)
1.5 - 2.0	10	
2.0 - 2.5	14	
2.5 - 3.0	19	
3.0 - 3.5	20	
3.5 - 4.0	8	
4.0 - 4.5	4	
4.5 - 5.0	8	
5.0 - 5.5	8	
5.5 - 6.0	8	
6.0 - 6.5	8	
6.5 - 7.0	6	
7.0 - 7.5	6	
7.5 - 8.0	9	
8.0 - 8.5	7	No dust. Little resistance.
8.5 - 9.0	7	
9.0 - 9.5	4	
9.5 - 10.0	7	
10.0 - 10.5	7	
10.5 - 11.0	7	
11.0 - 11.5	8	
11.5 - 12.0	8	
12.0 - 12.5	23	
12.5 - 13.0	107	Possible limestone rockhead at 12.5m. Slightly irregular hammering.
13.0 - 13.5	143	
13.5 - 14.0	171	
14.0 - 14.5	132	
14.5 - 15.0	149	
15.0 - 15.5	188	Grey dust with limestone chippings. Regular hammering below 16m.
15.5 - 16.0	202	
16.0 - 16.5	339	
16.5 - 17.0	187	
17.0 - 17.5	126	
17.5 - 18.0		
18.0 - 18.5		
18.5 - 19.0		
19.0 - 19.5		
19.5 - 20.0		

BOREHOLE NO.	NE7
DATE	01/08/2016
DRILLING RIG	Comacchio Geo 205
CONTRACTOR	ADS
NOTES	Borehole dry. 19mm diameter standpipe installed to 17.5m depth.

Depth (m)	Time (s)	Comments
0.0 - 0.5		Inspection Pit : Pale brown gravelly clayey fine sand.
0.5 - 1.0		
1.0 - 1.5	34	Brown clayey dust. Irregular hammering.
1.5 - 2.0	79	
2.0 - 2.5	87	
2.5 - 3.0	52	No dust. Irregular hammering.
3.0 - 3.5	110	
3.5 - 4.0	180	
4.0 - 4.5	60	Occasional grey-brown clay returns. Very little hammering.
4.5 - 5.0	57	
5.0 - 5.5	83	
5.5 - 6.0	73	
6.0 - 6.5	78	
6.5 - 7.0	82	
7.0 - 7.5	70	
7.5 - 8.0	50	
8.0 - 8.5	80	
8.5 - 9.0	170	
9.0 - 9.5	168	No dust. Regular hammering. Probable rockhead.
9.5 - 10.0	97	
10.0 - 10.5	34	
10.5 - 11.0	135	
11.0 - 11.5	136	
11.5 - 12.0	85	Reddish-grey dust and chippings of limestone.
12.0 - 12.5	83	
12.5 - 13.0	27	12.5 - 13.0m : possible fissure.
13.0 - 13.5		
13.5 - 14.0		
14.0 - 14.5		
14.5 - 15.0		
15.0 - 15.5		
15.5 - 16.0		
16.0 - 16.5		
16.5 - 17.0		
17.0 - 17.5		
17.5 - 18.0		
18.0 - 18.5		
18.5 - 19.0		
19.0 - 19.5		
19.5 - 20.0		

BOREHOLE NO.	NE8
DATE	01/08/2016
DRILLING RIG	Comacchio Geo 205
CONTRACTOR	ADS
NOTES	Borehole dry. 19mm diameter standpipe installed to 13m depth.



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