

**PROPOSED RESIDENTIAL DEVELOPMENT
ON LAND ADJACENT TO ROMNEY AVENUE
FOLKESTONE
KENT, CT20 3QJ**

CONSTRUCTION STABILITY ASSESSMENT

**FOR
VILLAGE HOMES FOLKESTONE LTD**

31st July 2019

Report no: 3066 Stability

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1 Introduction and Brief

This report has been prepared for Village Homes Folkestone Ltd to assess Slope Stability and safe methods of working to provide guidance on the methods required for the safe construction of the proposed residential development on land adjacent to Romney Avenue, Folkestone, Kent, CT20 3QJ. Specifically, the report addresses the concerns of the local authority that *'Insufficient information has been submitted to demonstrate that the site can be developed safely without causing land instability issues. In addition, insufficient information has been submitted to detail the impact of any necessary engineering solutions upon the character of the area including the possible removal of all trees and the impact this may have on ecology. As such, the proposal is contrary to policies BE19 of the Shepway Local Plan (2006), emerging policy NE6 of the Places and Policies Local Plan (2018) and the NPPF which require that investigation and analysis is undertaken, which clearly demonstrates that the site can be safely developed and policies SD1 of the Local Plan Review which seeks proposals to maintain and improve the character and vitality of the built environment and protect and enhance local wildlife importance.'*

The proposal is to construct 8 dwellings with associated access road and parking.

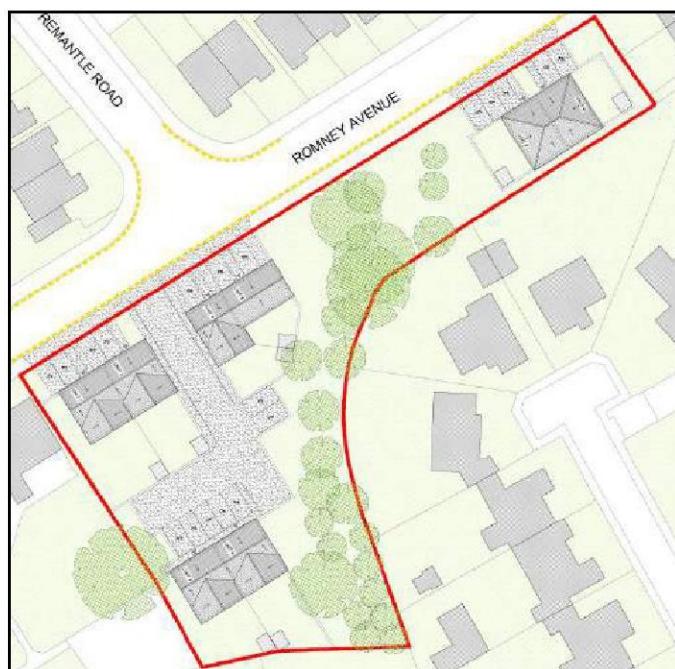


Figure 1.1 – Development Proposals – full drawing within Appendix 1

This document has been produced in accordance with current best practice and NPPF.

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2 Existing Site Conditions

2.1 Location

The development site is located at land adjacent to Romney Avenue, Folkestone, Kent, CT20 3QJ. The British National Grid Reference is: E: 620590, N: 136059. The figures below show the site in the wider area, more locally and then an aerial image to show the site in its current context.

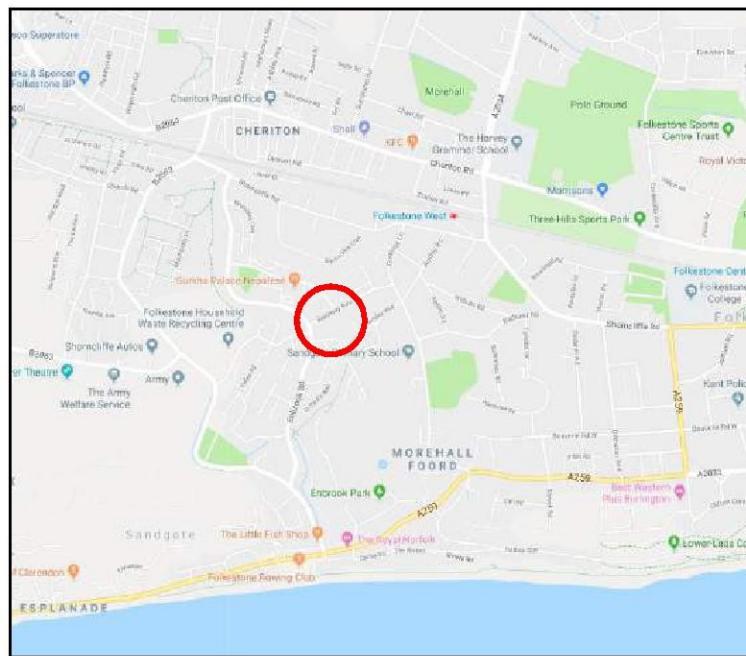


Figure 2.1 – Site location general area. Location shown by red circle. © Google Maps

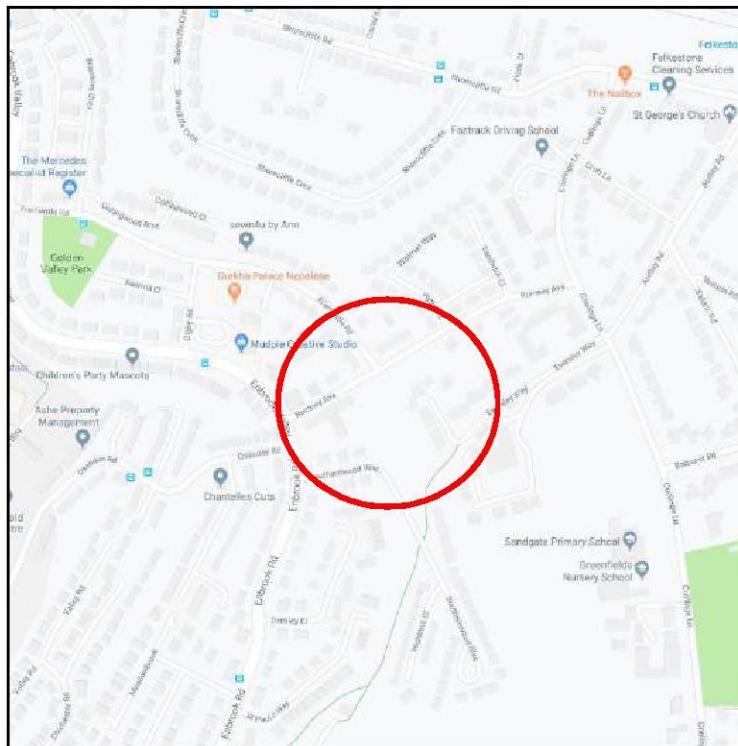


Figure 2.2 – Site Location shown by red circle. © Google Maps

The following aerial image provides additional information about the context of the site and surrounding areas.

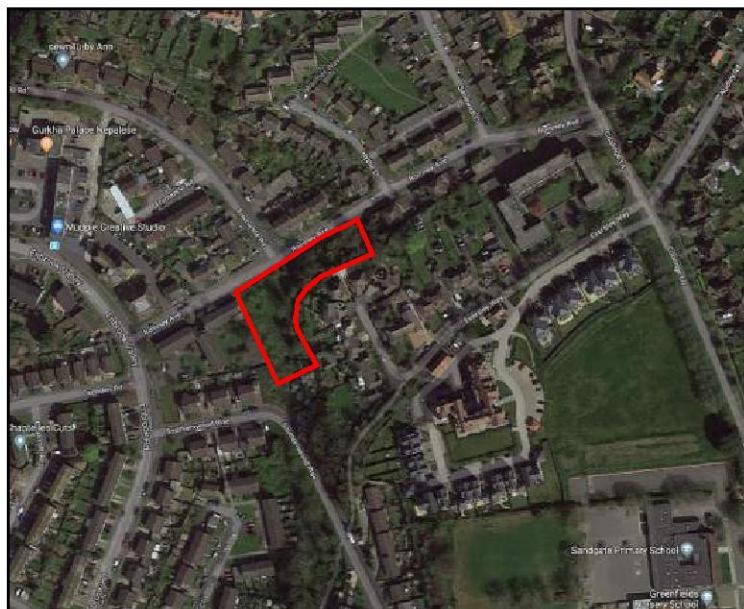


Figure 2.3 – Aerial image of site © Google Maps. Approximate site boundary shown in red.

The site is currently undeveloped and steeply sloped. It is bounded by Romney Avenue on the north west boundary, and residential dwellings on all other boundaries.

2.2 Site Topography

A review of the topographical survey indicates that the site generally falls from the east to west. Overall, there is a fall of approximately 17m as can be seen from the extract of the survey below.

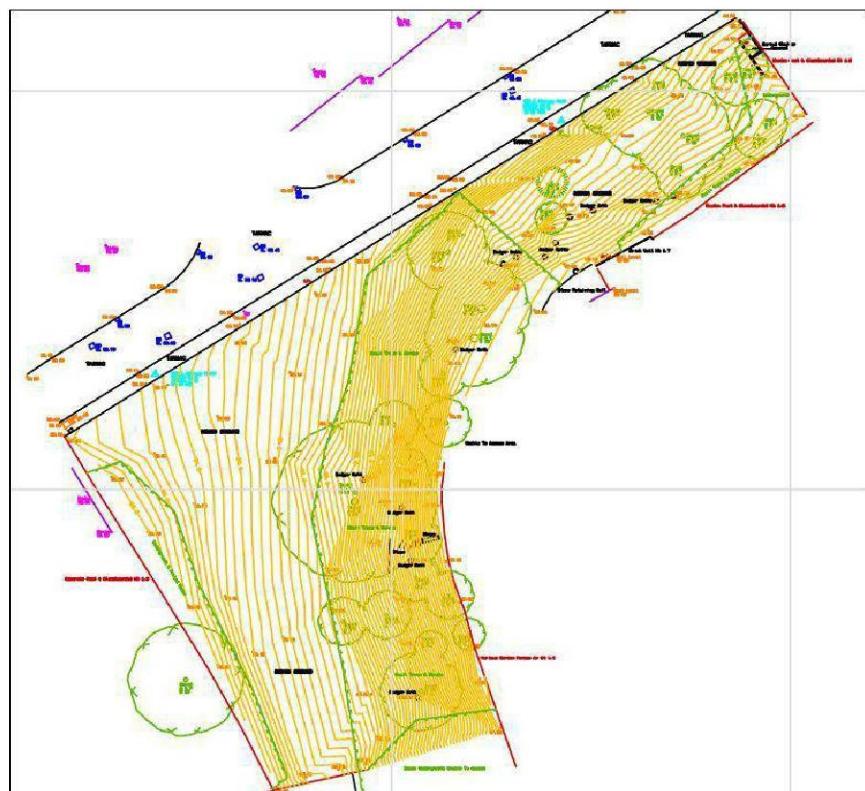


Figure 2.4 – extract of Topographic Survey

It can be seen that there are significant trees planted within the higher levels of the site and these are coincidentally the steeper parts of the site.

2.3 Site Geology

A review of the BGSonline bedrock mapping tool has identified that the development site is likely underlain by the Folkestone Formation (Sandstone). These sedimentary rocks are defined by the BGS as 'detrital, ranging from coarse to fine grained forming interbedded sequences'.

The site is also noted to be within the vicinity of the Sandgate Formation (Sandstone, Siltstone and Mudstone). These sedimentary rocks are defined by the BGS as 'detrital, ranging from coarse to fine grained forming interbedded sequences'.

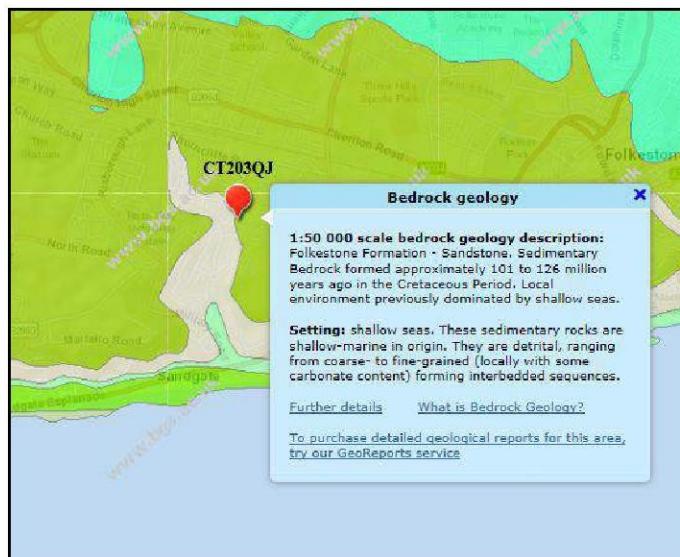


Figure 2.5 – BGS Extracts: Bedrock Geology © BGS

A review of the BGS online superficial deposits mapping tool has identified that the development site is not likely underlain by a superficial deposit. There are, however, superficial deposits within the area, comprising Peat. Peat is a partially decomposed mass of semi-carbonised vegetation which has grown under waterlogged, anaerobic conditions, usually in bogs or swamps.



Figure 2.6 – BGS Extracts: Superficial Geology © BGS

A site investigation carried out by Peter Baxter Associates (Ref: 1145/SI) indicates that the site's geology is as per BGS predictions. Percussion Drilling Logs have been appended to this

report at Appendix 4 and the full report should be referred to for the detailed design of any Temporary or Permanent Works.

2.4 Slope Stability

The Site Investigation included analysis of slope stability for a range of scenarios. The report concluded the following:-

1. *The existing upper slope is considered to be stable but close to failure. The expected failure mode is a shallow slip or translational failure. The existing trees and vegetation are expected to improve the slope stability from the values presented in Table 5, and it is recommended that these are left in place, with larger trees maintained and trimmed on an ongoing basis as necessary. The slope should be visually monitored over a period of years to confirm stability and failure modes. No construction on this upper slope will be possible. If further stability measures are required, or if the slope is not sustainable, a soil nailing solution may be investigated. This would require the clearance of most of the existing trees, which may raise aesthetic, ecological, and neighbour relation issues.*
2. *The fill is considered to be stable but close to failure. The toe of the fill slope must be stabilized or the current 1 in 1.5 slope reduced before the use of heavy plant, such as piling rigs, is permitted.*
3. *Excavations must be retained by retaining measures designed by a competent organization or individual. The soil strength values summarised on Table 4 and a minimum factor of safety of 1.50 are recommended. It is recommended that bored pile retaining walls or sheet piled retaining walls be installed prior to excavation. The study of a hypothetical 1.5m deep excavation indicated that a 600m diameter 8m deep bored pile wall at 750mm centres, reinforced with 6 x T16 reinforcement will provide a satisfactory factor of safety. Any design solution must account for the final maximum retained height and may incorporate a suitably designed slab as a prop. Such solutions are typically designed by piling contractors as part of a design and build package.*

These conclusions were reinforced by the inclusion of the Slope Stability Calculation Output Table 5 as shown in the figure below. It is clear though that, with care and appropriately designed works the scheme as promoted can be constructed in a safe and economically viable manner and that is discussed further in the following section.

TABLE 5 SLOPE STABILITY CALCULATION OUTPUT			
Analysis	Description	Factor of Safety	Failure Mode
1-1	Pre-existing slope	1.03	Shallow failure in lower slope
2-2	Current slope with fill	1.08	Shallow failure in upper slope
3-3	Stability of Fill	1.02	Failure in fill slope
4-4	1:2 excavation in Sandgate Formation to 33.25mAOD	0.89	Unacceptable
5-5	1.5m cut retained by 8m long piled retaining wall.	1.62 1.03	Failure through retaining wall Shallow failure in upper slope

Figure 2.7 – Slope Stability Calculations Output

3 Proposed Development

The proposal is to construct 8 dwellings with associated access road and parking. The figure below shows the Architect's current proposals with design contour levels shown.



Figure 3.1 – Proposed Site Plan with Proposed Levels – full drawing within Appendix 1.

The proposed development retains the steeper parts of the site as evidenced by the closely banded contours on the above extract. The plan also confirms that the extensive tree and shrub covering on that part of the site will be retained which will provide significant defence against the predicted shallow slope failures as modelled when the trees were removed. It is noteworthy that Network Rail and Highways England both use tree and shrub planting as accepted methods of ensuring slope stability is retained on steep cuttings and embankments so the Contractor must be made aware that the planting must be preserved.

The cuttings to form the new dwellings will require significant retaining solutions up to 5.00m in height as shown on sketch SK01 at Appendix 2.

A solution to achieve this height of wall would be the formation of contiguous piled walls with 600mm diameter reinforced concrete piles. In using augered piles in this way it ensures that the permanent works are in place before meaningful excavations are carried out thus ensuring slope stability is maintained and minimising risks of meaningful ground movements.

An example of a suitable foundation layout is shown at SK02 at appendix 3 and as below.



Figure 3.2 – Example of a retaining wall solution - Layout

The use of piles as a retaining solution would require the use of building foundations as props in order to ensure deflection was within acceptable limits. This has been used on other projects in these ground conditions successfully. The layout of the walls – shown by the purple lines above – lends itself to this solution. Specifically Units 1 and 2 would be normal construction; Units 3 and 4 would incorporate the retaining solution within their structure including floor slabs acting as props to the wall; Units 5 and 6 would similarly incorporate retaining walls within their structure including elements of propping and Units 7 and 8 would be a simple 'box' arrangement with floor slab acting as internal props.

The extract of a similar scheme drawing shows how a piled retaining wall was propped by ground beams into the foundations of the associated dwellings as an example of how this has been done in the area previously.

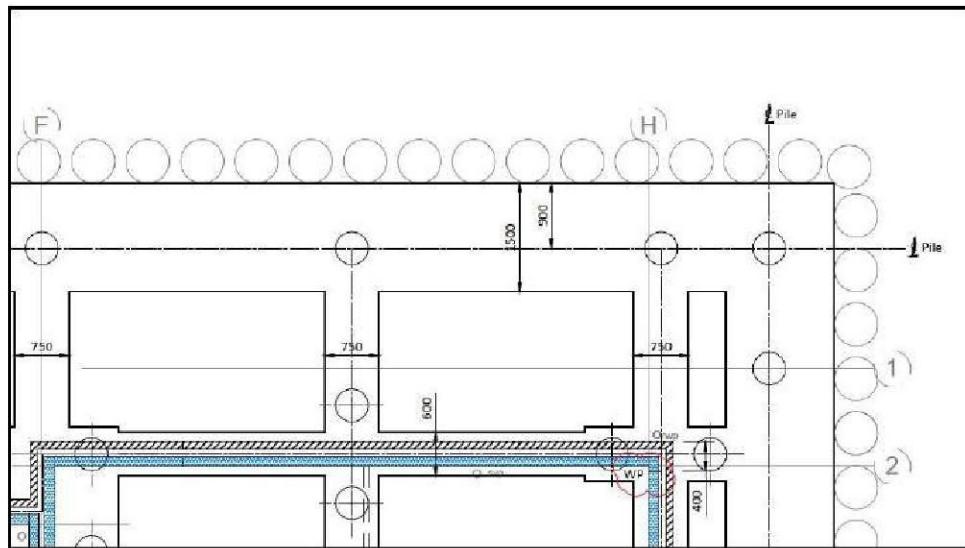


Figure 3.3 – shows extract of similar scheme where ground beams act as props to a piled retaining wall and brace the wall into the main structure to ensure deflections within limits.

In terms of the Temporary Works to provide safe bearing platforms for a piling rig, it will require the import of suitable fill material to provide a safe bearing platform. The platform will need to be designed by a suitably qualified Engineer. The lower parts of the site are sloped at about 1 in 5 which is too steep for a normal piling rig to traverse but to reduce the slope to about 1 in 15 would require excavations in excess of 2.5m deep at the line of the retaining wall – that would be too steep for slope stability to be maintained. Similarly, to sit a normal piling rig on such a slope would be unlikely to provide a stable solution.

Specialist piling plant is available from specialist contractors that are designed specifically to access steep slopes – as steep as 1 in 1 in some instances. This plant has very wide tracks to ensure imposed loads generated are within the tolerance of the site soil conditions and as soon as piles are commenced then stability improves. An example is shown below.



Figure 3.4 – specialist piling rig for steep slopes © TOR Drilling

By use of a specialist rig it will be possible to install the initial run of piles. That will in effect provide the Temporary Works support to allow excavations down to foundation level for the new buildings and the casting in of ground beams and additional propping support for the piled wall to thus ensure long term stability. All of this would require extensive detailed design by the specialist piling contractors taking full account of the findings of the Site Investigation and Slope Stability calculations therein, but it is entirely possible even on a site as constrained as this one. Once the main wall and supporting building foundations are in place then the remainder of the site can be built out using normal construction techniques. As the slope above the site would be unchanged, and all planting left intact the stability of that would also be ensured.

4 Conclusions

This document has been produced in accordance with current best practice and recommendations and guidance set out in the National Planning Policy Framework (NPPF).

The report concludes:

- The site is currently undeveloped. It is bounded by Romney Avenue on the north west boundary, and residential dwellings on all other boundaries.
- A review of the BGSonline bedrock mapping tool has identified that the development site is underlain by the Folkestone Formation (Sandstone).
- The proposal is to construct 8 dwellings with associated access road and parking.
- The Site Investigation included an assessment of Slope Stability and found that the site is stable but that specialist design would be required to maintain slope integrity for the project
- It has been shown that significant retaining structures will be required to maintain slope stability but that it is possible to configure a piled retaining wall tying that wall into the building structures or other foundations to provide propping to thus ensure that the wall retains the soils behind within deflection limits.
- The trees and planting on the steepest parts of the site are to be retained which will continue to provide stability to those slopes and soils as noted within the Site Investigation
- The construction of the initial piled retaining walls will require the use of specialist piling equipment designed for use on steep slopes and difficult soft terrain. Once the initial wall is in place it will act as Temporary Works to allow the permanent additional propping foundations to be excavated and installed
- All temporary and permanent works design and construction of the works must only be undertaken by suitable qualified and experienced Engineers and Contractors to ensure slope stability and ground integrity is maintained throughout.
- It is evident that, with care and the use of suitably equipped competent and experienced specialist contractors, the site can be constructed safely.

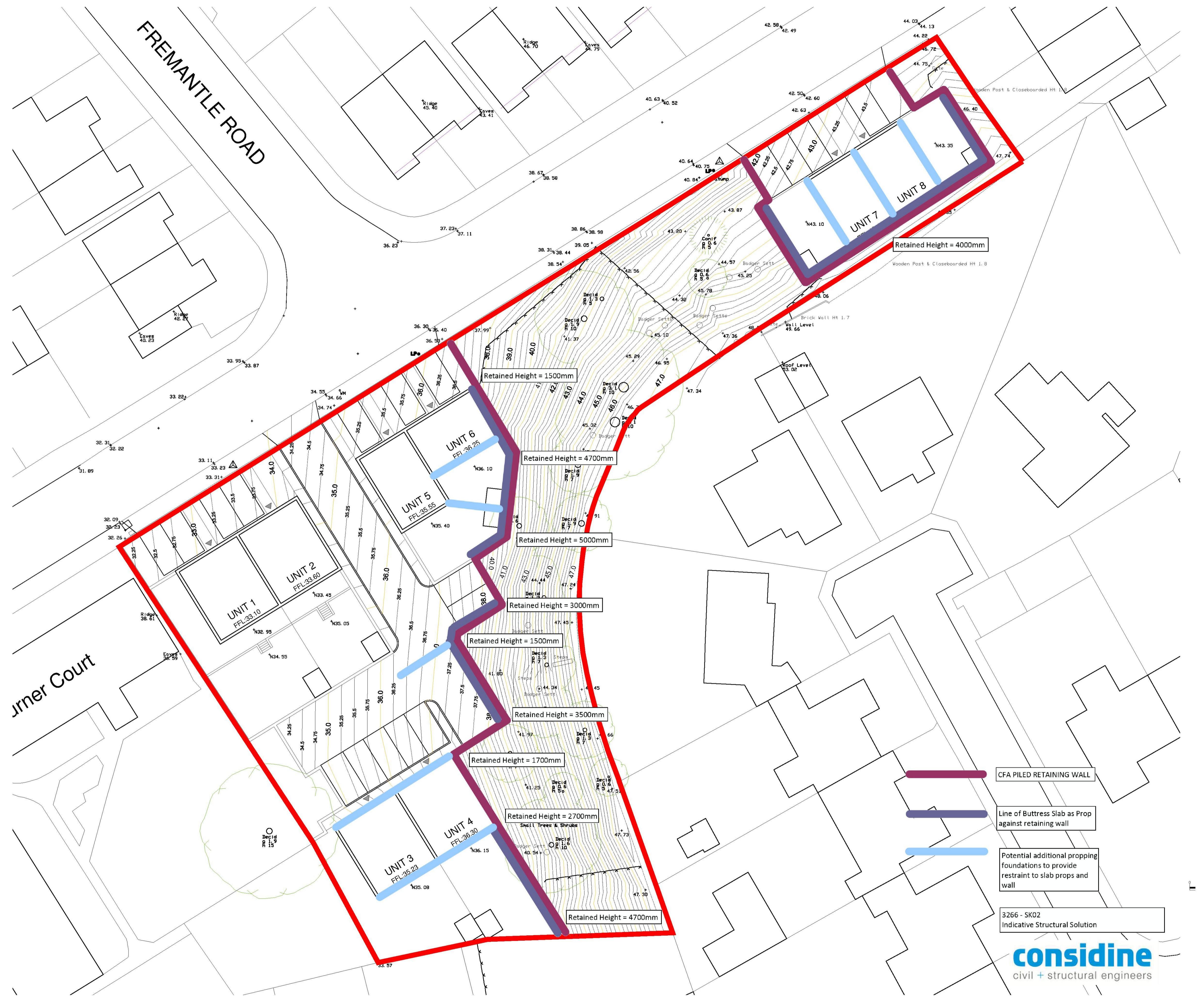
Appendix 1

Proposed Site Plan with Levels



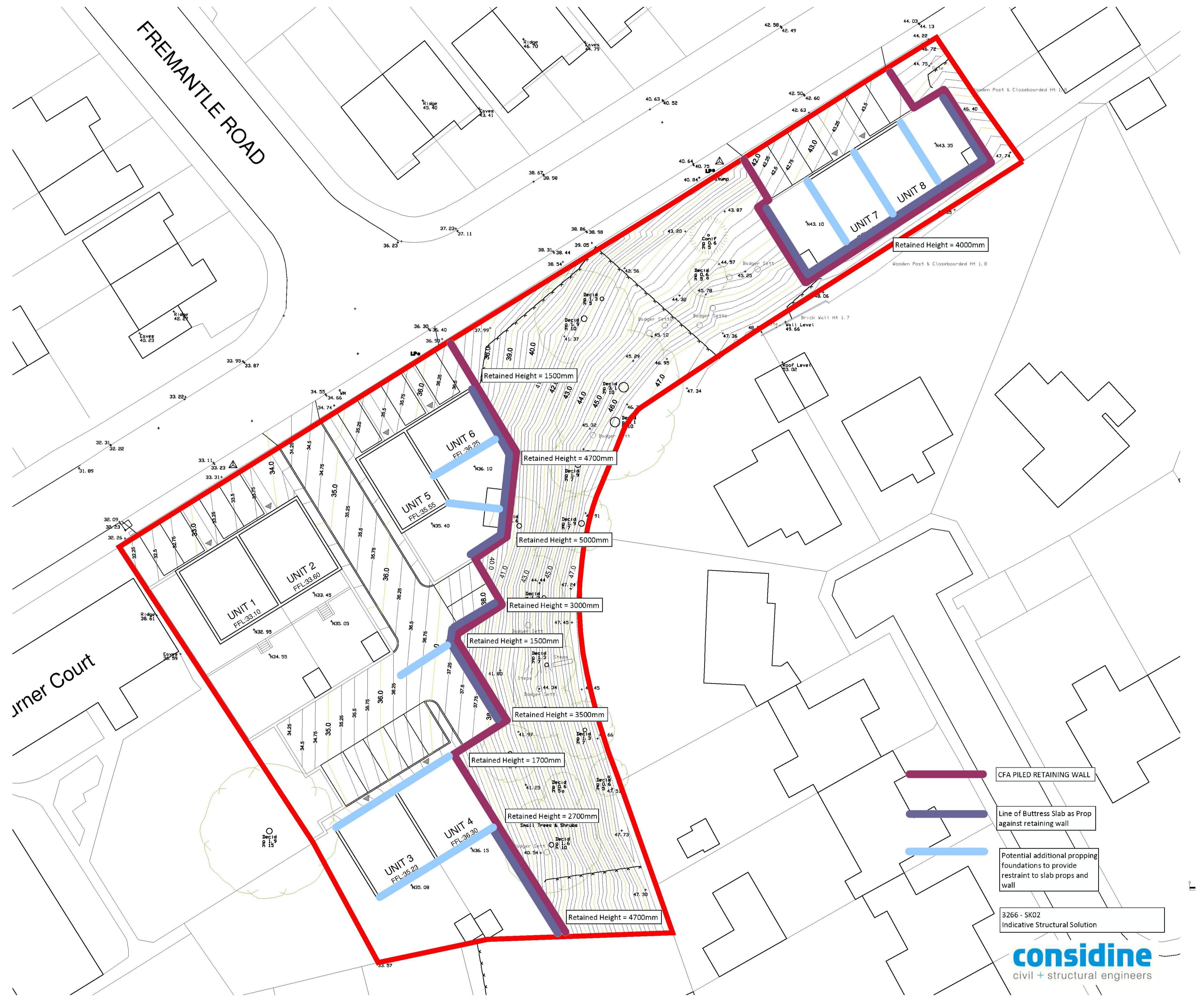
Appendix 2

Sketch showing Retained Heights around the site



Appendix 3

Sketch of Typical Foundation Layout for Propped Retaining Wall



Appendix 4

Piling Logs as extracted from the Peter Baxter Site Investigation Report

(Ref1145/SI)

APPENDIX B1
Borehole Logs

Percussion Drilling Log

Project Name: Folkestone Romney Avenue SI			Client: CLArchitects				Date: 21/09/2018						
Location: Land at Romney avenue, Folkestone CT20 3QJ			Contractor: Peter Baxter Associates Ltd				Co-ords: E620588.28 N136026.13						
Project No. : 1145			Crew Name: Craig				Drilling Equipment: Dando 2000						
Borehole Number BH1		Hole Type CP		Level 35.74m AoD		Logged By KB		Scale 1:50	Page Number Sheet 1 of 2				
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description					
		Depth (m)	Type	Results				MADE GROUND (concrete fragments and sand)	Loose brown silty SAND	Medium dense orange brown mottled grey clayey silty SAND			
		1.20	D	N=7 (0,0/1,2,2,2)	0.80	34.94		MADE GROUND (concrete fragments and sand)					
		1.20	SPT					Loose brown silty SAND					
		1.50	B					Medium dense orange brown mottled grey clayey silty SAND					
		2.00	D	N=8 (1,2/2,2,2,2)	2.40	33.34		Medium dense orange brown mottled grey clayey silty SAND					
		2.00	SPT					Medium dense orange brown mottled grey clayey silty SAND					
		2.50	B					Medium dense orange brown mottled grey clayey silty SAND					
		3.00	D	N=10 (1,2/2,2,3,3)				Medium dense orange brown mottled grey clayey silty SAND					
		3.00	SPT					Medium dense orange brown mottled grey clayey silty SAND					
		3.50	B					Medium dense orange brown mottled grey clayey silty SAND					
		4.00	D	N=12 (2,3/3,3,3,3)				Medium dense orange brown mottled grey clayey silty SAND					
		4.00	SPT					Medium dense orange brown mottled grey clayey silty SAND					
		4.50	B					Medium dense orange brown mottled grey clayey silty SAND					
		5.00	D	N=14 (0,2/3,3,4,4)				Medium dense orange brown mottled grey clayey silty SAND					
		5.00	SPT					Medium dense orange brown mottled grey clayey silty SAND					
		5.50	B		5.60	30.14		Medium dense orange brown mottled grey clayey silty SAND					
		7.00	D	N=21 (4,4/5,5,5,6)				Medium dense orange brown mottled grey clayey silty SAND					
		7.00	SPT					Medium dense orange brown mottled grey clayey silty SAND					
		7.50	B	7.90	27.84		Medium dense orange brown mottled grey clayey silty SAND						
		9.00	D				N=48 (5,7/8,12,13,15)				Medium dense orange brown mottled grey clayey silty SAND		
		9.00	SPT								Medium dense orange brown mottled grey clayey silty SAND		
		9.50	B								Medium dense orange brown mottled grey clayey silty SAND		
Hole Diameter		Casing Diameter					Chiselling				Inclination and Orientation		
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation		
15.45	150												
Remarks													



Percussion Drilling Log

Project Name: Folkestone Romney Avenue SI		Client: CLArchitects					Date: 21/09/2018										
Location: Land at Romney avenue, Folkestone CT20 3QJ			Contractor: Peter Baxter Associates Ltd				Co-ords: E620588.28 N136026.13										
Project No. : 1145			Crew Name: Craig				Drilling Equipment: Dando 2000										
Borehole Number BH1		Hole Type CP		Level 35.74m AoD		Logged By KB		Scale 1:50	Page Number Sheet 2 of 2								
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description									
		Depth (m)	Type	Results													
		11.00	D	N=49 (5,7/9,13,13,14)		15.45		End of Borehole at 15.450m		11							
		11.00	SPT														
		11.50	B														
		13.00	D							12							
		13.00	SPT														
		13.50	B														
		15.00	D														
		15.00	SPT														
		N=50 (5,8/10,13,13,14)															
		N=52 (5,8/10,13,14,15)															
Hole Diameter			Casing Diameter		Chiselling			Inclination and Orientation									
Depth	Base	Diameter	Depth	Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation				
15.45		150															
Remarks																	



Percussion Drilling Log

Project Name: Folkestone Romney Avenue SI			Client: CLArchitects				Date: 24/09/2018				
Location: Land at Romney avenue, Folkestone CT20 3QJ			Contractor: Peter Baxter Associates Ltd				Co-ords: E620585.69 N136062.13				
Project No. : 1145			Crew Name: Craig - South Eastern Drilling				Drilling Equipment: Dando 2000				
Borehole Number BH2		Hole Type CP		Level 36.69m AoD		Logged By KB		Scale 1:50	Page Number Sheet 1 of 2		
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description			
		Depth (m)	Type	Results							
								MADE GROUND			
								Soft dark brown slightly gravelly sandy CLAY with rootlets			
Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth	Base	Diameter	Depth	Base	Diameter	Depth	Top	Depth	Base	Inclination	Orientation
			15.45		150						
			15.45								
Remarks											



Percussion Drilling Log

Project Name: Folkestone Romney Avenue SI		Client: CLArchitects				Date: 24/09/2018						
Location: Land at Romney avenue, Folkestone CT20 3QJ			Contractor: Peter Baxter Associates Ltd				Co-ords: E620585.69 N136062.13					
Project No. : 1145			Crew Name: Craig - South Eastern Drilling				Drilling Equipment: Dando 2000					
Borehole Number BH2		Hole Type CP		Level 36.69m AoD		Logged By KB		Scale 1:50	Page Number Sheet 2 of 2			
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description				
		Depth (m)	Type	Results								
		11.00	D	N=44 (5,6/7,10,13,14)				Dense grey clayey silty SAND				
		11.00	SPT									
		11.50	B	N=46 (5,6/8,11,13,14)								
		13.00	D									
		13.00	SPT									
		13.50	B									
		15.00	D	N=48 (5,7/8,13,13,14)								
		15.00	SPT									
				15.45	21.24			End of Borehole at 15.450m				
Hole Diameter		Casing Diameter		Chiselling			Inclination and Orientation					
Depth	Base	Diameter	Depth	Base	Diameter	Depth Top	Depth	Base	Inclination	Orientation		
			15.45		150							
			15.45									
Remarks												



Percussion Drilling Log

Project Name: Folkestone Romney Avenue SI				Client: CLArchitects				Date: 20/09/2018					
Location: Land at Romney avenue, Folkestone CT20 3QJ				Contractor: Peter Baxter Associates Ltd				Co-ords: E620638.55 N136098.23					
Project No. : 1145				Crew Name: Site Serve Ltd				Drilling Equipment: Windowless Sampler					
Borehole Number WS1		Hole Type WLS		Level 45.15m AoD		Logged By KB		Scale 1:50		Page Number Sheet 1 of 1			
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description					
		Depth (m)	Type	Results									
		0.50	D					Very stiff brown slightly gravelly very sandy CLAY					
		1.50	D					Very stiff olive brown very sandy CLAY with layers of limestone fragments					
		3.30	D					Very stiff olive grey brown clayey SAND					
		4.00	D										
		5.10	D										
		5.50	D					Stiff orange brown sandy CLAY					
		5.80						Dense grey silty SAND					
		6.00						End of Borehole at 6.000m					
Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation					
Depth	Base	Diameter	Depth	Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation
Remarks													



Percussion Drilling Log

Project Name: Folkestone Romney Avenue SI			Client: CLArchitects				Date: 21/09/2018						
Location: Land at Romney avenue, Folkestone CT20 3QJ			Contractor: Peter Baxter Associates Ltd										
Project No. : 1145			Crew Name: Site Serve Ltd				Drilling Equipment: Windowless Sampler						
Borehole Number WS2		Hole Type WLS		Level 38.92m AoD		Logged By KB		Scale 1:50	Page Number Sheet 1 of 1				
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description					
		Depth (m)	Type	Results									
		0.00 - 0.40	B		0.45	38.47		TOPSOIL					
		0.60	D		0.75	38.17		Soft olive brown sandy CLAY with occasional rootlets					
		1.50	D					Medium dense orange brown silty SAND					
					3.00	35.92		End of Borehole at 3.000m					
Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation					
Depth	Base	Diameter	Depth	Base	Diameter	Depth	Top	Duration	Tool	Depth	Base	Inclination	Orientation
Remarks													



Percussion Drilling Log



Percussion Drilling Log

Project Name: Folkestone Romney Avenue SI				Client: CLArchitects				Date:					
Location: Land at Romney avenue, Folkestone CT20 3QJ				Contractor: Peter Baxter Associates Ltd									
Project No. : 1145				Crew Name: Site Serve Ltd				Drilling Equipment: Windowless Sampler					
Borehole Number WS4		Hole Type WLS		Level 38.70m AoD		Logged By KB		Scale 1:50	Page Number Sheet 1 of 1				
Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description					
		Depth (m)	Type	Results									
		0.00	B					Dense brown slightly clayey SAND with limestone fragments					
		1.40	D			0.75	37.95	Dense olive brown mottled orange brown silty SAND					
		2.50	D			3.00	35.70	End of Borehole at 3.000m					
Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation					
Depth	Base	Diameter	Depth	Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation
Remarks													

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