



# **West Winch Housing Access Road**

## **Environmental Statement Chapter 12: Geology & Soils**

### **Appendix 12.2: Mineral Resource Assessment**

Author: WSP

Document Reference: NCC/3.12.02

Version Number: 001

Date: October 2023



**Contents**

Foreword ..... 3

1 Introduction and Objectives..... 5

    1.1 Introduction..... 5

    1.2 Scope of Works ..... 6

    1.3 Limitations ..... 7

2 Site Description & Proposed Development ..... 8

    2.1 Site Description and Proposed Development..... 8

3 Mineral Planning Policy Review ..... 8

    3.1 National Planning Policy..... 8

    3.2 Local Planning Policy ..... 9

4 Nature of the Existing Mineral ..... 11

    4.1 Geology ..... 11

    4.2 WSP Ground Investigation ..... 17

    4.3 Hydrology ..... 19

    4.4 Mineral Resource Presence ..... 19

    4.5 Mineral Resource Size and Quality ..... 23

    4.6 INFORMATION FROM ADJACENT SCHEME..... 24

5 Practicability and viability of prior extraction..... 24

    5.2 Site Specific Considerations..... 24

    5.3 Market Considerations..... 26

    5.4 Effect on the viability and deliverability of the non-mineral development 26

6 Conclusions and Recommendations..... 27

**Tables**

Table 4-1 - Geological Mapping Summary ..... 12

Table 4-2 - BGS Borehole Summaries ..... 15

Table 4-3 - Deposit Details..... 21

Table 5-1 – Local Proposed Quarries..... 26

**Figures**

Figure 1-1 - Identified Mineral Safeguard Areas..... 6



## Foreword

WSP have prepared this Minerals Resource Assessment (MRA) on behalf of Norfolk County Council (the Applicant) in support of a scoping opinion for the proposed West Winch Housing Access Road.

It has been identified that the majority of the Site lies within a Minerals Safeguarding Area (MSA) within the Norfolk Minerals and Waste Development Framework, 2010-2026 (NMWDF).

Therefore, this MRA assesses the quality of the Sand and Gravel deposits and Silica Sand in terms of their importance and viability as mineral resources.

A ground investigation was completed along the Scheme by Norse Group in 2020. Following this WSP produced a ground conditions appraisal report which detailed the ground conditions along the route. The ground investigation comprised the advancement of nine trial pits and six window samples.

WSP concludes that the majority of the Site is not viable for extraction and that the development overrides the presumption for mineral safeguarding such that sterilisation of the mineral can be permitted, primarily due to:

- The Site is of strategic importance to the Borough Council of Kings Lynn and West Norfolk (BCKLWN). The Site has been allocated within the local plan and other sites have been proposed / allocated for mineral resource extraction.
- The Scheme development would be severely detrimentally affected due to the need to engineer the level differences created by the resource extraction or restoration of the Site to a workable development platform level following extraction of any resource.
- Viable deposits are not present in all areas of the Site (Zone 1 on **Figure 4**)
- Sand and Gravel and Silica Sand deposits in Zone 2 are shown to be unsuitable for extraction due to either
  - Being overlain by Overburden >2m.
  - Shallow water table.
  - Variable Strata throughout these location including soils with high clay content and presence of clay bands.



- Particle Size Distribution tests show high fine contents meaning extensive screening and sorting required.
- Suitable bands of deposits are <2m thick.
- In areas previously stated as not suitable for minerals resource extraction (by Sibelco).
- Deposits have potentially already been worked.



# 1 Introduction and Objectives

## 1.1 Introduction

- 1.1.1 WSP have prepared this Minerals Resource Assessment (MRA) on behalf of Norfolk County Council in support of a scoping opinion of the proposed West Winch Housing Access Road ('the Scheme') as shown on **Drawing 9893-WSP-XX-00-AL-SK-0007** in **Appendix 12.2.A**. The land within which the scheme is located (as denoted by a red line) is referred to as the 'Site'.
- 1.1.2 An EIA scoping opinion was provided by Norfolk County Council (as Planning Authority) in May 2021 in response to a request for an EIA scoping opinion for the Scheme made by WSP in March 2021 on behalf of Norfolk County Council as Applicant. The Minerals and Waste Planning Authority, following their review of Chapter 9 – 'Geology and Soils' of the WWHAR EIA Scoping Report, requested that a Mineral Safeguarding Assessment (MSA) be submitted as part of the Environmental Statement (ES) for the Scheme. This report presents a Minerals Resource Assessment (MRA) to ascertain any future requirement for minerals safeguarding and thus the need for an MSA to be submitted as part of the ES.
- 1.1.3 It has been identified the majority of the Site lies within a Minerals Safeguarding Area (MSA) within the Norfolk Minerals and Waste Development Framework, 2010-2026 (NMWDF). This includes Sand and Gravel Deposits in the far north and south of the Site and Silica Sand (a mineral of national importance) in the central areas of the Site. (as shown on **Figure 1-1** below)
- 1.1.4 Policy E2.1 of the West Winch Growth Area Strategic Policy and Core Strategy Policy CS16 of the NMWDF, the district and borough councils are requested to consult the County Planning Authority on planning applications that may prejudice the future use of the MSA. This application is made by the County as Applicant, but consultation will nonetheless be undertaken.



1.1.5 This will need to demonstrate that the proposed development can acceptably sterilise the site without significant harmful impact on the supply of local minerals. This will be undertaken by this Minerals Resource Assessment.

1.1.6 Consideration is given in the MRA to avoid unnecessary sterilisation of mineral resources and encourages prior extraction where practicable and viable before non-mineral development takes place, to minimise loss and / or contamination.

**Figure 1-1 – Proposed relief road route and Identified Mineral Safeguard Areas**



## 1.2 Scope of Works

1.2.1 Accordingly, this Mineral Resource Assessment has been prepared, and addresses the following:

- Description of the Site and Proposed Development;
- Site geology and potential for a mineral resource to be present – analysis of British Geological Survey (BGS) mapping data and



available site borehole records completed in ground investigations required for the first phase of development;

- Mineral planning policy review – national and local planning policy;
- The practicability and viability of the prior extraction of the mineral - taking account of site-specific constraints; a market appraisal; transport considerations; and, effect on the deliverability and viability of the non-mineral's development; and
- An assessment of compliance with Policy.

1.2.2 This report has been prepared in general accordance with:

- Norfolk Minerals and Waste Development Framework, Core Strategy and Minerals and Waste Development Management Policies Development Plan Document 2010 – 2026;
- Norfolk Minerals and Waste Development Framework, Mineral Site-Specific Allocations Development Plan Document, December 2017;
- Norfolk Minerals and Waste Development Framework, Revised Policies Map, December 2017;
- Kings Lynn and West Norfolk Local Plan – Site Allocations and Development Management Policies (SADMP) Plan, 2016;
- BGS - A guide to mineral safeguarding in England, October 2007; and
- The National Planning Policy Framework.

### 1.3 Limitations

1.3.1 This report is addressed to and may be relied upon by the client (Norfolk County Council). It may not be relied upon or transferred to any other parties without the express agreement of WSP in writing. The report should be read and used in full. No responsibility will be accepted where this report is used, either in its entirety or in part, by any other party. WSP cannot be held liable for third party information.



1.3.2 The limitations of this assessment are attached in **Appendix 12.2.C**.

## 2 Site Description & Proposed Development

### 2.1 Site Description and Proposed Development

2.1.1 The Scheme is located between the A47 (northern extent) and the A10 (southern extent), crossing a number of existing Grade 2 and 3 agricultural land parcels. The village of West Winch is located to the south of Kings Lynn with the area immediately to the east of the town allocated for up to 3,500 dwellings. The WWHAR is required to provide additional local highway capacity necessary for the construction of these new dwellings

2.1.2 The Site location is provided as **Drawing 9893-WSP-XX-00-AL-SK-0007** in **Appendix 12.2.A**. and an Exploratory Hole plan as **Drawing 9893-WSP-XX-00-AL-SK-0012** in **Appendix 12.2.A**.

2.1.3 The Scheme is located on predominantly greenfield agricultural land (Grade 2 and 3) with the exception of an area of scrubland where the Scheme joins the A47 (Northern Section). The agricultural fields are bound by hedgerows; however, many boundaries are marked by rough grass and/or drainage ditches lined with reeds and rushes. Small areas of woodland and individual trees are noted along the Scheme.Heading 3.

## 3 Mineral Planning Policy Review

### 3.1 National Planning Policy

National planning policy for minerals is set out in Section 17 of the National Planning Policy Framework (NPPF) 'Facilitating the sustainable use of minerals'.

3.1.1 National policy is clear that "it is essential that there is a sufficient supply of minerals to provide the infrastructure, buildings, energy and goods that the country needs. Since minerals are a finite natural resource, and can only be worked where they are found, best use needs to be made of them to secure their long-term conservation" (Paragraph 203). Further Paragraph 205 adds that local planning authorities should "not normally permit other development





proposals in mineral safeguarding areas where they might constrain potential future use for these purposes.” However, the site forms part of a strategic housing allocation and the adopted Local Plan “sets out policies to encourage the prior extraction of minerals, where practical and environmentally feasible, if it is necessary for non-mineral development to take place” (Paragraph 204d).

3.1.2 With respect to further guidance on the scope of Mineral Assessments, the National Planning Policy Guidance (NPPG) refers to the detailed advice on Mineral Safeguarding in the BGS report “Mineral Safeguarding in England: Good Practice Advice” (2011). This identifies that there are two levels of Mineral Assessment:

1. “A site-specific desk-based assessment of the existing surface and solid geological mineral resource information, comprising information on the mining and quarrying history, mineral assessments and market appraisals, boreholes, site investigations, geological memoirs, technical reports, mining plans, and the thickness of superficial geological deposits.
2. Analysis of the site-specific information derived from level 1 including:
  - An estimate of the economic value (for example quality and quantity) of the mineral resource.
  - It’s potential for use in the forthcoming development and an assessment of whether it is feasible and viable to extract the mineral resource ahead of development to prevent unnecessary sterilisation.
  - Where prior extraction can be undertaken, an explanation of how this will be carried out as part of the overall development scheme.”

### **3.2 Local Planning Policy**

3.2.1 It has been identified the majority of the Site lies within a Minerals Safeguarding Area (MSA) within the Norfolk Minerals and Waste Development Framework, 2010-2026 (NMWDF).



3.2.2 With respect to mineral safeguarding, Policy E2.1 of the West Winch Growth Area Strategic Policy and Core Strategy Policy CS16 of the NMWDF (adopted 2011), identifies the mineral resources in Norfolk which are to be safeguarded, including sand and gravel, silica sand and Carstone areas. The extent of the Mineral Safeguarding Areas (MSAs) for each resource are defined on the Map extract as shown in **Figure 1-1** above. In 2016 the Borough Council adopted their Site Allocations and Development Management Policies Plan (SADMP).

3.2.3 The current Site area is shown in the redline boundary. The Site is located in Sand and Gravel Deposits in the far north and south of the site and Silica Sand (a mineral of national importance) in the central areas of the site.

3.2.4 Policy E2.74 of the SADMP notes that the Site could be underlain by Silica Sand Deposits, and in line with the adopted Minerals Plan these deposits should be investigated for viability and seek to avoid sterilising them if they prove viable. However, that the following needs to be taken into account during any assessment:

- the Growth Area is a long-standing proposal contributing to housing provision in the area;
  - the significant constraints to alternative locations in the area (for housing provision);
  - the adverse effects likely on the existing built up area (of any extraction activities);
  - the likelihood of a resulting unsuitable landform post extraction; and
  - the likely lengthy period of any suggested extraction, and the delay to housing delivery.

3.2.5 Policy E2.75 states that northern landholding of the proposed West Winch Growth Area which overlaps with the proposed WWHAR Scheme has already been surveyed for these purposes and it's has been demonstrated (to the satisfaction of the minerals planning authority) that's there is no exploitable deposit here.



3.2.6 Policy E2.76 states that's even though the southern portion of the West Winch Growth Area has yet to be surveyed, it is understood that the extent of the overall allocation area means that it is unlikely that the overall scale of the development within the plan period would be prejudiced. The council is advised that any exploitation would be likely to proceed and be completed relatively rapidly, and the land largely reusable for other developments afterwards.

3.2.7 Therefore, this MRA assesses the quality of the Sand and Gravel deposits and Silica Sand in terms of their importance and viability as mineral resources.

## 4 Nature of the Existing Mineral

### 4.1 Geology

4.1.1 The BGS Map Sheet 145 with part of 129 Solid and Drift – King's Lynn and the Wash (1:50,000, 1978) has been reviewed along with WSP Ground Appraisal Report (see Section 4.2 for more details) and the underlying geology is presented in **Table 4-1** together with EA aquifer designations for the relevant geological units.

**Table 4-1 - Geological Mapping Summary**

| Geological unit   | Thickness (m)* | Location  | Description*  | Aquifer designation        |
|---|----------------|---|---|----------------------------|
| Topsoil   | 0.30 – 3.55    | Across the scheme*  | Dark brown to brownish grey, slightly gravelly, sandy silty, slightly clayey topsoil with some rootlets and straw and an organic odour.   | No data                    |
| Alluvium  | 1              | One borehole north of the scheme*   | Dark grey, sandy silty clay with occasional roots and a slight organic odour.   | Secondary (A)              |
| Head  | 1.50           | One borehole south of the scheme*<br>Potentially located west area of the Hardwick Interchange. | Mottled orange brown and grey, slightly silty to very silty, slightly gravelly clayey fine to medium sand.  | Secondary Undifferentiated |
| Raised Beach Deposits   | No data        | Hardwick Interchange.   | Shingle, sand, silt and clay (from BGS maps as not encountered in GI)   | Secondary A                |
| Lowestoft Formation   | 0.40 – 4.80    | Central and Southern section's*   | Firm to very stiff orange brown to dark grey, sandy, silty gravelly clay, with fine to coarse angular to sub-rounded flint, chalk and mudstone gravels.   | Secondary Undifferentiated |
| Tottenham Gravel Member<br><b>(SAND AND GRAVELS)</b>                    | 0.40 – 1.85    | Central and southern section's*   | Dark brown to brownish grey, clayey, silty gravelly fine to medium sand with fine to coarse angular to sub-rounded flint, quartz, ironstone and carstone gravels.   | Secondary A Aquifer        |
| Sandringham Sand Formation<br>(Leziate Member)<br><b>(SILICA SANDS)</b> | N/A            | Localised in the Northern section and the north of the Central section.                         | Pale grey fine to medium-grained, cross-bedded quartz sands with bands of silt or clay and pyrite nodules. Glauconite is locally abundant. (from BGS maps as not encountered in GI)   | Principal Aquifer          |
| Sandringham Sand Formation<br>(Mintlyn Member)<br><b>(SILICA SANDS)</b> | 0.50 – 4.60    | Northern, Central and majority of the Southern section's*                                       | Light brown to dark grey silty, gravelly fine to medium sand with laminations and thin beds of weak to moderately weak sandstone, ironstone and siltstone. Cohesive encountered comprised stiff mottled reddish-brown sandy gravel clay with fine to coarse angular to sub-rounded flint, ironstone, chert and phosphatic nodules gravels | Principal Aquifer          |

| <b>Geological unit</b>   | <b>Thickness (m)*</b>    | <b>Location</b>  | <b>Description*</b>  | <b>Aquifer designation</b> |
|--|--------------------------|--|--|----------------------------|
| Sandringham Sand Formation<br>(Roxham and Runcton Member)<br><b>(SILICA SANDS)</b> | 0.20 – 2.60              | Northern, Central and majority of the Southern section's*. | Firm to stiff silty sandy clay and dark grey to brown silty, gravelly fine to medium sand, with fine to medium subrounded flint, sandstone, pyrite nodules and phosphate nodules gravels | Principal Aquifer          |
| Kimmeridge Clay Formation  | 0.40 – 3.55 (not proven) | Northern, and Southern sections.                           | Firm to stiff, dark grey to bluish grey laminated clay with lenses of light grey silty fine sand and occasional shell fragments.   | Unproductive Stratum       |



4.1.2 There are several publicly available BGS borehole records located adjacent to and within 100m of the Site which confirm the above site profile. Where geological strata have been named, the ground profile presented as **Table 4-2** was identified. Locations are noted on **Figure 3** in **Appendix 12.2.A**.

**Table 4-2 - BGS Borehole Summaries**

| Strata  | Description  | Depth to base (m bgl)                                     | Water strikes (m bgl)  | Encountered In   |
|---|--|---|--|--|
| Topsoil   | Not Provided<br>TF61NW257- Stony<br><br>Cryoturbation bed, orange-brown sandy stony clay and clayey sand (TF61SW120)   | 0.20- 0.79<br><br>1.80                                    | None recorded  | TF61NW305<br>TF61NW304<br>TF61NW293<br>TF61NW302<br>TF61SW120<br>TF61NW295             |
| Made Ground   | Loose grey - brown clayey silty sand, with some gravel, brick, rubble, wood fragments and occasional roots.<br>TF61NW355, TF61NW356– Concrete<br>TF61NW259 – sandy flint gravel  | 0.80 - 1.90   | 0.70 (TF61NW355)<br>1.70 (TF61NW356)<br>0.80 (TF61NW257)   | TF61NW355<br>TF61NW356<br>TF61NW109<br><br>TF61NW262<br><br>TF61NW259<br><br>TF61NW257 |
| Lowestoft Formation (Glacial Deposits)                                  | Soft brown very sandy clay<br><br>Stiff light brown, light grey / dark grey clay with chalk sand and fine and medium coarse chalk, flint and ironstone gravel                    | 0.58<br><br>8.23<br><br>8.87(TF61NW237)                   | 8.23   | TF61NW302<br><br><br>TF61NW237   |
| Tottenhill Gravel Member<br><b>(SAND AND GRAVELS)</b>                   | Fine and medium-grained sand, gravel of flint, chalk and peat clay fragments   | 5.60  | None Recorded  | TF61SW120  |
| Sandringham Sand Formation<br>(Leziate Member)<br><b>(SILICA SANDS)</b> | Soft grey silty clay and fine grey/ brown/ ref-brown silty, clayey sand<br><br>Soft blue-grey clay with seams of fine red-brown silty sand. (TF61NE305)<br>Sandstone (TF61NW302) | 2.13 – 3.84<br><br><br>Not proven (TF61NW305)<br><br>8.84 | 2.62 (rose to after 10mins) (TF61NE305)<br><br>3.05 (TF61NW304)<br><br>8.23, rising to 7.32 in 10 mins (TF61NW302) | TF61NW305<br>TF61NW304<br>TF61NW302  |

| Strata  | Description  | Depth to base (m bgl)         | Water strikes (m bgl)                                     | Encountered In  |
|---|--|-------------------------------|---|---|
| Sandringham Sand Formation<br>(Weathered Mintlyn Member)<br><b>(SILICA SANDS)</b> | Fine and medium brown clayey sand with some medium coarse gravel (TF61NW293)   | 0.90 - 2.13                   | None Recorded   | TF61NW293<br>TF61NW295  |
| Sandringham Sand Formation<br>(Mintlyn Member)<br><b>(SILICA SANDS)</b>           | Dark grey-green sandy clay<br>Soft dark grey silty clay with partings of fine silty sand (TF61NW293)                                     | Not Proven                    | 3.05 (TF61NW293)  | TF61NW304<br>TF61NW293<br>TF61NW203<br>TF61NW109<br>TF61NW295                           |
| Kimmeridge Clay Formation   | Firm becoming stiff dark grey / grey-brown friable silty clay with some compressed shells. Fissured with depth and very stiff with depth | 102 (TF61NW237)<br>Not Proven | 3.60 (TF61NW262)<br>1.50 (TF61NW257)<br>12.35 (TF61NW257) | TF61NW355<br>TF61NW356<br>TF61NW237<br>TF61NW109<br>TF61NW262<br>TF61NW259<br>TF61NW257 |
| Ampthill Clay   | Note Provided  | Not Proven                    | None Recorded   | TF61NW237   |





## 4.2 WSP Ground Investigation

- 4.2.1 A ground investigation was completed along the Scheme by Norse Group in 2020. Following this WSP produced a ground conditions appraisal report which detailed the ground conditions along the route and information on groundwater levels as well as including a Generic Quantitative Risk Assessment.
- 4.2.2 The purpose of the investigation was to identify existing ground conditions along the alignment of the Scheme, consider geotechnical behaviour of the strata influencing settlement, foundation and earthworks design and to provide preliminary geotechnical parameters to inform outline geotechnical design.
- 4.2.3 The ground investigation comprised the advancement of nine trial pits and six window samples. It should be noted that this Ground Investigation was undertaken on a reduced scope due to ongoing access issues across the proposed access road route. An exploratory hole plan is presented as **Drawing 9893-WSP-XX-00-AL-SK-0007** in **Appendix 12.2.A**.
- Geology Encountered
- 4.2.4 The geology encountered across the length of the Scheme was variable.
- 4.2.5 Topsoil was encountered within all exploratory holes ranging in thickness from 0.30m to 0.65m, and generally comprised dark brown to brownish grey, slightly gravelly, sandy silty, slightly clayey topsoil with some rootlets and straw and an organic odour.
- 4.2.6 Alluvium was encountered underlying the topsoil in one location in the north of the Scheme (TP217) and comprised dark grey, sandy silty clay with occasional roots and a slight organic odour. This deposit measured 1m in thickness and reached up to 1.60m bgl.
- 4.2.7 The Head Deposits were encountered underlying the topsoil at one location in the south of the Scheme (WS106) and comprised mottled orange brown and



grey silty, gravelly fine to medium sand with sub-angular to subrounded flint gravels. These deposits measured 1.50m thick.

- 4.2.8 Tottenhill (**Sands and Gravels**) were encountered within the central and southern sections of the Scheme and generally comprised dark brown to brownish grey, clayey, silty gravelly fine to medium sand with fine to coarse angular to sub-rounded flint, quart, ironstone and Carstone gravels. The deposit ranged in thickness between 0.40m and 1.85m.
- 4.2.9 The Lowestoft Formation was encountered within the central and southern sections of the scheme and generally comprised firm to very stiff orange brown to dark grey, sandy, silty gravelly clay, with fine to coarse angular to sub-rounded flint, chalk and mudstone gravels. The deposit ranged in thickness between 0.40m to 4.80m.
- 4.2.10 The Mintyln Beds Formation (**Sandringham Sands**) was encountered throughout the length of the Scheme and generally comprised light brown to dark grey silty, gravelly fine to medium sand with laminations and thin beds of weak to moderately weak sandstone, ironstone and siltstone. Cohesive deposits were encountered and comprised stiff mottled reddish-brown sandy gravel clay with fine to coarse angular to sub-rounded flint, ironstone, chert and phosphatic nodules gravels. The deposit ranged in thickness between 0.50 to 4.60m.
- 4.2.11 Roxham and Runcton Beds (**Sandringham Sands**) were encountered throughout the length of the Scheme and generally comprised firm to stiff silty sandy clay and dark grey to brown silty, gravelly fine to medium sand, with fine to medium subrounded flint, sandstone, pyrite nodules and phosphate nodules gravels. The deposit ranged in thickness between 0.20 to 2.60m.
- 4.2.12 The Kimmeridge Clay Formation was encountered predominantly in the northern and southern sections of the scheme and generally comprised firm to stiff dark grey to bluish grey laminated clay with lenses of light grey silty fine sand and occasional shell fragments. The maximum depth encountered was 5.45m bgl due to exploratory holes terminating within this stratum.



4.2.13 The exploratory hole logs are shown within **Appendix 12.2.B**.

### 4.3 Hydrology

4.3.1 During the ground investigation groundwater was encountered within the predominately granular strata, such as the Tottenhill Sands and Gravels, Mintyln Member and the Roxham and Runcton Beds as well as within the Lowestoft Formation.

4.3.2 11 groundwater monitoring visits were completed between August and December 2020, groundwater. During these monitoring visits groundwater was encountered within seven exploratory holes predominately within the granular strata as well as within the Lowestoft Formation. Groundwater levels ranged from 0.10m bgl to 3.41m bgl.

### 4.4 Mineral Resource Presence

4.4.1 It has been identified the majority of the Site lies within a Minerals Safeguarding Area (MSA) within the Norfolk Minerals and Waste Development Framework, 2010-2026 (NMWDF) as shown in **Figure 1-1** above.

4.4.2 WSP have zoned the site according to the following parameters. The zoned areas are shown on **Figure 4** in **Appendix 12.2.A**.

- Zone 1 – No viable deposits (not viable for extraction)
- Zone 2 – Deposits noted however show to be unsuitable for extraction due to either
  - Being overlain by Overburden >2m
  - Shallow water table
  - Variable Strata throughout these location including soils with high clay content and presence of clay bands.
  - Particle Size Distribution tests show high fine contents meaning extensive screening and sorting required



- Suitable bands of deposits are <2m thick
- In areas previously stated as not suitable for minerals resource extraction
- Deposits have potentially already been worked

4.4.3 A more specific breakdown of Zone 2 unsuitability is shown on **Figure 5** in **Appendix 12.2.A**.

4.4.4 **Table 4-3** below shows the thickness of the anticipated sand and gravels encountered during the works.

**Table 4-3 - Deposit Details**

| Borehole Location        | Apparent Stratum             | Thickness (m) of Deposit | Base of stratum proven | Thickness of overburden (m) | Uniformity Coefficient (Cu) (D60/D10) | Sand and Gravel % | Material Class (Highways) | Comments   |
|--------------------------|------------------------------|--------------------------|------------------------|-----------------------------|---------------------------------------|-------------------|---------------------------|--|
| WS101                    | Sandringham Sands (Mintylyn) | 4.50                     | 5.00 Unproven          | 0.4                         | 6                                     | 87                | 1B, 6E/6R, 6J             | Sample taken from 1.2 – 2.0m<br>Water strike at 2.5m |
| WS103                    | Tottenhill Sand & Gravels    | 1.70                     | 2.00                   | 0.3                         | No data                               | No data           | No data                   | Clay lenses and bands throughout                     |
| WS103                    | Sandringham Sands (Mintylyn) | 1.85                     | 3.85                   | 2.00                        | No data                               | No data           | No data                   | Clay layers present                                  |
| WS103                    | Sandringham Sands (Roxham)   | 1.60                     | 5.45 Unproven          | 3.85                        | No data                               | No data           | No data                   | Described as Clay                                    |
| WS105                    | Tottenhill Sand & Gravels    | 0.9                      | 1.20                   | 0.30                        | No data                               | No data           | No data                   | No comment   |
| WS105                    | Sandringham Sands (Mintylyn) | 2.10                     | 3.30                   | 1.20                        | No data                               | No data           | No data                   | Described as Clay                                    |
| WS105                    | Sandringham Sands (Roxham)   | 2.15                     | 5.45 Unproven          | 3.30                        | No data                               | No data           | No data                   | Described as Clay                                    |
| WS106                    | Tottenhill Sand & Gravels    | 1.85                     | 3.85                   | 2.00                        | No data                               | No data           | No data                   | Water strike at 3.00m                                |
| WS107                    | Tottenhill Sand & Gravels    | 0.95                     | 1.35                   | 0.40                        | No data                               | No data           | No data                   | No comment   |
| WS107                    | Sandringham Sands (Roxham)   | 0.55                     | 1.90                   | 1.35                        | No data                               | No data           | No data                   | No comment   |
| WS208 (TP208 on drawing) | Tottenhill Sand & Gravels    | 1.30                     | 1.60                   | 0.30                        | No data                               | No data           | No data                   | No comment   |
| WS208                    | Sandringham Sands (Mintylyn) | 2.30                     | 3.90                   | 1.60                        | No data                               | No data           | No data                   | Described as Clay                                    |
| (TP208 on drawing)       | Sandringham Sands (Roxham)   | 1.10                     | 5.00 Unproven          | 3.90                        | No data                               | No data           | No data                   | Occasional clay lenses                               |
| WS211 (TP211 on drawing) | Tottenhill Sand & Gravels    | 0.40                     | 0.80                   | 0.40                        | No data                               | No data           | No data                   | No comment   |
| WS211                    | Sandringham Sands (Mintylyn) | 1.60                     | 2.40                   | 0.80                        | No data                               | No data           | No data                   | Described as Clay                                    |
| (TP211 on drawing)       | Sandringham Sands (Roxham)   | 2.60                     | 5.00 Unproven          | 2.40                        | No data                               | No data           | No data                   | No comment   |

| Borehole Location | Apparent Stratum             | Thickness (m) of Deposit | Base of stratum proven | Thickness of overburden (m) | Uniformity Coefficient (Cu) (D60/D10) | Sand and Gravel % | Material Class (Highways) | Comments  |
|-------------------|------------------------------|--------------------------|------------------------|-----------------------------|---------------------------------------|-------------------|---------------------------|---|
| TP207             | Tottenhill Sand & Gravels    | 1.15                     | 1.50                   | 0.35                        | 5                                     | 82                | 2A / 2B                   | Sample 0.5 – 0.7m                                   |
| TP207             | Sandringham Sands (Mintylyn) | 1.10                     | 3.00 Unproven          | 1.90                        | 5                                     | 57                | 2A / 2B                   | Described as Silt. Sample 1.9-2.1m                  |
| TP210             | Sandringham Sands (Mintylyn) | 0.70                     | 2.70                   | 2.00                        | >10                                   | 77                | 2A/2B                     | Sample 2.1-2.3                                      |
| TP210             | Sandringham Sands (Roxham)   | 0.30                     | 3.00 Unproven          | 2.70                        | No data                               | No data           | No data                   | No comment  |
| TP213             | Tottenhill Sand & Gravels    | 0.50                     | 0.85                   | 0.35                        | 4                                     | 93                | 1B, 6E/6R, 6M             | Sample 0.5- 0.7                                     |
| TP213             | Sandringham Sands (Mintylyn) | 0.5                      | 1.90                   | 1.40                        | 4                                     | 90                | 1B, 6E/6R, 6M             | Sample 1.7-1.9                                      |
| TP213             | Sandringham Sands (Roxham)   | 0.20                     | 2.10                   | 1.90                        | No data                               | No data           | No data                   | Water strike at 2.10m                               |
| TP214             | Tottenhill Sand & Gravels    | 1.10                     | 1.50                   | 0.40                        | 5                                     | 81                | 2A / 2B                   | Water strike at 1.50m<br>Sample 0.5-0.7             |
| TP215             | Tottenhill Sand & Gravels    | 0.95                     | 1.40                   | 0.45                        | 6                                     | 88                | 1B, 6E/6R, 6J             | Sample 0.5-0.7                                      |
| TP216             | Sandringham Sands (Mintylyn) | 1.30                     | 1.65                   | 0.35                        | No data                               | No data           | No data                   | Described as Clay                                   |
| TP216             | Sandringham Sands (Roxham)   | 1.35                     | 3.00 Unproven          | 1.65                        | 6                                     | 86                | 1B, 6E/6R, 6J             | Water strike at 2.90m<br>Sample 2-2.5               |
| TP217             | Sandringham Sands (Mintylyn) | 0.70                     | 2.30                   | 1.60                        | 6                                     | 87                | 1B, 6E/6R, 6J             | Water strike in overburden at 1.00m<br>Sample 2-2.3 |
| TP217             | Sandringham Sands (Roxham)   | 0.30                     | 2.60                   | 2.30                        | No data                               | No data           | No data                   | No comment  |



4.4.5 Cross sections of the deposits are shown in **Figure 5** in **Appendix 12.2.A**.

4.4.6 Relevant logs from a previous investigation (Hardwick Green) have also be included for information purposes only.

#### **4.5 Mineral Resource Size and Quality**

4.5.1 As anticipated, sand and gravels and Silica sands underlie the Site in the north, south central and southern areas.

4.5.2 These deposits, are for the most part, located at near surface.

4.5.3 The Tottenhill Sand and gravels are encountered in the central and southern areas of the Site however do not show a thickness of greater than 1m in many locations. This would therefore prove difficult in extracting and sorting such thin bands of deposits.

4.5.4 The Sandringham Sands deposits encountered are of varying depths and are highly variable in their composition, with thicker deposits noted in the centre of the Site, however these are described as comprising clay and in places display high fine contents (>10%) and are highly variable with regard to composition including the clay content and display presence of clay bands. This would mean viable deposits could not be targeted and would require sorting / screening following extraction.

4.5.5 Particle size distribution tests undertaken on samples from both the River Terrace deposits and Glaciofluvial deposits from the sand and gravel layers confirmed material descriptions of sand and gravel. Coefficient of uniformity (Cu) ratios were in the range of 4 to 6 indicating the material was uniformly graded across the majority of the granular deposits (with only a few locations having high sand contents i.e. >90%). Samples with higher fines content are shown in Zone 2 on **Figure 4** in **Appendix 12.2.A**. PSD grading certificates are shown in **Appendix 12.2.D**.

4.5.6 It should be highlighted that the Silica Sand deposits encountered across the Site are highly variable in composition, location and thicknesses, (Areas show in Zone 2 in **Figure 4** in **Appendix 12.2.A**) and therefore the potential volume



recovered from the Site shown is estimated to be much lower than anticipated.

4.5.7 Details of individual locations are shown within the cross section on **Figure 5** in Appendix 12.2.A

#### **4.6 INFORMATION FROM ADJACENT SCHEME**

4.6.1 A Minerals Resource Assessment was undertaken at the proposed Hardwick Green site (located and overlaps the scheme in the north west) where it is stated that soil samples were sent to Sibelco (Global Minerals company who have regional offices in Kings Lynn and work other quarries in the area) to ascertain whether there was a silica sand resource in the site. The assessment concluded that no viable resource existed.

### **5 Practicability and viability of prior extraction**

5.1.1 The following focuses on the practicability and viability of the prior extraction of the potential area of sand and gravel across the Site, noting the findings of the Site investigation discussed in the previous section, which demonstrated the poor suitability of the deposit for extraction.

#### **5.2 Site Specific Considerations**

**Zone 1** – Deposits are not present in these areas

**Zone 2** - Deposits are shown to be unsuitable for extraction due to either:

- Being overlain by Overburden >2m
- Shallow water table
- Variable Strata throughout these location including soils with high clay content and presence of clay bands.
- Particle Size Distribution tests show high fine contents meaning extensive screening and sorting required
- Suitable bands of deposits are <2m thick





- In areas previously stated as not suitable for minerals resource extraction (by Sibelco)
- Deposits have potentially already been worked

5.2.1 **Scheme wide** - It is considered that the viability of the Scheme would be severely detrimentally affected due to the need to engineer the level differences created by the resource extraction or restoration of the Site to a workable development platform level following extraction of the resource.

5.2.2 It is understood at this time that only minor level changes are anticipated along the Scheme route with a maximum of 1.1m of fill and 1.5m of cut required. (it should be noted that the level information does not include the A47 junction requirements, however this area does not have any viable deposits regardless). It is likely that material, if shown to be suitable would be required to be retained on site as part of the cut / fill balance and would be documented in the site's earthwork strategy and Materials Management Plans.

5.2.3 The proposed cut and fill at the Site shown on the cross section on drawing **WWHAR-A10 Plan and Profile** in **Appendix 12.2.A**.

5.2.4 The West Winch Growth Area is of strategic importance to the Borough Council of Kings Lynn and West Norfolk (BCKLWN). The West Winch Growth Area has been allocated within the SADMP. The WWHAR (Referred to in policies E.2.52-55 of the SADMP) is required to allow for the access to the West Winch Growth Area.

5.2.5 WSP considers that there are strong material considerations to indicate that the need for the WWHAR overrides the presumption for mineral safeguarding such that sterilisation of the mineral can be permitted. This has also previously been demonstrated in Policy E2.74-76 as noted in section 3.2 for the wider West Winch Growth Area which the WWHAR will serve.



### 5.3 Market Considerations

5.3.1 There are several quarries and several proposed quarries within 10km of the Site area.

**Table 5-1 – Local Proposed Quarries**

| Quarry                        | Distance from site | Material         | Allocated   | Resource (T)      |
|-------------------------------|--------------------|------------------|---|-------------------|
| Land East of Grandcourt Farm  | 5km                | Silica Sands     | Yes   | 3,000,000         |
| Land at Mintlyn South, Bawsey | 7km                | Silica Sands     | Yes   | 1,200,000         |
| Various quarries Tottenhill   | 6-9km              | Sand and Gravels | One allocated,<br>One granted,<br>Two not allocated | 1,855,000 (Total) |
| North of River Nar, Pentney   | 9km                | Sand and Gravels | No  | 850,000           |
| Shouldham and Marham          | 10km               | Silica Sands     | No  | 16,000,000        |

### 5.4 Effect on the viability and deliverability of the non-mineral development

5.4.1 The viability of the scheme would be compromised. The uncertainty caused by mineral safeguarding and its effect the viability of the scheme, and in turn the supply of housing in South East Kings Lynn.



## 6 Conclusions and Recommendations

6.1.1 This Mineral Resource Assessment (MRA) has been prepared on behalf of Norfolk County Council in support of a scoping opinion for the proposed West Winch Housing Access Road ('the Scheme')

6.1.2 WSP concludes that the majority of the Site is not viable for extraction and that the development of the Scheme overrides the presumption for mineral safeguarding such that sterilisation of the mineral can be permitted, primarily due to:

- The Site is of strategic importance to the Borough Council of Kings Lynn and West Norfolk (BCKLWN). The site has been allocated within the local plan and other sites have been proposed / allocated for mineral resource extraction.
- The Scheme would be severely detrimentally affected due to the need to engineer the level differences created by the resource extraction or restoration of the Site to a workable development platform level following extraction of any resource.
- Viable deposits are not present in all areas of the Site (Zone 1 on Figure 4)
- Sand and Gravel and Silica Sand deposits in Zone 2 are shown to be unsuitable for extraction due to either:
  - Being overlain by Overburden >2m
  - Shallow water table
  - Variable Strata throughout these location including soils with high clay content and presence of clay bands.
  - Particle Size Distribution tests show high fine contents meaning extensive screening and sorting required.
  - Suitable bands of deposits are <2m thick.



- In areas previously stated as not suitable for minerals resource extraction (by Sibelco).
- Deposits have potentially already been worked.

6.1.3 Location specific information is show on **Figure 5** in **Appendix 12.2.A**.