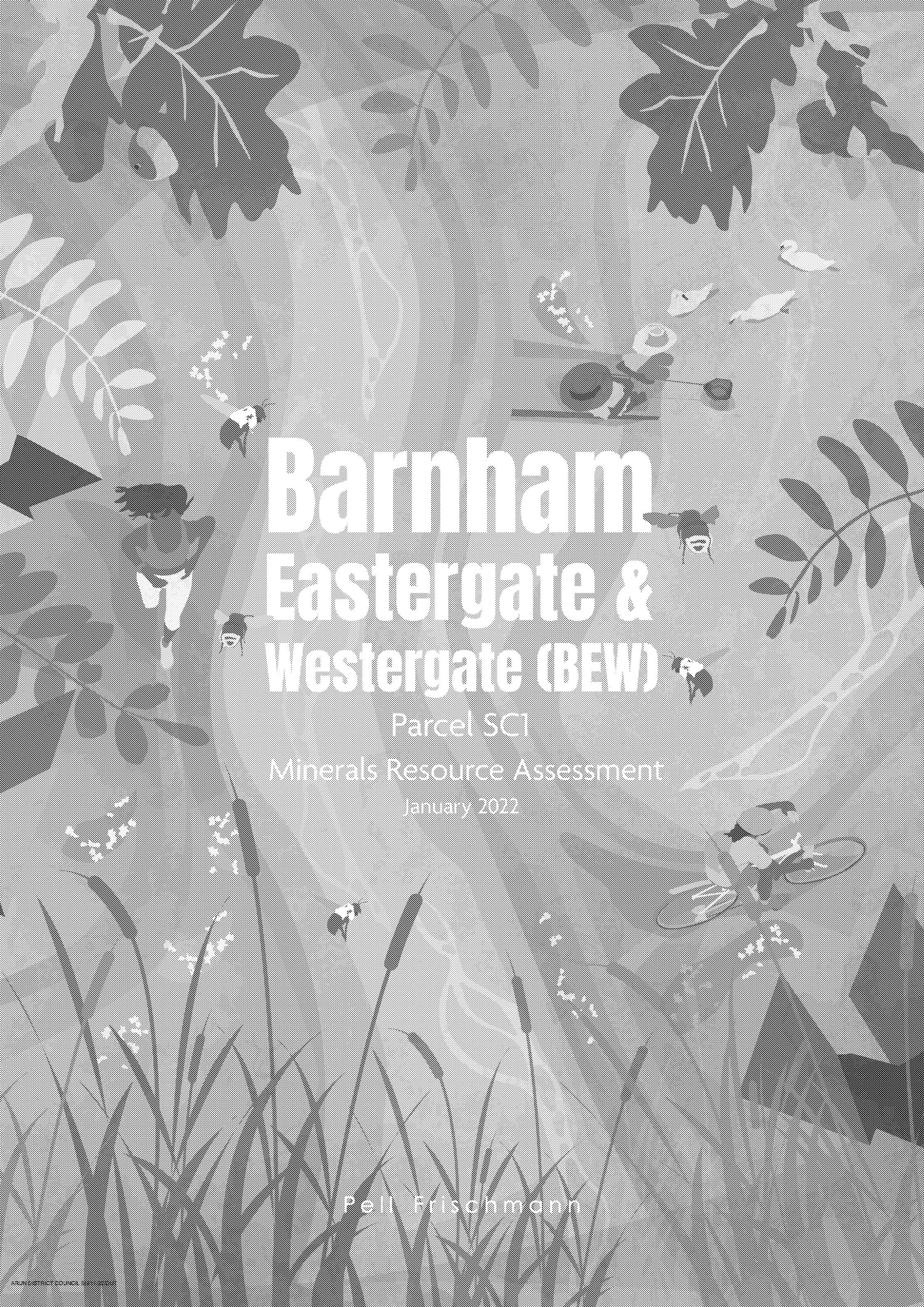




Barnham Eastergate & Westergate (BEW)

Parcel SC1

Minerals Resource Assessment

January 2022

Pell Frischmann

Pell Frischmann

Barnham Eastergate Westergate, Parcel SC1

Mineral Resource Assessment

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Appendix B WYG Geotechnical Investigation

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Appendix D Sand and Gravel Map

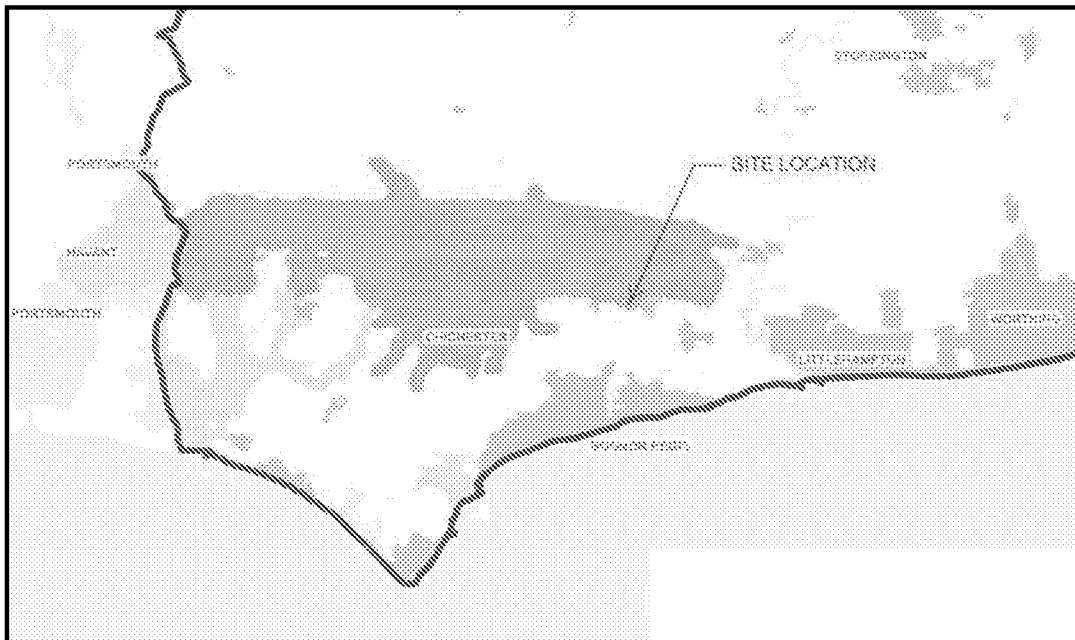
1 Introduction

1.1 Background

Pell Frischmann has been commissioned by CC Projects, Ashmarden Ltd and Hanbury (PM) Ltd. (promoting the site together as 'The Southern Consortium') to provide transport planning and highways consultancy services in connection with emerging masterplan proposals for a strategic residential-led mixed use development on land forming part of the site allocation at Barnham/ Eastergate/ Westergate, (BEW), West Sussex. The application site comprises land south of Barnham Road and north of the railway as well as the route of the A29 realignment including the early connection referred to as the Hanbury Link (the 'Site'). The development is referred to as BEW Parcel SC1.

This assessment identified that the site is located within a mineral safeguarding area as designated by the West Sussex County Council Joint Mineral Local Plan¹. The area is classified as being within a sharp sand and gravel mineral safeguarding area, refer to Figure 1

Figure 1: Site Location - Sharp Sand and Gravel Mineral Safeguarding Area



1.2 Scope and Objective of the Report

This report has been prepared in accordance with the Draft Mineral Safeguarding Guidance² to allow planning application discussions with the Minerals Planning Authority. This Mineral Resource Assessment (MRA) has been scoped to include the following:

- Review of site-specific geological information.
- Review of historical quarrying in the site vicinity.
- Assessment of the mineral recovery potential considering acceptability and viability.
- Assessment of the considerations affecting the mineral recovery potential.
- Assessment of whether mineral sterilisation will occur as part of the development.
- Assessment of constraints to mineral extraction.

¹ West Sussex County Council, *Joint Minerals Local Plan*, dated July 2018

² West Sussex Joint Minerals Local Plan, *Draft Minerals Safeguarding Guidance*, dated April 2016

1.3 Sources of Information

This MRA will reference the PF Phase 1 Land Contamination Desk Study, report reference A13394-PF-C-ZZ-XX-RPT-002, which should be read in conjunction with this report and includes the following sources of information:

- GroundSure Geo-Insight Report
- GroundSure Enviro-Insight Report
- Historical maps (1876-1994) 1:2,500
- Historical maps (1876-2014) 1:10,560
- 1:50,000 Scale BGS Map
- British Geological Survey Onshore Borehole Database
- WYG Hydrology and Hydrogeology Report⁶

1.4 Description of the Project

The site is currently farmland. Outline planning permission (with all matters reserved except for the A29 realignment) for the demolition of existing structures and mixed use development to provide residential dwellings (Use Class C3), care home/senior living accommodation (Use Classes C2/C3), flexible retail and community floorspace (Use Classes E/F2/sui generis), a primary school, plus associated open space, landscaping, drainage and all other associated ancillary works; and realignment of the A29 and early connection to existing A29, including construction of a new road carriageway, junctions and associated infrastructure, refer to **Error! Reference source not found.**

³ WYG Group Limited, *Barnham Eastergate Westergate: Hydrogeology and Hydrology Report*, Report Reference A076162-3, dated November 2017

Table 1: Summary of Anticipated Ground Conditions

Strata	Typical Composition	Top of Stratum (m bgl)	Thickness (m)
Topsoil	Slightly gravelly sandy silt	0.0	0.3 - 0.45
Alluvium / River Terrace Deposits	Layers of clay, sandy silt and gravelly sand	0.3 - 0.45	2.6 – 4.15
London Clay	Slightly sandy clay	2.9 – 4.6	Not proven

m bgl = metres below ground level

2.2 Groundwater and Hydrology

Groundwater monitoring was undertaken by WYG as part of their ground investigation. Groundwater was recorded in window samples over a period of 12 months and the groundwater conditions encountered are summarised in Table 2. The WYG window sample logs and groundwater monitoring data are presented in Appendix B.

Table 2: Summary of Groundwater Conditions

Window Sample	Max level (m bgl)	Min level (m bgl)	Variation (m)
WS01	0.9	1.5	0.6
WS02	0.8	1.6	0.8
WS03	1.0	2.6	1.6
WS06	1.2	2.5	1.3
WS08	0.5	2.0	1.5
WS09	0.4	2.5	2.1
WS11	0.7	2.5	1.8

The western portion of the site is at a medium to high risk of flooding from rivers and the sea. The GroundSure report indicates this area of the site therefore has a 1 in 30 or greater chance of flooding in any given year.

No flood defences are located within 250m of the site.

2.3 Ground Mining and Mineral Extraction

No current or historical mining areas were identified within 1,000m of the site boundary.

A review of the BGS BRITPITS database identified three ground workings within 1,000m of the site boundary. The BRITPIT database covers active; inactive mines; quarries; oil wells; gas wells and mineral wharves; and rail deposits throughout the British Isles. These are summarised in Table 3.

Table 3: Summary of Historic Ground Workings			
Name	Commodity	Approx. Distance	Status
West Barnham Brick Field	Clay & Shale	350m East	Ceased - shown on historic mapping to be present until 1950 when it was converted to residential development
Woodgate Brick Field	Clay & Shale	830m South	Ceased
Northfields Farm Gravel Pit	Sand & Gravel	930m North	Ceased

2.4 Environmentally Sensitive Areas

The GroundSure report classifies the site as a Nitrate Vulnerable Zone therefore the area drains into either nitrate polluted areas or areas that could be polluted by nitrates.

2.5 Unexploded Ordnance

A preliminary UXO desktop study was reported in the PF Phase 1 Land Contamination Desk Study, report reference A13394-PF-C-ZZ-XX-RPT-002, which concluded the site is a low UXO risk, and contractors should exercise all reasonable precautions with regard to UXO.

3 Mineral Safeguarding

3.1 Guidance

The West Sussex, Joint Minerals Local Plan, dated July 2018 states the following under Policy M9: Safeguarding Minerals:

(a) Existing minerals extraction sites will be safeguarded against non-mineral development that prejudices their ability to supply minerals in the manner associated with the permitted activities.

(b) Soft sand (including potential silica sand), sharp sand and gravel, brick-making clay, building stone resources and chalk reserves are safeguarded against sterilisation. Proposals for non-mineral development within the Minerals Safeguarded Areas (as shown on maps in Appendix E) will not be permitted unless:

- Mineral sterilisation will not occur; or
- it is appropriate and practicable to extract the mineral prior to the development taking place, having regards to the other policies in this Plan; or
- the overriding need for the development outweighs the safeguarding of the mineral and it has been demonstrated that prior extraction is not practicable or environmentally feasible.

3.2 Definitions

The mineral under consideration is sharp sand and gravel. The Mineral Assessment Report 183⁴ defines this mineral as "part of a deposit that is a potentially workable material". A mineral may be described as 'potentially workable' if it meets the following general criteria:

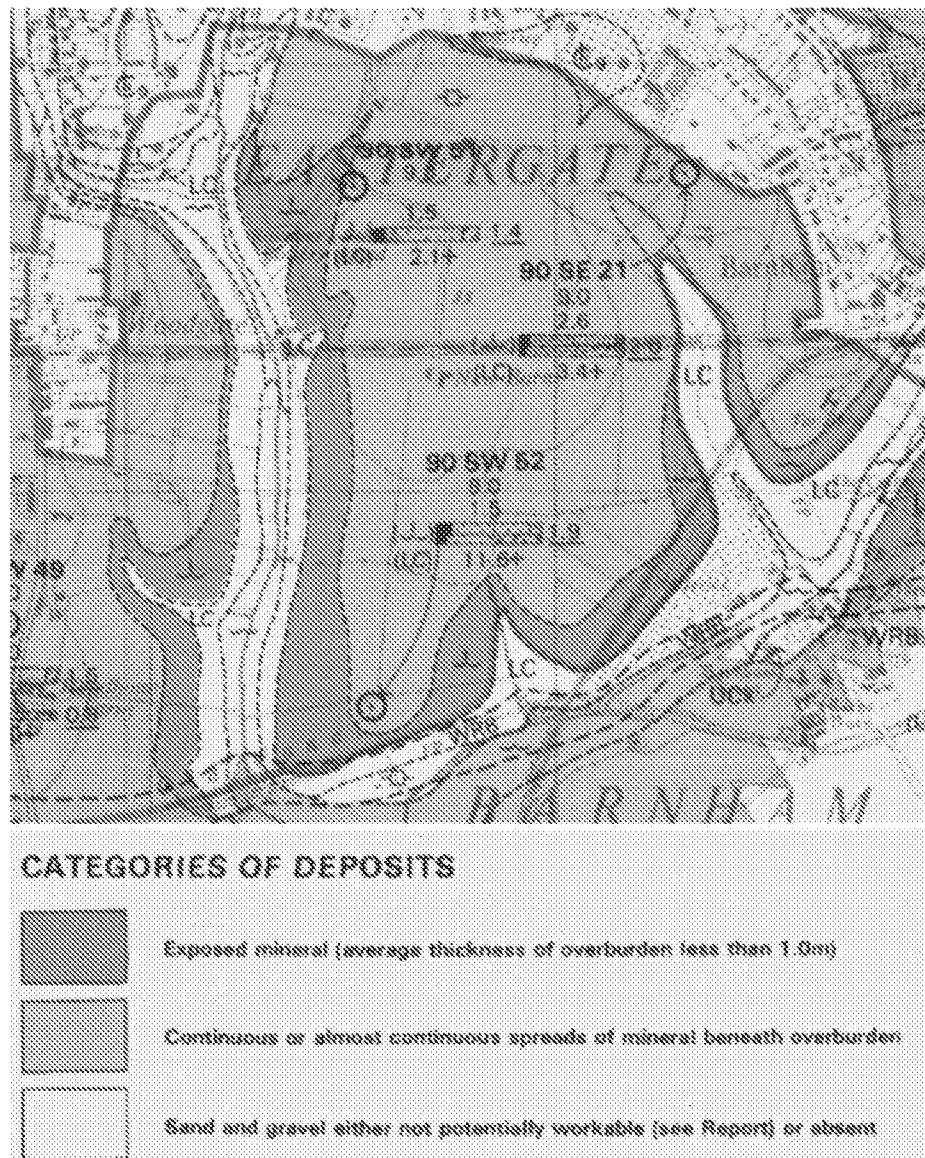
- The deposit should average at least 1m in thickness.
- The ratio of overburden to sand and gravel should be no more than 3:1.
- The proportion of fines (particles passing a 0.063mm sieve) should not exceed 40 percent.
- The deposit should lie within 25m of the surface.

Bedrock is defined as the formation underlying rock head. Overburden is any material between the surface and the mineral. Waste is defined as any material other than mineral or bedrock.

The anticipated mineral distribution at the site is shown in the map reproduced from Mineral Assessment Report 183, in Appendix C.

⁴ Mineral Assessment Report 183: *The sand and gravel resources of the country around Chichester and north of Bognor Regis, Sussex*, Lovell and Nancarrow, Institute of Geological Sciences (1983)

Figure 3 – Mineral Extents and Investigation Locations. Scheme extents outlined in green.



3.3 Mineral Distribution in Historic Boreholes

Previous boreholes at the site have been reviewed to identify the variation in thickness of mineral and overburden across the scheme area. The summary of these is presented in Table 4. The previous boreholes have been sourced from Mineral Assessment Report 183 and the previous WYG geotechnical investigation. The locations of the investigations from the Mineral Resource Assessment Report 183 are shown Appendix C. The locations of the WYG window samples can be found in the WYG report in Appendix B.

The distribution of mineral, overburden and depth to bedrock are summarised in Table 4.

Table 4: Mineral Thicknesses from Previous Investigations					
ID	Thickness of Overburden	Overburden Description	Thickness of Mineral	Mineral Description	Depth to Bedrock
WS01	1.90m	Sandy SILT and Sandy CLAY	1.20m	Gravelly fine to coarse SAND	3.1m bgl
WS02	0.45m	Sandy SILT	2.55m	Very clayey GRAVEL and Gravelly SAND	3.0m bgl
WS03	1.90m	Sandy CLAY	2.60m	Silty SAND	4.5m bgl
WS06	No mineral present within window sample borehole				
WS08	No mineral present within window sample borehole				
WS09	1.0m	Sandy CLAY	2.05m	Gravelly SAND	3.1m bgl
WS10	No mineral present within window sample borehole				
WS11	1.9m	Sandy CLAY	3.1m+	SAND	Not proven to 5.0m
90 SW 51	1.5m	Silty CLAY	1.4m	Clayey SAND	2.9m bgl
90 SW 52	1.5m	Clayey SILT	1.9m	Clayey SAND and Sandy GRAVEL	3.4m bgl
90 SE 21	2.6m	Silty CLAY	2.0m	Gravelly SAND	4.6m bgl

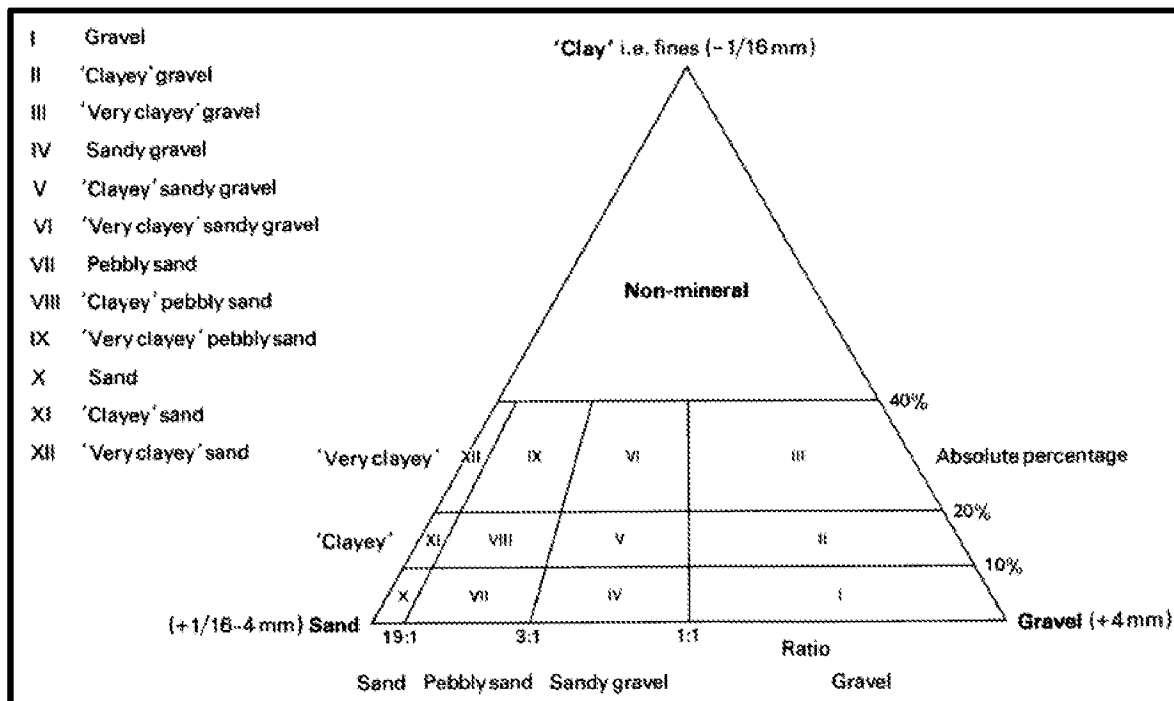
In addition, the Mineral Resource Assessment Report 183 involved particle size distribution testing of samples from the boreholes. The results of this testing are presented in Table 5.

Table 5: Particle Size Distribution from Previous Investigations				
Investigation	Depth (m bgl)	Fines %	Sand %	Gravel %
90 SW 51	1.5 – 2.5	13	73	14
90 SW 51	2.5 – 2.9	8	77	15
90 SW 52	1.5 – 2.5	14	75	11
90 SW 52	2.5 – 3.4	6	58	38
90 SE 21	2.6 – 3.6	6	86	8
90 SE 21	3.6 – 4.6	4	49	47

3.4 Mineral Quality

The mineral classification as per Mineral Resource Assessment Report 183 is shown in Figure 4. The report defines non-mineral as soil having a fines content greater than 40%. The laboratory testing results indicates the mineral comprise a clean sand and gravel with minor fines content which would indicate a Gravel (I) type material.

Figure 4 – Diagram showing the descriptive categories used in the classification of sand and gravel



4 Extraction Considerations

An assessment of the key considerations and constraints to mineral extraction are considered below.

4.1 Importation of Inert Fill

Mineral extraction will require excavation and storage of overburden material (clays and silts) which are approximately 1.5m to 2.5m in thickness. The mineral may then be extracted until bedrock material is encountered (at approximately 3m to 4.5m below ground level). Following extraction, the overburden material can be replaced, but inert fill will need to be imported if the site is to be returned to existing levels.

If importation and backfilling is required the costs associated with sourcing, transporting and placing this material will need to be considered. As this material will form the foundation for housing and road developments the material will need to be placed and compacted under engineering controls to ensure settlement effects are not adverse and do not affect the proposed road and housing development. If this fill material is cohesive this will need to be placed close to the optimal moisture content to ensure adequate compaction is achieved, which may require drying, likely requiring the earthworks program to only be achievable during the summer months.

As the site is generally level, significant earthworks are not anticipated to be required for the scheme development. Therefore, site won fill is not anticipated to be available to be used for backfilling extraction excavations.

4.2 Groundwater

Shallow groundwater is present across the site with groundwater levels generally recorded between 1.0m and 2.0m below ground level across the site. As per the depths to bedrock in Table 4, to extract the mineral, the required excavation will vary between 2.9m and 4.6m below ground level. Excavations of that depth below the groundwater table presents the following challenges:

- Shallow groundwater will decrease the stability of the sides of any excavation significantly. Shallow batters will be required to provide a safe working platform for the excavators working to extract the mineral.
- If the extracted mineral is to be replaced with inert fill following extraction, it will not be possible to adequately place cohesive inert fill beneath the water table without significant excavation dewatering. Placing fill beneath the water table generally requires large sized granular material to overcome these challenges, which is not anticipated to be economical.
- The surface of the scheme area has been observed from site walkovers to be wet and soft with water ponding on the surface following rainfall. Shallow water with surficial ponding is anticipated to present additional challenges for a significant earthworks program and may require construction of additional haul roads.

4.3 Drainage and Flooding

If the extracted mineral is not to be backfilled to existing levels or is only partially backfilled, the associated change in site elevation presents a significant increase in risk of flooding in the area. The site is considered to be at high risk of flooding with anecdotal evidence of seasonal flooding currently affecting the towns of Barnham and Eastergate and surficial ponding of water at the site observed from site walkovers. For drainage design of the proposed scheme, discharge rates will be increased by 40% to account for 100-year climate change which presents another increase in flooding risk on top of any decrease in site elevation due to mineral extraction.

The current geological strata of the area comprise the cohesive 'overburden material' overlying the sands and gravel 'mineral' with London Clay forming the bedrock for the site. London Clay is a low permeability material and therefore current infiltration of surface runoff water will be through the permeable sand and gravel layers overlying the London Clay. If these permeable sand and gravel layers are removed and replaced with low permeability

compacted cohesive fill this will affect infiltration drainage through the area resulting in more surface flooding than is currently present.

4.4 Visual Impact

If the extracted mineral is not to be backfilled to existing levels with inert fill, the proposed housing development will be 'sunk' from the surrounding ground which will impact the desirability of this housing development and aesthetics.

4.5 Overburden Removal

If the extracted mineral is not to be backfilled to existing levels with inert fill, the release of overburden in the over-consolidated London Clay will result in long term heave which can affect the road construction and housing foundations.

4.6 Cleaning and Processing

As discussed in Section 3.4 the laboratory testing indicates the sand and gravel has a minor fines content, therefore minimal processing and washing of excavated mineral is anticipated to make the mineral suitable for market.

4.7 Proximity to Existing Infrastructure

The site is bordered by residential and commercial developments and a railway line crosses the central portion. The railway line is sensitive to ground movements and excavation in the vicinity of the railway line or other sensitive structures may need to be monitored to ensure ground movements resulting from excavation and dewatering do not affect them.

4.8 Development Size

The development is relatively large accommodating an area of 70ha north of the railway line. This large area will allow large earthworks operations to take place, with large batters able to be accommodated to account for unstable ground, storage of overburden material and mineral processing facilities will be able to be accommodated.

4.9 Environmental Impact

Any mineral extraction activity shall have an unavoidable impact on the local environment (flora and fauna) and on the quality of living for local residents. Some of the issues that are associated with such impact are as follows:

- Noise: Heavy machinery carrying out the excavation works and increased traffic on surrounding roads will result in higher levels of daytime noise.
- Traffic: Local roads, which are generally minor roads, would be subjected to a significant increase in heavy traffic loading associated with the transport of extracted mineral away from the site.
- Dust: Mineral extraction operations may result in an increase of air-borne dust unless rigorous dust suppression controls are implemented.

4.10 Regional Mineral Distribution

The sand and gravel resource distribution for the region is shown on the plan drawing in Appendix E. This plan shows the distribution of mineral with different categories, either exposed mineral (with overburden thickness less than 1m), continuous mineral (spread of mineral beneath overburden) and areas where the mineral is not workable or absent. The scheme development area falls predominately into the category of continuous mineral. Large areas north of Eastergate are categorised as being exposed mineral where the thickness of overburden is

less than 1.0m and therefore may be considered to be more desirable for extraction, although it is recognised that some areas of this have been developed since production of the map.

5 Development Considerations

5.1 Overview

The development will require the preparation of land parcels with the capacity for construction of residential units. A roadway south of the A29 will be constructed as part of the works. Figure 5 shows the BEW Parcel SC1 (green boundary) which forms part of the wider BEW site allocation (red boundary).

Figure 5 – Proposed Development



5.2 Housing Supply

The National Planning Policy Framework (NPPF) (July 2021) sets out the Government's planning policies for England and aims to proactively deliver sustainable development to support the Government's housing and economic growth objectives to meet the needs of the country. Local Planning Authorities are required to identify and supply deliverable sites sufficient to provide a minimum of five years' worth of housing. Where there is a significant under delivery of housing over the previous 3 years a 20% buffer should apply.

The Arun District Council Authority Monitoring Report 2019-20 presents the Council's latest published evidence base on the Housing Land Supply. It identifies that the Council considers that it has a 3.3 year land supply.

6 Preliminary Engineering Assessment

6.1 Sterilisation

Construction of the proposed roadway and housing development will sterilise the resource beneath the scheme. The volume of mineral sterilised in the SC1 parcel is roughly estimated to be between 1.4 and 1.8 million cubic metres, this is based on an extractable area of 70ha and a mineral thickness of 2.0m to 2.5m. The road corridor area estimated to be between 0.2 and 0.25 million cubic metres based on an extractable area of approximately 10ha.

6.2 Extraction Approaches

It is considered likely that any extraction will have to take place during preparation of development parcels and road corridor. As discussed in Section 4.1, due to high groundwater on the site it is anticipated to be problematic to backfill the extracted mineral with inert cohesive fill under wet conditions without an extensive dewatering regime. The source of the backfill material would also need to be addressed.

6.3 Timing for Extraction

Prior extraction is likely to delay construction of the scheme. Currently the scheme requires minimal earthworks other than topsoil stripping and minor cut and fill, to create a level surface. Prior extraction will introduce an extensive earthworks program to extract the mineral (excavation anticipated to be up to 4.5m below ground level) and replacement of the excavated material with overburden and imported fill. Placing fill beneath the groundwater table is anticipated to be problematic and time-consuming, increasing the delay to the scheme program.

7 Summary and Conclusions

This report considered the available site setting and geotechnical information to assess the sharp sand and gravel mineral resource with regards to the proposed site development.

The development will involve a realignment of the A29 and early connection to existing A29, including construction of a new road carriageway, junctions and associated infrastructure, together with the construction of residential dwellings, care home/senior living accommodation, retail and community floorspace, a primary school, and associated open space landscaping.

The ground investigation information indicates the mineral resource is overburdened by between 1.0m to 2.0m of silt and clay. The mineral is generally described as a mixture of sand and gravel and is approximately 1.5m to 2.5m in thickness. The bedrock for the site is London Clay and the top of this layer was generally encountered at between 3.0m to 5.0m below ground level. Groundwater monitoring was conducted within the scheme area over a period of a year and recorded groundwater levels generally varied between 1.0m and 2.0m below ground level.

The proposed development will sterilise the mineral beneath the development. Assuming an average mineral thickness over the scheme area this will result in sterilisation of approximately 3 million m³ of material. This report has considered the feasibility of prior extraction and the potential constraints. The main constraints identified are high groundwater affecting excavation works and replacement of the excavated mineral with inert fill beneath the water table. It is also noted that any extraction process will likely have a detrimental impact on the quality of living for local residents. Similarly, extraction processes are also likely to be associated with a negative impact on the local flora and fauna.

The report has considered two main approaches to prior extraction, either backfill to existing levels with imported fill or not replacing the material extracted and reducing the site levels. Backfilling with cohesive fill beneath the water table presents challenges in achieving suitable strength values for the lands proposed use as a roadway and residential development, therefore it is anticipated that significant dewatering works will be required during construction which will delay the extraction program and increase cost. Not returning the site to its existing level is not considered to be feasible due to the significantly increased flooding risk and visual effects on the residential development.

As discussed in Section 5.2, Local Planning Authorities are required to identify and supply deliverable sites sufficient to provide a minimum of five years' worth of housing and apply a 20% buffer where there has been a significant under delivery of housing over the previous 3 years. The Arun District Council Authority Monitoring Report 2019-20 presents the Council's latest published evidence base on the Housing Land Supply and identifies that the Council considers that it has a 3.3 year land supply. This development will provide parcels for residential dwellings, assisting the Arun Council to meet forecasted housing demand

The sand and gravel mineral at the site is considered to be relatively accessible (with a thin layer of overburden material) and to have a minor fines content therefore requiring minimal processing. However the geotechnical constraints discussed above to prior mineral extraction are anticipated to significantly increase the cost and may make prior extraction economically unfeasible. Scheme programme delays resulting from a large earthworks regime that are not required for the permanent design are anticipated to also detrimentally affect the project. Regionally additional shallow mineral resource areas are present in the surrounding area that can be utilised for sand and gravel banks. It is also considered that the overriding need for the housing development in the area to meet growing housing concerns will outweigh the benefits of prior extraction of the sand and gravel resources.

Appendix A Development Plans

Appendix B WYG Geotechnical Investigation
Investigation Plan
Window Sample Logs
Groundwater Monitoring Data

Appendix C Historic Geotechnical Investigations

Mineral Assessment Report 183 Investigation Plan

Mineral Assessment Report 183 Borehole Logs

Appendix D Sand and Gravel Map

