

Piling Risk Assessment



Geotechnical & Environmental Consultants

Piling Risk Assessment

At

**Land South of Ranelagh Road, Havant, Hampshire,
PO9 1NR**

For

Jacobs Foreman Developments Limited

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REPORT 14639/PRA

Piling Risk Assessment

Job Title: Land South of Ranelagh Road, Havant, Hampshire, PO9 1NR

Client: Jacobs Foreman Developments Limited

CONTROL DOCUMENT

SOILS LIMITED DOCUMENT REFERENCE NUMBER:
14639/PRA

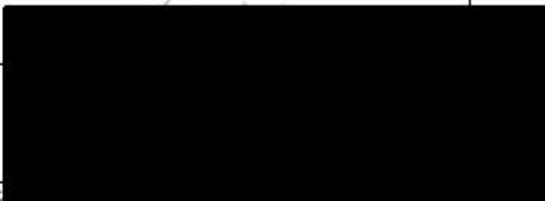
DOCUMENT TYPE:
Contamination Assessment & Remediation Strategy

DOCUMENT STATUS: Final

Revision: 1.00

DATE: January 2015

Note: This is not a valid document for use in the design of the project unless it is titled **Final** in the Document Status box.

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Current regulations and good practice were used in the preparation of this report reviewed by an appropriately qualified person at the time of preparation of the scheme design to ensure that any recommendations given remain valid in light of changes in regulation and practice, or additional information obtained regarding the site.



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Piling Risk Assessment

At

Land South of Ranelagh Road, Havant, Hampshire, PO9 1NR

For

Jacobs Foreman Developments Limited

Commission

Soils Limited was commissioned by Jacobs Foreman Developments Limited to provide a Piling Risk Assessment (PRA) for the proposed development site at land south of Ranelagh Road, Havant, Hampshire, PO9 1NR.

This report must be read in conjunction with the Phase I Desk Study (ref. 13284/DS, November 2012), the previously submitted contamination report undertaken at the site (ref. 13284/GI, dated November 2012), the Soakaway Letter Report (ref. 14186/SL, dated 19th March 2014, the updated Phase II Ground Investigation (ref. 14099/GIR/Rev2.01, dated December 2014) and the Phase III Ground Investigation (ref. 14492/GIR, dated October 2014) all undertaken for the above site by Soils Limited.

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- Appendix A: Borehole Logs;
- Appendix B: CHD Piling Information (Roger Bullivant).

Section 1 Introduction

1.1 Client's Brief and Objectives

The client's brief was to undertake a Piling Risk Assessment (PRA) to identify the environmental risks associated with the adoption of a piled foundation scheme for the proposed development and to subsequently identify any appropriate risk management approaches and monitoring requirements which should be adopted to limit and control the risks to a practicable minimum.

This report provides a brief summary of the ground and groundwater conditions encountered across the site with respect to contamination and considers the potential impact of the proposed use of piled foundations on the site. This report will develop the existing conceptual model specific for the site, which will in-turn be used as a technical basis for qualitative risk assessment in accordance with CIRIA 552 methodology. The report will then outline a suitable approach for risk limitation and control. In addition, this report will outline a range of further risk management strategies which may be adopted on the site if deemed effective and/or appropriate.

This report has been prepared in line with the guidance given in the following primary reference: *Piling and Penetrative Ground Improvement methods on Land Affected by Contamination: Guidance on Pollution Prevention. Environment Agency National Groundwater and Contaminated Land Centre report NC/99/73. May 2001.*

1.2 Location

The site was located south of Ranelagh Road, in Havant, Hampshire and had an approximate site area of 2.5Ha. The centre of the site had an approximate O.S. Land Ranger Grid Reference of was SU 708 063.

The general site location plan was given on Figure 1.

1.3 Proposed Redevelopment

The proposed development was to include the erection of 81No. dwellings consisting of 10No. two-bed flats, 12No. two-bed flats, 6No. two-bed houses and 53No. three-bed houses. The proposed redevelopment included soft and hard landscaping such as access roads and private gardens.

In compiling this report reliance was placed on drawing number SS/RR/02, Ranelagh Road Site Setup, undated, provided by Foreman Homes. Any change or deviation from the scheme outlined in the drawing could invalidate the recommendations or conclusions presented within this report. Soils Limited must be notified about any such changes.

1.4 Limitations and Disclaimers

This Piling Risk Assessment report relates to the site referred to as land south of Ranelagh Road, Havant, Hampshire, PO9 1NR and was prepared for the sole benefit of the Jacobs Foreman Developments Limited (The "Client") and was prepared solely for the brief described in section 1.3 of this report.

Soils Limited disclaims any responsibility to the client and others in respect of any matters

outside the scope of the above.

This report has been prepared by Soils Limited, with all reasonable skill, care and diligence within the terms of the Contract with the client, incorporation of our General Terms and Condition of Business and taking account of the resources devoted to us by agreement with the Client.

This report is personal and confidential to the client and Soils Limited accept no responsibility of whatsoever nature to third parties to whom this report, or any part thereof, is made known. Any such party relies on the report wholly its own risk.

The Client may not assign the benefit of the report or any part to any third party without the consent of Soils Limited.

The ground and groundwater may exhibit a variety of characteristics that vary from place to place across a site, and also with time. Whilst a ground investigation will mitigate to a greater or lesser degree against the resulting risk from variation, the risks cannot be eliminated.

The recommendations given in this report were prepared for the sole benefit of the client in accordance with their brief. As such these do not necessarily address all aspects of ground behaviour at the site.

An appropriately qualified person must review the recommendations given in this report at the time of preparation of the scheme design to ensure that any recommendations given remain valid in light of changes in regulation and practice, or additional information obtained regarding the site.

Ownership of land brings with it onerous legal liabilities in respect of harm to the environment. "Contaminated Land" is defined in Section 57 of the Environment Act 1995 as *"Land which is in such a condition by reason of substances in, on or under the land that significant harm is being caused or that there is a significant possibility of such harm being caused or that pollution of controlled waters is being, or is likely to be caused"*.

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Section 2 Site History and Ground Conditions

2.1 Summary of Site History

The site comprised open undeveloped land until the 1897 historical map. Sometime after this date the site was developed as Brockhampton Nurseries until the 1932 map. No structures were present on any of the subsequent historical maps.

The study of historic maps revealed that from the site environs were largely undeveloped with the exception of Portsmouth Water Works including a tannery and pump house noted on the oldest historical map (1867). The tannery was not present on the 1909 map edition. Residential properties on Ranelagh Road began appearing on the 1897 map. An industrial development to the south of the site was noted on the 1987 map.

The Envirocheck Datasheets indicated that no historic landfill sites or registered landfill sites were present within the 250m search radius.

The Envirocheck Datasheets indicated that the site was located within a groundwater source protection zone 1.

2.2 Site Investigation

Various phases of investigation and assessment have been undertaken on the site culminating in the revised Ground Investigation Report (14099/GIR/Rev 2) issued in December 2014. Prior to this Soils Limited undertook a Phase I Desk Study and a Phase II Ground Investigation Report (13284/DS, 13284/GIR) issued in November 2012, further infiltration testing was carried out in March 2014 followed by further Phase III Ground Investigation Report (14492/GIR) in October 2014.

2.3 Geology

The 1:50 000 Geological Survey of Great Britain (England and Wales) map showed the east of the site to be located on River Terrace Deposits underlain by Undifferentiated Chalk comprising Lewes Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formation (the White Chalk Subgroup).

4.1.1 River Terrace Deposits

The rivers of Hampshire have deposited extensive spreads of River Terrace Deposits in the Southampton area, representative of ancient floodplains. In total, eleven terraces have been recorded. The River Terrace Deposits consist predominantly of gravels made up of subangular to subrounded flints with a significant sand component locally with lenses of silt, clay or peat.

The five highest terraces have appreciable clay content. Poorly sorted, clayey and sandy silts and silty clays overlie the 1st, 3rd, 5th and 6th terraces and locally at above terrace gravels.

4.1.1 Lewes Nodular Chalk Formation, Seaford Chalk Formation and Newhaven Chalk Formation – The White Chalk Subgroup

The Lewes Nodular Chalk Formation is composed of hard to very hard nodular chalks and hardgrounds with interbedded soft to medium hard chalks (some grainy) and marls; some griotte chalks. The softer chalks

become more abundant towards the top. Nodular chalks are typically lumpy and iron-stained. Brash is rough and flaggy or rubbly, and tends to be dirty. First regular seams of nodular flint, some large, commence near the base and continue throughout.

Seaford Chalk Formation can be described as firm white chalk with conspicuous semi-continuous nodular and tabular flint seams. Hardgrounds and thin marls are known from the lowest beds. Some flint nodules are large to very large.

The Newhaven Chalk Formation is a soft white friable microporous limestone composed of coccolith biomicrites with a varying proportion of larger shell fragments.

At various levels clay sized material occurs as marl seams and partings. Close to the surface the upper few metres are invariably discoloured brown, due to leaching from the overlying strata. The interface with any overlying stratum is invariably extremely irregular as a result of localised weathering and general solution. Weathering by frost action may extend to a depth of several metres.

Occasional erosional features, such as pipes, swallow holes and solution cavities, usually in-filled with drift deposits, are found in the chalk. The features sometimes manifest themselves at the surface as shallow circular depressions. Solution features may be reactivated by the concentrated ingress of water from leaking drains or soakaways. Reactivation may lead to surface collapse.

2.4 Hydrogeological and Hydrological Setting

The following section has been reproduced from the Phase I Desk Study (ref: J13284/DS), dated November 2012, and as a result some of the aquifer status terminology may be out dated however this section remains relevant and therefore has been retained:

To assess the vulnerability of groundwater to contamination, consideration must be given to the leaching characteristics of the overlying soils and the characteristics of the strata in the unsaturated zone. Information on the geological strata, such as lithological type and permeability characteristics has been combined with the physical properties of the soil to produce varying degrees of vulnerability.

*The Environment Agency Groundwater Vulnerability Map showed the site to be situated on superficial deposits classified as **Secondary A Aquifer**, associated with the River Terrace Deposits. No bedrock aquifer designation was recorded.*

Secondary A Aquifers are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.

*The site was situated on soils having an **High(U)** Leaching Potential classification.*

*The site **was situated** on a Groundwater Source Protection Zone 1 for Bedhampton and Havant Springs public water supply abstraction.*

Any works or development, which may have an impact on surface water, aquifer or groundwater quality, must be approved by the Environment Agency prior to implementation.

*The nearest **potable abstraction** point was noted 218m west of the site.*

The nearest Surface Water Feature was approximately 51m to the west of the site, which was Hermitage Stream.

The site had an approximate elevation of 4m AOD.

Groundwater was anticipated to be flowing in a westerly direction, towards a Pumping Station abstraction to the west.

2.5 Summary of Ground Conditions - Soil

Ground conditions encountered during all phases of intrusive works undertaken were broadly comparable. The sequence of ground conditions encountered across the site is shown in detail on the relevant engineering logs in Appendix A and is summarised as follows:

- Topsoil/Made Ground (GL to maximum of >1.35m bgl);
- Head Deposits (to approximately 2m below ground level, locally greater than 4.00m);
- Lewes Nodular Chalk Formation (encountered at variable depths across the site, typically below between 2.00 and 2.80m bgl).

Made Ground was encountered in eleven of the trial holes from ground level to depths of between 0.50 and 1.20m bgl. The Made Ground comprised dark brown, silty CLAY with occasional brick rubble, flint cobbles and ash.

Potential contamination within the Made Ground was identified through laboratory testing. A single exceedance of the **ATRISK^{soil} SSV for a residential land-use scenario** was noted within a sample taken from within WS8.

Head Deposits were encountered immediately below the Topsoil or Made Ground in all locations and were observed to depths of between >4.00m bgl. The Head Deposits comprised soft to firm orange-brown, CLAY with variable quantities of flint and chalk gravel. Locally the Head Deposits became orange-brown slightly clayey SAND with abundant gravel. At the interface between the Head Deposits and the Lewes Nodular Chalk Formation, a very gravelly band was noted within WS2-3, WS7-10.

No evidence of potential contamination within the Head Deposits was identified through olfactory and visual screening of the samples recovered and laboratory testing of samples did not identify contaminants at concentrations of risk to the end-user.

Lewes Nodular Chalk Formation was encountered in eight trial holes immediately below the Head Deposits at depths between 2.00m bgl and 2.80m bgl. Where encountered the soils of the Lewes Nodular Chalk Formation were typically highly

weathered – recovered as soft, grey yellow white clayey sandy gravelly CHALK. The Lewes Nodular Chalk Formation persisted to the maximum depth of the investigation (4.00m bgl) and was inferred to the full depth of the dynamic probe holes (6.00m bgl).

No evidence of potential contamination was observed through olfactory and visual screening of samples recovered from the Lewes Nodular Chalk Formation. Furthermore the results of laboratory testing did not identify any contaminants of concern within the samples recovered from the Lewes Nodular Chalk Formation.

Borehole logs are provided in Appendix A.

2.6 Summary of Groundwater Conditions

Groundwater was encountered in three of the trial holes during the course of the October 2012 investigation at a depth of 2.30m bgl in TP3 and S3, and at a depth of 3.00m bgl in TP4. Groundwater was not encountered during drilling in the February 2014 investigation but was encountered in three of the trial pits excavated during the November 2014 investigation at depths of 3.00m bgl (TP103, TP108 and TP109).

Changes in groundwater level occur for a number of reasons including seasonal effects and variations in drainage. The investigation phases during which groundwater was encountered were conducted in October 2012 and November 2014 when groundwater levels should have been rising from their annual minimum (lowest elevation). However, the summer of 2012 was one of the wettest on record resulting in uncharacteristically high groundwater levels for the time of year.

Groundwater equilibrium conditions may only be conclusively established by means of a series of measurements made in a standpipe, or piezometer installed in the ground after completion of the site works.

Dual-purpose groundwater and soil-gas monitoring wells were installed within four of the windowless sampler boreholes to facilitate post-works monitoring.

Dual-purpose groundwater and soil-gas monitoring wells were installed within WS1-4 to 4.00m bgl to facilitate post-works groundwater monitoring. Groundwater, where present, was recovered from the wells for laboratory chemical analysis.

At the time of reporting seven return monitoring visits had been completed. Table 2.1 shows the groundwater observations recorded.

Table 2.1 Post-works Groundwater Observations within Wells (m bgl)							
Borehole	6.11.12	15.11.12	3.12.12	20.12.12	04.01.13	01.02.13	14.11.14
WS1	2.52	2.69	2.61	1.09	1.13	1.99	Not located
WS2	3.60	3.65	3.61	2.65	2.71	4.05	Not located
WS3	2.47	2.54	2.58	0.95	1.01	2.56	2.74
WS4	1.38	1.61	1.35	0.27	0.35	0.91	1.13

A full Soil-Gas Risk Assessment was not requested as part of the specification of works.

Groundwater monitoring was not undertaken during the February 2014 (ref: 14099) phase of investigation, as this did not form part of the brief. At the time of reporting, January 2015, two return groundwater monitoring visits were outstanding.

Section 3 Development Proposal and Hazard Identification

3.1 Development Proposal

The proposed development was to include the erection of 81No. dwellings consisting of 10No. two-bed flats, 12No. two-bed flats, 6No. two-bed houses and 53No. three-bed houses. The proposed redevelopment included soft and hard landscaping such as access roads and private gardens.

In compiling this report reliance was placed on drawing number SS/RR/02, Ranelagh Road Site Setup, undated, provided by Foreman Homes. Any change or deviation from the scheme outlined in the drawing could invalidate the recommendations or conclusions presented within this report. Soils Limited must be notified about any such changes. A plan showing the proposed redevelopment is provided in Figure 2.

This report is necessary as the proposed piled foundations required to support the proposed structures are to be taken into the underlying Principal Aquifer of the White Chalk Sub-group. Piles will be required to pass through the Made Ground and the Superficial Deposits to find the proposed competent bearing stratum of the White Chalk Sub-group.

The Made Ground has been shown to have been locally impacted by Lead contamination, the underlying cohesive soils of the Head Deposits and the Lewes Nodular Chalk Formation were not contaminated.

3.2 Hazard Identification

There are 6 possible generic pollution scenarios identified by the Environment Agency and these are:

- Creation of preferential pathways, through a low permeability layer (an aquitard), to allow potential contamination of an underlying aquifer;
- Creation of preferential pathways, through a low permeability surface layer, to allow upward migration of land gas, soil gas or contaminant vapours to the surface;
- Direct contact of site workers and others with contaminated soil arisings which have been brought to the surface;
- Direct contact of the piles or engineered structures with contaminated soil or leachate causing degradation of pile materials (where the secondary effects are to increase the potential for contaminant migration);
- The driving of solid contaminants down into an aquifer during pile driving;
- Contamination of groundwater and, subsequently, surface waters by concrete, cement paste or grout.

The following assessment will consider the applicability of the Environment Agency's generic scenarios and consider the significance of the various risks.

Section 4 Conceptual Site Model and Qualitative Risk Assessment

4.1 General

The following sections define the main components of the conceptual site model (CSM) in terms of the key Source-Pathway-Receptor relationships, which in-turn provide a basis for subsequent qualitative risk assessment.

4.2 Sources

Two contamination sources are identified:

- Localised soil contamination (Lead) within the Made Ground;
- Liquid cement from the piling process.

One sample tested showed **concentrations in excess of the relevant DEFRA SGV and ATRISK^{soil} SSV for a residential land-use scenario**. In WS8 at 0.40 bgl Lead was recorded at a concentration of 385mg/kg against the residential end-use ATRISK^{soil} SSV of 276mg/kg..

Following the discovery of Lead in exceedance of the relevant guidelines groundwater samples were collected onsite for chemical analysis, the results of which showed no contamination to the groundwater.

4.3 Pathways

The identified contamination migration pathways identified include:

- Via permeable soils;
- Via groundwater in permeable soils;
- Via anthropogenic pathways (e.g. service trenches, the pile itself etc).

The viable pathways by which contaminants can migrate relate to downward migration through permeable superficial deposits such as the granular Head Deposits whereas less permeable superficial deposits of cohesive Head are likely to act as an aquitard (i.e. preventing downward migration into the underlying Principal Aquifer).

Impacted soils could be locally transported / displaced or pushed down by the activity of piling.

4.4 Receptors

The main identified receptors related to future end-users, construction workers and groundwater.

In summary the receptors identified included:

- Principal aquifer beneath the site represented by the Lewes Nodular Chalk Formation bedrock;
- Construction workers (particularly during foundation construction);
- Fabric of the piles themselves (concrete and steel reinforcement).

4.5 Discussion of Consequences of Piling on Contaminated Land

The proposed piling technique to be adopted for the development is Continuous Flight Auger (CFA) which is an auger displacement or screw-type pile. A steel hollow stem boring head with helical flights or 'bullet' is screwed into the ground while displacing the soil both laterally and as risings. When the founding depth is reached the direction of rotation is reversed and the auger is withdrawn.

During withdrawal concrete is pumped at a high pressure through the hollow stem and tip, forming a pile in the void created by the auger, reinforcement is added immediately after the auger has been removed. This method of pile construction involves no ground vibration.

A Roger Bullivant leaflet provides further information on the CFA Piling method and is presented in Appendix B.

The introduction of piles through the Made Ground and Superficial Deposits has the potential to drawdown any contaminated soil into the clean soils beneath.

However, in the context of the findings of the intrusive investigations (localised contamination hot-spot which has not contaminated the groundwater) it was determined that any contamination would not transfer into the groundwater of the principal aquifer. Furthermore given the small cross sectional area of the CFA pile and the highly localized nature of the Lead exceedance it is considered that the CFA pile will not intersect any hot spot, especially following the removal of the hotspot as specified in 14099/GIR/Rev 2.

This discussion is developed in the following risk assessment to identify appropriate risk management approaches.

4.6 Risk Assessment Summary

Table 4.1 provides a summary of the qualitative risk assessment process based on the proposed use of Continuous Flight Auger (CFA) Bored Piles. CFA Piles can be used for all foundation applications and are able to form bored piles whilst the technique produces minimal vibration and noise.

Table 4.1
Piling Qualitative Risk Assessment

Activity	Consequences	Consequence of Risk Being Realised	Probability of Risk Being Realised	Risk Classification	Risk Management Action Taken
Driving of piling head (assuming continuous flight auger piling technique)	Contaminated materials are brought to the surface as arisings	Medium	Low likelihood due to highly localized nature of the hotspot.	Low Risk	All waste arising's generated should be assessed in accordance with the Waste Management strategy, classified by the Contractor and treated accordingly with regard for Duty of Care
	Material and/or contamination is drawn downwards into the underlying aquifer	Medium	Low likelihood due to highly localized nature of the hotspot.	Low Risk	Remediation of near surface soils including removal of known hot-spot contamination, excavation and removal of near surface impacted Made Ground is to be undertaken as part of the proposed development
	Disruption/agitation of contaminants in soil leading to temporary dissolution of hydrocarbon products and therefore temporarily greater mobility/distribution of contaminants	Low	Unlikely due to no hydrocarbons being detected onsite.	No Risk	No Risk
	Release of soil-gas and vapour as a result of the agitation of the soil / perched water	Medium	Zero probability - no contamination within the tested groundwater and no soil gas risk having been identified.	No Risk	No Risk
	Direct contact with contaminated soils and water by construction workers	Medium	Likely Change this as a/ hot-spot removed and b/ no other contamination found	Moderate Risk therefore this is 'no risk'	Use of appropriate PPE and site set up in line with health and safety guidance for working on contaminated sites
Injection of concrete	Injected concrete under pressure could migrate into voids/pore spaces outside of the annulus of the pile and thereby enter into the general groundwater table	Low	Medium likelihood	Low Risk	Real-time monitoring of the volumes of concrete and pumping pressure and comparison with the expected volumes/pressures required to form the pile.
General use of deep concrete piles	Finished concrete piles can act as new preferential pathways for contaminated groundwater migration	Medium	Low likelihood	Low Risk	The selection of cast in situ piles represents the best available opportunity to limit preferential migration of water around the annulus of the pile

Table 4.1
Piling Qualitative Risk Assessment

Activity	Consequences	Consequence of Risk Being Realised	Probability of Risk Being Realised	Risk Classification	Risk Management Action Taken
	Finished concrete piles can act as new preferential pathways for vertical soil-gas / vapour transmission to the near surface and adjoining properties	Low (given that identified contamination was present at shallow depth and limited lateral extent) You might want to change this if the hot spot is being removed.	Low likelihood	Low Risk	Adequate soil-gas assessment and protection measures should be incorporated into the new structures
	Degradation of the concrete in the pile from known contamination in the ground	Medium (if pile fails)	Low likelihood	Low Risk	An appropriate mix of corrosion resistant cement should be used based on the known ground/groundwater conditions.

Section 5 Conclusions & Recommendations

5.1 Choice of Piling Technique

The use of driven or bored Continuous Flight Auger (CFA) cast in-situ piles are considered to be a suitable technique due to the highly limited extent of contamination and the negligible risk posed to groundwater.

In addition, pressurised and bottom-fed concrete injection offers the best opportunity to create a good seal between the pile and the soil stratum which will act to minimise the creation of new long-term preferential pathways for water and/or soil-gas or vapour. Any short-term pathways created by the piling are considered to represent a low risk to the wider environment within the context of the current situation at the site, particularly following remediation.

It is understood that the client's preferred choice of piling technique was **Continuous Flight Auger** (CFA) and this risk assessment has confirmed this technique to be one of the more favourable techniques given the conditions present on the site.

At the time of reporting, the proposed choice of piling technique had been informally discussed Environment Agency however this document is to be submitted to the Environment Agency in support of these initial discussions.

5.2 Environmental Risk Management

The key environmental risks associated with the use of piles on the site are considered to be:

- Material and/or contamination drawn downwards into the underlying aquifer;
- Direct contact with contaminated soils and water by construction workers.

The remediation of near surface soils including removal of known hot-spot contamination, excavation and removal of near surface impacted Made Ground is to be undertaken as part of the proposed development.

The proposed use of CFA piles will minimise the potential to drag down near surface contamination into the underlying aquifer through the piling process.

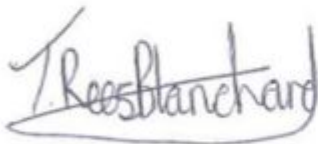
There may be areas of contamination that have not been identified during the course of the intrusive investigation. Such occurrences may be discovered during the construction phases for the development of the site and will be dealt with in accordance with the Discovery Strategy given in the following paragraph

Groundworkers should be instructed to report to the Site Manager any evidence for such contamination, this may comprise visual indicators, such as fibrous materials within the soil, discolouration, or odours and emission. Upon discovery advice must be taken from a suitably qualified person before proceeding, such that appropriate remedial measures and health and safety protection may be applied.

Regular inspections of excavations, during the construction phase of the development, are to be undertaken by the site supervisor. Such inspections must be recorded with appropriate notes and photographs (even where potential contamination is not identified).

The following figures and appendices complete this report:

Figure 1	Site Location Map
Figure 2	Proposed Development Layout
Appendix A	Borehole Logs
Appendix B	CFA Piling Information (Roger Bullivant)



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Director



PROJECT:	DATE:	 <i>Geotechnical & Environmental Consultants</i>
Land south of Ranelagh Road, Havant, Hampshire	January 2015	
CLIENT:	SCALE:	
Jacobs Foreman Developments Limited	Not to scale	
TITLE:	REF:	
Figure 1: Location Plan	14639	



Project: Land south of Ranelagh Road, Havant, Hampshire

Client: Jacobs Foreman Developments Limited

Date: January 2015

Figure 2: Proposed Development Plan

Job Number: 14639

soils
LIMITED
*Geotechnical & Environmental
Consultants*

Appendix A

Borehole Logs

Borehole Log

Borehole No.

BH 1

Sheet 1 of 2

Project Name: Land South of Ranelagh Road

Project No.
14492

Co-ords: -

Hole Type
CP

Location: Havant, Hampshire, PO9 1NR

Level:

Scale
1:50

Client: Foreman Homes

Dates: 29/08/2014 - 02/09/2014

Logged By

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.30	D					Grass and TOPSOIL.	
		0.50 - 0.70	B		0.50			Orange brown silty CLAY.	
					0.90			Brown clayey SAND and flint.	1
		1.20	D	N=11 (5,6/4,3,2,2)					
		1.20 - 1.65	D						
		2.00	D	N=13 (3,2/2,3,4,4)					2
		2.00 - 2.45	D						
		3.00	B	N=12 (2,2/3,3,3,3)	3.00			Brown clayey SAND and flint.	3
		3.00 - 3.50	B		3.10			CHALK and flints.	
		4.00	D	N=20 (2,3/4,6,5,5)					4
		4.30 - 4.45	D						
		5.00	D	N=21 (3,3/6,6,5,4)					5
		5.00 - 5.45	D						
		6.00	D						6
		6.50	D	N=20 (2,2/3,3,7,7)					
		6.50 - 6.95	D						7
		7.50	D						
		8.00	D	N=19 (3,3/3,3,6,7)					8
		8.00 - 8.45	D						
		9.00	D						9
		9.50	D	N=13 (1,2/2,3,4,4)					
		9.50 - 9.95	D						10

Continued on next sheet

Remarks

1 Hour day work cleaning access to borehole (flytipping). 1 Hour day work dig pit to 1.20m bgl.

Borehole Log

Borehole No.

BH 1

Sheet 2 of 2

Project Name: Land South of Ranelagh Road

Project No.
14492

Co-ords: -

Hole Type
CP

Location: Havant, Hampshire, PO9 1NR

Level:

Scale
1:50

Client: Foreman Homes

Dates: 29/08/2014 - 02/09/2014

Logged By

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		10.50	D						
		11.00		N=15 (1,2/3,3,4,5)					11
		11.00 - 11.45	D						
		12.00	D						12
		12.50		N=6 (1,3/2,1,1,2)					
		12.50 - 12.95	D						13
		13.50	D		13.50				
		14.00		N=26 (6,5/5,6,7,8)					14
		14.00 - 14.45	D						
		15.00	D						15
		15.50		N=29 (5,6/6,7,8,8)					
		15.50 - 15.95	D						16
								End of borehole at 16.00 m	
									17
									18
									19
									20

Remarks

1 Hour day work cleaning access to borehole (flytipping). 1 Hour day work dig pit to 1.20m bgl.

Borehole Log

Borehole No.

BH 2

Sheet 1 of 2

Project Name: Land South of Ranelagh Road

Project No.
14492

Co-ords: -

Hole Type
CP

Location: Havant, Hampshire, PO9 1NR

Level:

Scale
1:50

Client: Foreman Homes

Dates: 02/09/2014 - 04/09/2014

Logged By

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.30	D		0.10			Grass and TOPSOIL	
		0.50 - 0.70	B		0.40			Earth backfill. MADE GROUND	
								Orange brown silty CLAY.	
		1.20		N=8 (2,2/2,2,2,2)	1.10			Brown clayey SAND and flint.	1
		1.20 - 1.65	D						
		2.00 - 2.20	U		2.10			CHALK and flints.	2
		2.20	D						
		3.00		N=16 (4,5/4,4,4,4)					3
		3.00 - 3.45	D						
		4.00		N=18 (5,6/5,5,4,4)					4
		4.00 - 4.50	B						
		5.00		N=18 (3,3/3,5,5,5)					5
		5.00 - 5.45	D						
		6.00	D						6
		6.50		N=33 (4,6/6,6,7,14)					7
		6.50 - 6.95	D						
		7.50	D						8
		8.00		N=10 (1,1/1,2,3,4)					
		8.00 - 8.45	D						
		9.00	D						9
		9.50		N=12 (2,2/3,2,3,4)					
		9.50 - 10.00	B						10

Continued on next sheet

Remarks

2 Hours day work get rig to borehole and equipment. 1 Hour day work dig pit to 1.20m bgl.

Borehole Log

Borehole No.

BH 2

Sheet 2 of 2

Project Name: Land South of Ranelagh Road

Project No.
14492

Co-ords: -

Hole Type
CP

Location: Havant, Hampshire, PO9 1NR

Level:

Scale
1:50

Client: Foreman Homes

Dates: 02/09/2014 - 04/09/2014

Logged By

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		10.50	D						
		11.00		N=14 (3,3/2,2,4,6)					11
		11.00 - 11.45	D						
		12.00	D						12
		12.50		N=14 (2,3/3,2,4,5)					13
		12.50 - 12.95	D						
		13.50	D						14
		14.00		N=15 (1,2/4,4,5,2)					15
		14.00 - 14.45	D						
		15.00	D						16
		15.50		N=13 (1,1/1,4,5,3)					17
		15.50 - 15.95	D						
		16.50	DD						18
		17.00		N=16 (3,2/3,3,4,6)					19
		17.00 - 17.45	D						
					17.50			End of borehole at 17.50 m	20

Remarks

2 Hours day work get rig to borehole and equipment. 1 Hour day work dig pit to 1.20m bgl.

Borehole Log

Borehole No.

BH 3

Sheet 1 of 3

Project Name: Land South of Ranelagh Road

Project No.
14492

Co-ords: -

Hole Type
CP

Location: Havant, Hampshire, PO9 1NR

Level:

Scale
1:50

Client: Foreman Homes

Dates: 27/08/2014 - 29/08/2014

Logged By

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.30	D		0.15			Grass and TOPSOIL	
		0.50 - 0.70	B					SAND and flint	
		1.20		N=8 (3,3/2,2,2,2)	1.30				1
		1.20 - 1.65	D					Brown clayey SAND and flint.	
		2.00		N=6 (1,2/2,2,1,1)					2
		2.00 - 2.50	B						
		3.00		3 (3,3/1,1,,1)	3.20				3
		3.00 - 3.45	D					CHALK with occasional flint.	
		3.50 - 4.00	B						
		4.00		N=16 (2,2/2,2,4,8)	4.60				4
		4.00 - 4.45	D						
		4.60 - 5.00	B		4.60			Fine GRAVEL and flint	
		5.00		N=24 (2,4/7,7,5,5)	5.10				5
		5.00 - 5.45	D					CHALK and flint	
		6.00	D						6
		6.50		N=26 (2,2/6,7,8,5)					7
		6.50 - 6.95	D						
		7.50	D						8
		8.00		N=15 (3,2/2,3,4,6)					
		8.00 - 8.45	D						
		9.00	D						9
		9.50		N=14 (3,3/3,3,4,4)					
		9.50 - 9.95	D						10

Continued on next sheet

Remarks

1 Hour 30 minutes day work dig pit to 1.20m bgl. Go to yard for 8", rides and 6" casing. 30 Minutes day work get water.

Borehole Log

Borehole No.

BH 3

Sheet 2 of 3

Project Name: Land South of Ranelagh Road

Project No.
14492

Co-ords: -

Hole Type
CP

Location: Havant, Hampshire, PO9 1NR

Level:

Scale
1:50

Client: Foreman Homes

Dates: 27/08/2014 - 29/08/2014

Logged By

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		10.50	D						
		11.00		N=15 (3,4/4,3,4,4)					11
		11.00 - 11.45	D						
		12.00	D						12
		12.50		N=24 (2,7/5,5,7,7)					13
		12.50 - 12.95	D						
		13.50	D						14
		14.00		N=24 (3,5/6,5,6,7)					15
		14.00 - 14.45	D						
		15.00	D						16
		15.50		N=19 (2,4/4,5,5,5)					17
		15.50 - 15.95	D						
		16.50	D						18
		17.00		N=21 (3,5/5,5,5,6)					19
		17.00 - 17.45	D						
		18.00	D						20
		18.50		N=26 (1,3/3,6,7,10)					
		18.50 - 18.95	D						
		19.50	D						
		20.00		N=30 (2,4/4,8,9,9)					

Continued on next sheet

Remarks

1 Hour 30 minutes day work dig pit to 1.20m bgl. Go to yard for 8", rides and 6" casing. 30 Minutes day work get water.

Borehole Log

Borehole No.

BH 3

Sheet 3 of 3

Project Name: Land South of Ranelagh Road

Project No.
14492

Co-ords: -

Hole Type
CP

Location: Havant, Hampshire, PO9 1NR

Level:

Scale
1:50

Client: Foreman Homes

Dates: 27/08/2014 - 29/08/2014

Logged By

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		20.00 - 20.45	D						
		21.00	D						21
		21.50 21.50 - 21.95	D	N=28 (4,5/5,6,7,10)					
					22.00			End of borehole at 22.00 m	22
									23
									24
									25
									26
									27
									28
									29
									30

Remarks

1 Hour 30 minutes day work dig pit to 1.20m bgl. Go to yard for 8", rides and 6" casing. 30 Minutes day work get water.

Borehole Log

Borehole No.

BH 4

Sheet 1 of 2

Project Name: Land South of Ranelagh Road

 Project No.
14492

Co-ords: -

 Hole Type
CP

Location: Havant, Hampshire, PO9 1NR

Level:

 Scale
1:50

Client: Foreman Homes

Dates: 26/08/2014 - 27/08/2014

Logged By

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.30	D		0.10			CONCRETE	1 2 3 4 5 6 7 8 9 10
		0.50 - 0.70	B					SAND backfill. MADE GROUND	
		1.20		N=14 (3,3/3,3,4,4)	0.90			Brown clayey SAND.	
		1.20 - 1.65	D						
		2.00		N=18 (5,6/5,5,4,4)	1.80			Brown clayey SAND and flint.	
		2.00 - 2.45	D						
		3.00		N=10 (4,4/3,2,2,3)	3.20			CHALK with occasional flint.	
		3.00 - 3.45	D						
		4.00 - 4.50	B						
		4.50		N=19 (2,4/4,4,5,6)					
		4.50 - 4.95	D						
		5.00		N=20 (3,5/6,7,4,3)					
		5.00 - 5.45	D						
		6.00	D						
		6.50		N=7 (2,2/1,2,2,2)					
		6.50 - 7.00	B						
		7.50	D						
		8.00		N=7 (1,2/2,1,2,2)					
		8.00 - 8.45	D						
		9.00	D						
		9.50		3 (2 for 225mm/3 for 225mm)					
		9.50 - 10.00	B						

Continued on next sheet

Remarks

1 Hour 30 minutes day work dig pit to 1.20m bgl. Go to yard for more 6" casing.

Borehole Log

Borehole No.

BH 4

Sheet 2 of 2

Project Name: Land South of Ranelagh Road

Project No.
14492

Co-ords: -

Hole Type
CP

Location: Havant, Hampshire, PO9 1NR

Level:

Scale
1:50

Client: Foreman Homes

Dates: 26/08/2014 - 27/08/2014

Logged By

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		10.50	D						
		11.00		N=4 (1,1,1,1,1)					11
		11.00 - 11.45	D						
		12.00	D						12
		12.50		N=7 (1,1,1,2,2,2)					13
		12.50 - 12.95							
		13.50	D						14
		14.00		N=8 (1,1,2,2,2,2)					
		14.00 - 14.45	D						
		15.00		0 (0 for 0mm/0 for 0mm)					15
		15.00 - 15.45	D		15.50				
								End of borehole at 15.50 m	16
									17
									18
									19
									20

Remarks

1 Hour 30 minutes day work dig pit to 1.20m bgl. Go to yard for more 6" casing.

Appendix B
CFA Piling Information (Roger Bullivant)



BORED AND DISPLACEMENT PILES



ROGER BULLIVANT

PRE-CAST CONCRETE PILES

PILE TYPE RB Pre-cast concrete pile

SIZE (NOM) & GENERAL LOAD CAPABILITY

mm sq.	SWL (kN)*	mm sq.	SWL (kN)*
150	200	250	600
175	300	275	700
200	400	300	800
225	500	350	1200

*Dependent upon ground conditions

APPLICATION

This pile may be used for all types of structures and foundations, from housing, through other forms of domestic building, to commercial and industrial buildings and installations. The piles can also be used for all types of civil engineering applications from bridges to embankment support, power and transmission towers and rail-related structures.

The RB Pre-cast Concrete Piling System is quick to install and very cost-effective in most ground conditions. This pile is environmentally attractive as no spoil or arisings are generated from pile installation.

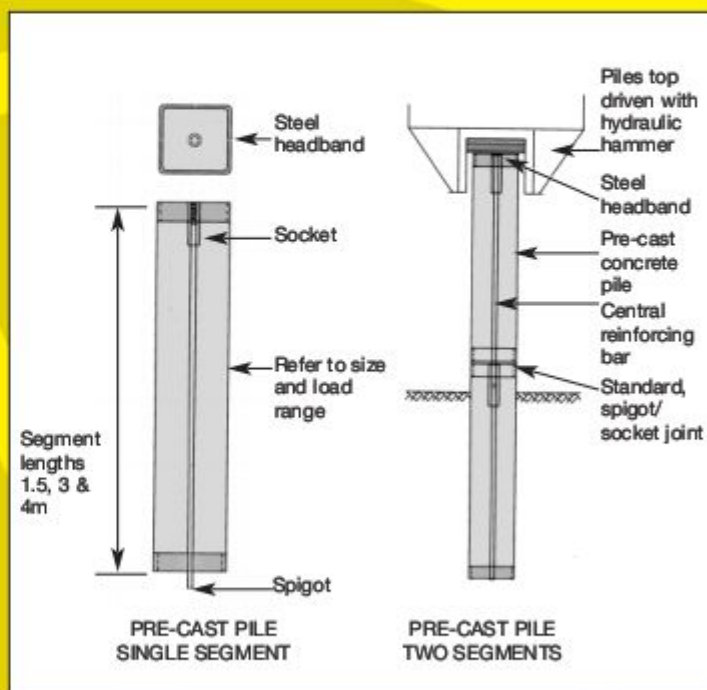
In its standard form the pile is a compression pile with small tensile and bending resistance capability. The design is however, easily adapted to accommodate larger tension and bending forces. The standard segment lengths of 1.5m, 3m and 4m can be complemented as required by 6m segments and by tapered lead sections or enlarged lead sections, as required.

INSTALLATION

RB pre-cast concrete piles are usually top-driven using hydraulic drop hammers, some of which are supersilenced and are part of the company's fleet of remotely operated "Quiet" hammers. Hammer capacities range from 1T up to 10T for our general purpose low noise, low vibration hammers and can be mounted on a variety of tracked or wheeled rigs, depending upon project location, type, access and headroom constraints. All rigs are designed and purpose-built in-house to meet specific site access and transportation criteria.

The smaller sizes of RB pre-cast concrete pile may also be jacked into the ground using a totally vibrationless system utilising RB in-house designed and built jack-down piling rigs.

Quality assurance procedures apply to pile manufacture and delivery, unloading, storage and installation. RB pre-cast concrete piles are suitable for all open, unrestricted site activities, however the variety of segment lengths and existence of specialist equipment makes them ideal for restricted access and low headroom applications.



RB 5000 series rig incorporating the RB "Quiet" Hammer, installing 200mm square pre-cast concrete piles for the foundations to houses



**MINIMISES QUARRYING AND
TRANSPORTATION**

**AVOIDS UNNECESSARY REMOVAL OF
CONTAMINATED MATERIALS**

**PROVIDES EXCELLENT
WORKING PLATFORM**

THE BENEFITS

RB 5000 series rig can install 250, 275 and 300mm square pre-cast concrete piles



RB 5000 series low-headroom rig installing 250mm square pre-cast concrete piles inside an existing warehouse to provide additional support for a new floor slab



FEATURE	ADVANTAGE	BENEFIT
Segmental	Minimal product wastage	Lower costs, saving you money
Short segments	Load, unload and handle by forklift	Quicker production, reduced time - lower preliminary costs
Short segments	Reduced flexing when moved	Minimises cracking - more durable longer life
Single bar reinforcement	No wasted resources	Environmentally friendly
Multi-size range	No over-design	Value engineering
Quality concrete	Enhanced load capacity	Value engineering
Lighter segments	Controlled loading, stacking and pitching	Safer handling - less accidents
Simple design	Versatile - design alternatives straightforward	Easy accommodation of alternative loadings
Simple jointing system	Rapid installation - environmentally friendly	Lower preliminary costs - user acceptability
Modern manufacturing plants	Rapid mobilisation of production facilities	Reduced lead-in times, certainty of build time
Large stock-holding	Large projects accommodated	Flexible service to customers
ISO 9000 accreditation	Consistent Quality Assured products	Reliability - secondary checking costs eliminated
Lightweight equipment	Reduced piling platform requirement	Lower preparation costs, saving you money
Smaller, more powerful equipment	More rapid mobilisation	Lower set-up charges
Specialist plant available	Difficult access, low headroom accommodated	Lower costs compared with large rigs or demolition
Directly employed permanent labour	Dedicated, accurate trustworthy	Certainty of project outcome - peace of mind
In-house geotechnical design team	Technical expertise - rapid deployment	Value engineering - speedy problem solving
Just-in-time deliveries	Minimises stockpiling areas on site	Reduced associated costs - storage area platform

TUBULAR STEEL PILES UNRESTRICTED ACCESS

PILE TYPE RB tubular thick wall steel cased pile driven in up to 6m lengths, with a spigot and socket connection.

SIZE (NOM) & GENERAL LOAD CAPACITY

Dia.	Nominal wall thickness	Max structural capacity*	SWL (kN)*
125mm	10mm	500kN	350
140mm	8mm	400kN	350
165mm	7mm	380kN	350
175mm	10mm	720kN	500
220mm	7mm	500kN	500
240mm	10mm	1000kN	1000
346mm	10mm	1250kN	1250

*Dependent upon ground conditions.

APPLICATION

Whilst clearly being suitable for taking large axial loads, these piles are particularly suitable for accommodating significant horizontal loads and vertical tension loads, induced by large bending moments/horizontal reactions and uplift/heave reactions respectively.

These piles are also very suitable for driving in difficult or uncertain ground conditions up to 50m deep. Hard driving conditions and fill, obstructions or boulders can also be dealt with using this system.

These piles are ideal where embedment is required on a steeply sloping bedrock and supplemental rock-socketing by drilling through the end can be achieved in extreme slope conditions or where load capacity at rockhead needs to be increased.

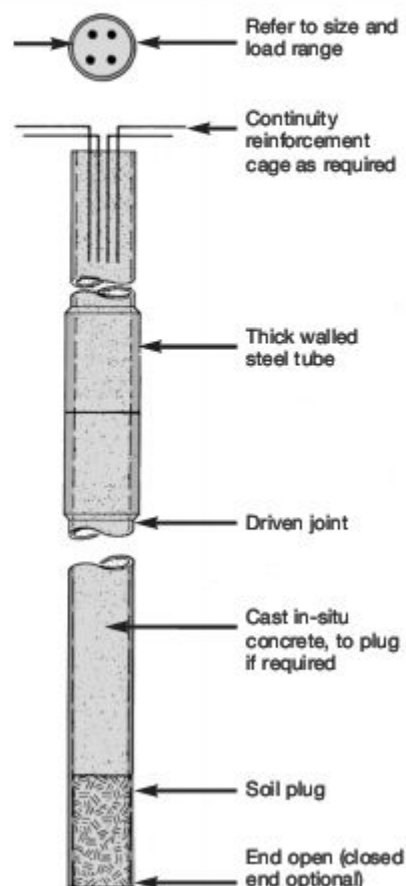
INSTALLATION

These piles are top driven to 'set' or length using purpose-built rigs with hydraulic hammers. The internal void can subsequently be filled with concrete or grout if required and reinforcement incorporated for bonding into pile cap or ground beams. Normally the piles are driven open ended so that a soil plug is rapidly formed. In exceptional circumstances the open end can be closed using a welded end plate.

SITE REQUIREMENTS

The site should be firm, dry, flat and level, and capable of sustaining the load of the piling rigs which typically will weigh up to 35T. Access roads must be suitable for normal delivery vehicles.

TYPICAL INSTALLATION



RB tubular steel piles being driven to a set through strata containing obstructions, for the foundations to a factory unit



COST EFFECTIVE
best value solution

SUITABLE FOR CONTAMINATED SOILS

HIGH PRODUCTIVITY
minimises contract period

TUBULAR STEEL PILES RESTRICTED ACCESS

PILE TYPE RB tubular thick wall steel cased pile driven in maximum 3m segment lengths, with a spigot and socket connection.

SIZE (NOM) & GENERAL LOAD CAPACITY

Dia.	Nominal wall thickness	Max structural capacity*	SWL (kN)*
125mm	10mm	500kN	350
140mm	8mm	400kN	350
165mm	7mm	380kN	350
175mm	10mm	720kN	500
220mm	7mm	500kN	500
240mm	10mm	1000kN	1000
346mm	10mm	1250kN	1250

*Dependent upon ground conditions.

APPLICATION

These piles are suitable for limited headroom and/or restricted access situations. They can cater for tension and/or bending loads or be provided with a drilled rock socket for increased stability, dependent upon ground conditions.

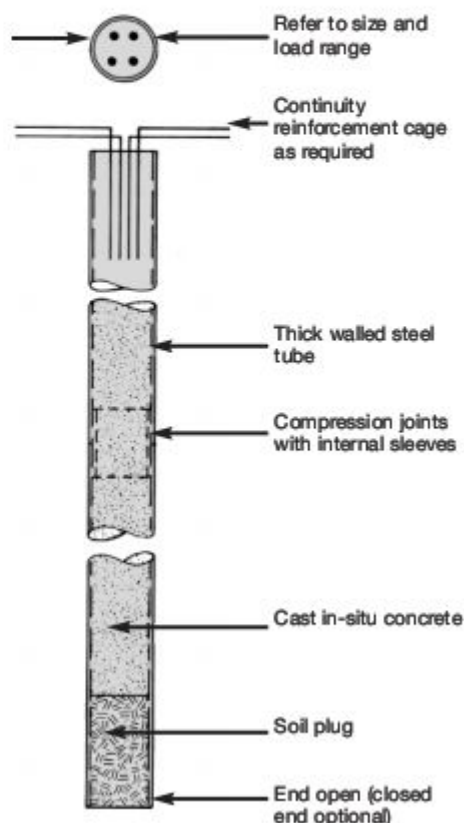
INSTALLATION

They are top driven to a length or 'set' using remotely operated piling rigs with up to 5T hydraulic hammers. The internal void can be filled with concrete or grout, as required and reinforcement installed for bonding into pile cap or ground beams.

SITE REQUIREMENTS

Generally minimum 2m headroom for 125mm and 165mm diameters; other diameters - 4.5m. The working surface must be firm, dry and level.

TYPICAL INSTALLATION



RB 5000 series driven piling rig installing steel tubular piles, adjacent to the external wall, within a warehouse



COST EFFECTIVE
best value solution

SUITABLE FOR CONTAMINATED SOILS

HIGH PRODUCTIVITY
minimises contract period

CONTINUOUS HELICAL DISPLACEMENT (CHD) BORED DISPLACEMENT PILES

PILE TYPE RB continuous helical displacement pile

This is a bored pile which displaces the soil through which it is constructed. It creates no appreciable arisings and therefore, there is minimal spoil to remove from site.

SIZE (NOM) & GENERAL LOAD CAPABILITY

There are currently two standard sizes as shown below:

Designation	Central core max. dia.	Helical concrete flange max. dia	SWL (kN)* (nominal)
300/600	300mm	600mm	700
400/700	400mm	700mm	1200

**Dependent on ground conditions.*

APPLICATION

This type of pile can be used for all foundation applications where bearing piles are required for either buildings or structures. The pile may also be used where there is a retaining requirement. The ability to form bored piles without producing any spoil makes this kind of pile particularly advantageous on contaminated sites. There is minimal vibration and noise.

In most ground conditions, this pile is an ideal alternative to CFA (continuous flight auger). Enhanced load carrying capacity may be achieved compared with CFA piles of similar dimensions, due to compaction of the soil during boring. In some ground conditions improvements of up to 30% have been demonstrated with a consequential shortening of the pile and reduction in cost.

INSTALLATION

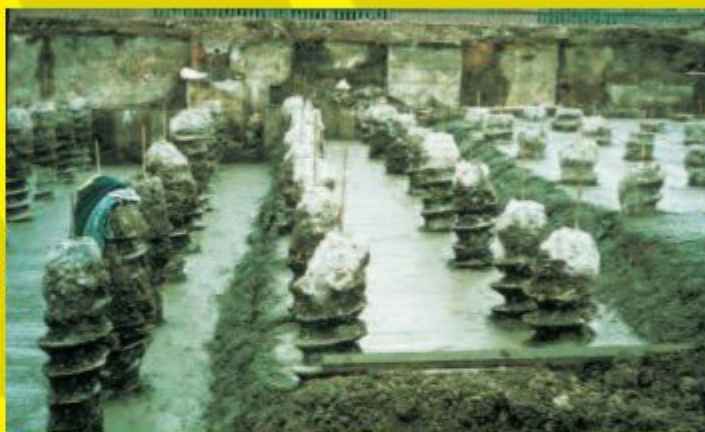
The piles are formed using a highly efficient multi-flight, bullet ended shaft, driven by a high torque rotary head, enabling penetration of the strata without bringing material to the surface. Data is recorded using computerised instrumentation.

Nominal surface heaving may occur but compared with the arisings from CFA boring, the volume is negligible.

RB 7000 series rig



Completed CHD piles awaiting basement floor construction



COST EFFECTIVE
best value solution

SUITABLE FOR CONTAMINATED SOILS

HIGH PRODUCTIVITY
minimises contract period

Once drilled to calculated or proven depth, concrete is pumped under pressure down the hollow shaft to the boring head and out of the tip while the shaft is reverse rotated and withdrawn from the bore. Reinforcement in the form of cage or single bar is introduced into the bore upon completion of the concreting operation.

Reinforcement is left protruding from the pile as appropriate for forming connections to following structural elements. Surface heave and waste concrete is cleared from the formation to complete pile construction.

Whilst the rig is relatively large it can be operated on both open, unrestricted access sites and in difficult, confined areas. Headroom of 22m is required for the standard rig but lower headroom options are available together with rigs for constructing bored piles inside buildings.

THE BENEFITS OF USING THE CHD SYSTEM

- The system creates no appreciable arisings therefore:
 - there is no double handling of spoil on site and no spoil heaps.
 - there is virtually no spoil to remove.
 - there are no associated adverse environmental effects or costs.
- There is no vibration and minimal noise; thus piles can be constructed closer to existing buildings and structures than with other systems.
- Pile integrity is enhanced as the displacement boring method reduces the potential for "necking".
- Another environmental benefit is that better use is made of the pile materials, thereby minimising the number of lorry movements to the site and saving natural materials by reducing waste.
- Geotechnically, this type of pile performs better than a similar CFA pile. Different ground conditions produce varying benefits, but the most useful is the potential to shorten the pile.
- This installation system is rapid and as a result provides benefits to contract programming.
- Rapid installation also eliminates the need for on-site static agitators, pumps and pump-lines. Concreting is carried out using mobile concrete pumps.

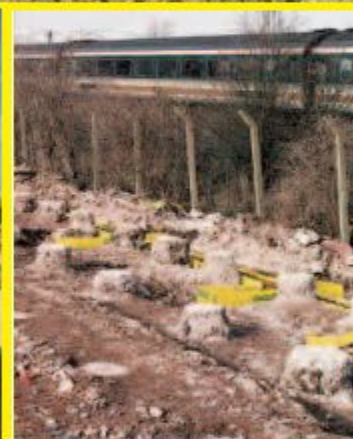
CHD piles being formed at a large unrestricted construction site



Drilling procedure initiated



Completion of the concrete procedure in readiness for the steel reinforcement.
N.B. Minimal soil arisings



NO SPOIL PRODUCED

REDUCED VIBRATION
compared with traditional dynamic compaction

TOTAL AREA TREATMENT

CONTINUOUS FLIGHT AUGER (CFA) PILES

PILE TYPE RB continuous flight auger piles

SIZE (NOM) & GENERAL LOAD CAPABILITY

Dia	SWL (kN)*
300mm	700
400mm	1250
450mm	1550
500mm	1900
600mm	2500

*Dependent upon ground conditions.

APPLICATION

General all purpose application for new and refurbishment projects.

The piles are speedily installed and can cater for a variety of ground conditions. They are cost-effective and can accommodate large working loads, depending upon the ground conditions into which they are installed.

The standard size range may be complemented with intermediate sizes if required and pile lengths of up to 19m can be constructed.

Standard reinforcement details are used where appropriate which will comprise single centrally positioned reinforcing bars or reinforcement cages as required to suit horizontal or bending moment loadings.

Special cages can be manufactured to suit specific loading situations.

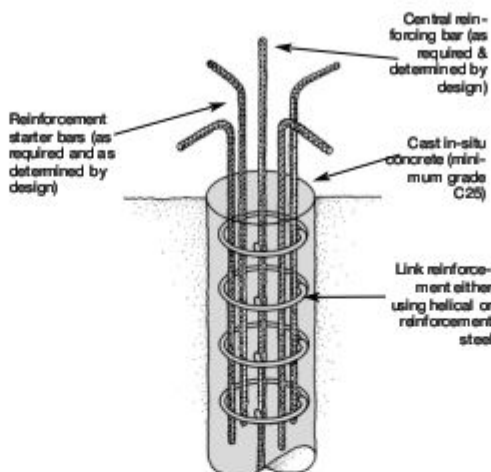
INSTALLATION

RB CFA piles are formed using hollow stem auger boring techniques, which will produce arisings from the bores in most UK ground conditions. Having produced a bore to calculated depth through known strata, concrete is pumped into the bore under pressure and continues to be pumped as the auger flight is lifted.

Concrete simultaneously fills the void left by the auger extraction. The reinforcement is installed in the bore after the pile has been concreted.

The company operates a fleet of bored piling rigs which have the capability of installing computer-controlled continuous flight auger (CFA) piles and sectional flight auger (SFA) piles. These are suited to all types of conditions from open, unrestricted access sites to very confined, low-headroom situations.

CFA piles being installed for the foundation system to a retail unit extension



Diagrammatic view of CFA pile.

Regional Offices

HEAD OFFICE

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