

National significant infrastructure project in the Energy Sector Little Crow Solar Park, Scunthorpe

PRELIMINARY ENVIRONMENTAL INFORMATION REPORT

TECHNICAL APPENDICES

VOLUME 2

On behalf of INRG Solar (Little Crow) Ltd

November 2018

PREFACE

This report has been produced for the purpose of providing Preliminary Environmental Information in relation to an application to be made to the Secretary of State for Department for Business, Energy & Industrial Strategy under Section 37 of the Planning Act 2008, seeking a Development Consent Order (DCO) for the Little Crow Solar Park. It is anticipated the application will be submitted Summer 2019.

This report forms part of a suite of documents supporting the statutory pre-application consultation for the Little Crow Solar Park under Sections 42 and 47 of the Planning Act 2008. The statutory consultation runs from **Monday 3rd December 2018 until 5pm on Monday 4th March 2019.**

The Preliminary Environmental Information Report [PEIR] has been coordinated by Pegasus Group and consists of the following documents:

- PEIR Volume 1: Main Written Statement
- PEIR Volume 2: Technical Appendices
- PEIR Non-Technical Summary

Copies of the consultation material, including the PEIR and drawings, may be inspected free of charge during the consultation period at the following locations and during normal working hours.

North Lincolnshire	Development Management Team
Council Civic Centre	Ashby Road, Scunthorpe, DN16 1AB
Scunthorpe Central	Carlton Street
Library	Scunthorpe, DN15 6TX
Park Library	Avenue Vivian Scunthorpe, DN15 8LG
Bottesford Library	Cambridge House, Cambridge Avenue, Bottesford, DN16 3LG

Electronic copies of the documents referred to above will also be available to download free of charge from Monday 3 December 2018 at the applicant's website <u>www.littlecrowsolar.co.uk</u> For paper copies of documents there will be a minimum charge of 25p per side (black and white) and 45p per side (colour).

Any representation in respect of the proposed development must be made in writing, stating the grounds of the response or representation, and give an address to which correspondence relating to the representation may be sent. Any person may comment on the proposals. Responses must be made before 5pm on Monday 4 March 2019.

Please send any representations or request for paper copies of documents to: -

Email:info@littlecrowsolar.co.ukPostal:Little Crow Solar Park Development Team, Pegasus Group, Equinox North,
Almondsbury, Bristol, BS32 4QLOnline:www.littlecrowsolar.co.uk

CONTENTS

CONTENTS

			Main Report	Technical Appendices
1.	INTRODUCTI	ION	✓	
	FIGURE 1.1	SITE LOCATION PLAN	✓	
	FIGURE 1.2	COPY OF NOTICE PUBLICISING PROPOSED APPLICATION	√	
	APPENDIX 1.1	LITTLE CROW SOLAR PARK STATEMENT OF COMMUNITY CONSULTATION (PEGASUS GROUP, NOVEMBER 2018)		1
2.	ASSESSMENT	SCOPE AND METHODOLOGY	✓	
3.	THE DEVELO	PMENT SITE AND ITS ENVIRONS	\checkmark	
	APPENDIX 3.1	FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY (CLIVE ONIONS LTD, NOVEMBER 2018)		~
	APPENDIX 3.2	PHASE I GROUND CONDITIONS DESK STUDY (INTEGRAL, NOVEMBER 2018)		~
4.	THE DEVELO	PMENT	✓	
	FIGURE 4.1	DRAWING PACK	✓	
	APPENDIX 4.1	CONSTRUCTION TRAFFIC MANAGEMENT PLAN (TRANSPORT PLANNING ASSOCIATES, NOVEMBER 2018)		~
	APPENDIX 4.2	PPENDIX LANDSCAPE AND ECOLOGICAL .2 MANAGEMENT PLAN (CLARKSON & WOODS AND PEGASUS GROUP, NOVEMBER 2018)		~
	APPENDIX 4.3	DECOMMISSIONING PLAN (INRG SOLAR (LITTLE CROW) LTD, NOVEMBER 2018)		~
	APPENDIX 4.4	NETWORK CONSTRAINTS (SMS, NOVEMBER 2018)		✓
	APPENDIX 4.5	AIR QUALITY AND CARBON ASSESSMENT (BUREAU VERITAS, NOVEMBER 2018)		✓
	APPENDIX 4.6	DRAFT DEVELOPMENT CONSENT ORDER		✓
5.	LEGISLATION, CLIMATE CHANGE, ENERGY PLANNING POLICY & GUIDANCE		\checkmark	
6.	LANDSCAPE	AND VISUAL	✓	
	FIGURE 6.1	SITE CONTEXT	\checkmark	

PRELIMINARY ENVIRONMENTAL INFORMATION REPORT

CONTENTS

			Main Report	Technical Appendices
	FIGURE 6.2	TOPOGRAPHY	✓	
	FIGURE 6.3	LVIA VIEWPOINTS	✓	
	FIGURE 6.4	ENVIRONMENTAL DESIGNATIONS	✓	
	FIGURE 6.5	LANDSCAPE CHARACTER AREAS	✓	
	FIGURE 6.6	LANDSCAPE MASTERPLAN / MITIGATION PLAN	✓	
	APPENDIX 6.1	ASSESSMENT CRITERIA		✓
	APPENDIX 6.2	ASSESSMENT VIEWPOINT PHOTOGRAPHS		✓
	APPENDIX 6.3	VIEWPOINT ASSESSMENT		✓
7.	ECOLOGY AN	D NATURE CONSERVATION	✓	
	FIGURE 7.1	PHASE 1 HABITAT MAP AND TARGET NOTES	~	
	FIGURE 7.2	DESIGNATED SITES FOR NATURE CONSERVATION WITH 1KM	✓	
	APPENDIX 7.1	EXTENDED PHASE 1, ARABLE PLANTS, GREAT CRESTED NEWTS & WATER VOLE SURVEY REPORT (CLARKSON & WOODS ECOLOGICAL CONSULTANTS, NOVEMBER 2018)		~
	APPENDIX 7.2	WINTERING BIRDS SURVEY (CLARKSON & WOODS ECOLOGICAL CONSULTANTS, NOVEMBER 2018)		~
	APPENDIX 7.3	BREEDING BIRDS SURVEY (CLARKSON & WOODS ECOLOGICAL CONSULTANTS, NOVEMBER 2018)		~
	APPENDIX 7.4	BAT ACTIVITY SURVEY (CLARKSON & WOODS ECOLOGICAL CONSULTANTS, NOVEMBER 2018)		✓
8.	CULTURAL H	ERITAGE	1	
	APPENDIX 8.1	LAND AT SANTON, HIGH SANTON, SCUNTHORPE HERITAGE BASELINE (PEGASUS GROUP, NOVEMBER 2018).		~
	APPENDIX 8.2	LITTLE CROW, SANTON, NORTH LINCOLNSHIRE – GEOPHYSICAL SURVEY REPORT (SUMO, SEPTEMBER 2018).		~
	APPENDIX 8.3	LITTLE CROW SOLAR PARK, SCUNTHORPE, NORTH LINCOLNSHIRE – ARCHAEOLOGICAL WATCHING BRIEF (COTSWOLD ARCHAEOLOGY, NOVEMBER 2018).		~

PRELIMINARY ENVIRONMENTAL INFORMATION REPORT

CONTENTS

			Main Report	Technical Appendices
	APPENDIX 8.4	LITTLE CROW SOLAR PARK, SCUNTHORPE, NORTH LINCOLNSHIRE – ARCHAEOLOGICAL FIELDWALKING SURVEY (COTSWOLD ARCHAEOLOGY, NOVEMBER 2018).		~
9.	TRANSPORT	AND ACCESS	\checkmark	
	FIGURE 9.1	PROPOSED STUDY AREA	\checkmark	
	APPENDIX 9.1	ATC DATA DECEMBER 2017		✓
	APPENDIX 9.2	TRANSPORT STATEMENT (TPA, NOVEMBER 2018)		~
10.	AGRICULTUR	AL CIRCUMSTANCES	✓	
	FIGURE 10.1	PROVISIONAL ALC AROUND SCUNTHORPE	~	
11. SOCIO ECONOMIC			\checkmark	

Technical Appendix 1.1

STATEMENT OF COMMUNITY CONSULTATION



Statement of Community Consultation

INRG Solar (Little Crow) Ltd



Contents

01.	Introducing this Statement of Community Consultation	. 3
02.	The Developer and Development	. 4
03.	The Consenting Process and Nationally Significant Infrastructure Projects	. 5
04.	Classification as an Environmental Impact Assessment [EIA] Development	. 6
05.	Consultation Timetable, Scope and Responses	. 7
06.	Submitting Feedback and What Happens Next	. 10
07.	Consultation in Addition to Community Consultation	. 11

01 Introducing this Statement of Community Consultation

This Statement of Community Consultation ["SoCC"] is being prepared in accordance with Section 47 of the Planning Act 2008. This requires Applicants to prepare a Statement setting out how the Applicant proposes to consult people affected by the development or living in the vicinity about the proposed application. The Applicant is INRG Solar (Little Crow) Ltd and this SoCC sets out its approach to the statutory stages of community consultation for its proposed renewable led energy scheme on land to the east of the British Steel Site at Scunthorpe, North Lincolnshire, DN16 1XP.

This SoCC explains the community consultation being undertaken and covers:

- The developer and proposed development;
- The consenting process;
- Where and when the consultation is taking place and who is being consulted;
- How the consultation will be undertaken, including the materials that will be published and other engagement activities;
- Where people can view these materials and find out more; and
- The importance of feedback from local people and how they can provide their comments.

This SoCC covers the consultation running from Monday 3rd December 2018 to Monday 4th March 2019. Consultation is a key part of the development process. The Planning Act 2008 requires developers to publish their proposals widely, as well as consulting with the local community, local authorities, statutory bodies and persons with an interest in land partially affected by the proposed project.

This SoCC has been developed in consultation with North Lincolnshire Council. It has been designed to gather news and whilst proposals for the project are being developed, to allow people the opportunity to influence the development of the project and help members of the public understand how they can take part in the consultation. We have already undertaken a significant amount of local engagement.

This pre-application consultation follows non-statutory consultation that commenced in January 2018 and continued to the end of November 2018; this included public exhibitions undertaken in January 2018 and informal consultation with various consultees that will also be engaged as part of the application for a Development Consent Order.

02 The Developer and Development

Founded in 2009, INRG Solar Ltd has established itself as one of the largest developers of solar parks in the UK, responsible for the development of dozens of solar parks with a total capacity of over 300 megawatts.

The main element of the Little Crow project is the installation of a ground mounted solar park with a maximum design capacity of up to 150MWp (megawatts peak) to achieve a maximum export capacity value of 100MW. The photovoltaic panels will be laid out in rows across the site. In order to fully utilise the network connection capacity when the solar park is not exporting at peak capacity, the proposal will also include up to 90MW of battery-based electricity storage containers. There will also be electrical connection infrastructure, and a new substation compound is planned to be centrally located within the site, and will connect to the existing overhead electricity pylons which traverse the site.

The solar park will generate clean renewable energy for the equivalent of over almost 40,000 homes a year. The anticipated CO_2 displacement is around 50,000 tonnes per annum.

The proposal will provide a clean, renewable and sustainable form of electricity making a valuable contribution to the generation of electricity at a local level. The scheme would add to the Council's progress in meeting its renewable energy target. It would also assist in meeting national targets. Biodiversity mitigation and enhancement measures are also provided across the entire site. Construction traffic will arrive to site via the M180 Junction 4, the A15, the A18, the B1208 and B1207. From the M180 junction 4, vehicles will use the A15 northbound to the Briggate Lodge Roundabout and then travel east along the A18 towards Brigg. From the A18, vehicles will turn left onto the B1208. The B1208 measures between approximately 5.5 and 6 metres wide. Vehicles will travel along the B1208 to the junction with the B1207 and then continue straight ahead into the site access. No construction vehicles associated with the development proposal would travel through Broughton.



Site Location Plan

03 The Consenting Process and Nationally Significant Infrastructure Projects

The Little Crow Solar Park represents a significant planning and investment project and is defined as a National Significant Infrastructure Project ["NSIP"] in accordance with the Planning Act 2008.

INRG Solar (Little Crow) Ltd will apply to the Secretary of State for Business, Energy and Industrial Strategy ["BEIS"], via the Planning Inspectorate ["PINS"], and if successful will be granted a Development Consent Order ["DCO"] which authorises and permits the development.

INRG Solar (Little Crow) Ltd will seek powers in the DCO to construct, maintain, operate and then decommission the project. PINS will consider the application. Prior to submission of the application and during the examination period, interested parties will be entitled to raise their views and participate in the consenting process. When the examination has concluded, PINS will make a recommendation to the Secretary of State for BEIS having assessed the project in accordance with national policy and taking into account the local impact. The Secretary of State will then determine the application. Below is a summary of how the DCO application process works and further information on PINS and the planning process can be found here https://infrastructure.planninginspectorate.gov.uk

- Pre-application INRG Solar (Little Crow) Ltd notifies and consults the public, statutory consultees and those with an interest in the affected land on its proposed application, through early non-statutory consultation.
- Submission INRG Solar (Little Crow) Ltd will review the feedback received during consultation and finalise the proposals taking the feedback into account. A DCO application will then be submitted to PINS, who will appoint the examination team for the application.
- Acceptance after the application is submitted, PINS will decide whether it is suitable for examination.
- **Pre-examination** if accepted for examination, there will be an opportunity for people to register their interest in the application with PINS. Anyone registered will be kept informed of the progress of the application by PINS, including how they can provide comments. PINS will invite all those registered to a preliminary meeting that will explain the timetable and format of the examination.
- **Examination** the examination lasts six months. People who have registered their interest will be able to take part in the examination and send their comments to PINS.
- Decision following the examination, PINS will make its recommendation on the application to the Secretary of State, and the Secretary of State has the final decision as to whether consent is to be granted.

04 Classification as an Environmental Impact Assessment [EIA] Development

INRG Solar (Little Crow) Ltd is voluntarily preparing an Environmental Statement to support the DCO application. This means that an Environmental Impact Assessment will be carried out. This process will consider whether Little Crow Solar Park is likely to have significant effects on the environment. It will also look at potential measures for mitigation of such effects, if and where required. Various technical and environmental studies have already been carried out, and as part of this consultation, INRG Solar (Little Crow) Ltd is publishing a Preliminary Environmental Information Report ["PEIR"] and Non-Technical Summary ["NTS"]. The PEIR is available from 1st December 2018 and INRG Solar (Little Crow) Ltd must consult on it before it can make its application for a DCO. The PEIR takes the format of a Draft Environmental Statement.

INRG Solar (Little Crow) Ltd will supply copies of the PEIR to legally defined consultees. A copy of the PEIR is also available to others for a charge. Otherwise you can review a copy freely at the venues listed on page 8 or on INRG Solar (Little Crow) Ltd website: www.littlecrowsolar.co.uk

05 Consultation Timetable, Scope and Responses

We recognise that residents and communities have differing requirements for information, so our process of consultation will reflect this. The formal pre-application consultation is taking place from 3rd December 2018 to 4th March 2019. The formal consultation will deal with all aspects of the development proposal and INRG Solar (Little Crow) Ltd will be using the following methods:

- **Project website** documents, plans and maps showing the nature and location of the project are available at www.littlecrowsolar.co.uk along with a full list of consultation events.
- Newsletter to be sent to those most likely to be affected by the development, posted on the project website and made available to the wider community at local libraries and Council offices.
- Media press-release and advertisements will be issued during the pre-application process to include details of the consultation process and pubic exhibitions.
- Public exhibitions will be held at the locations around the development site and available to view at the project website www.littlecrowsolar.co.uk
- Political engagement / Parish Council briefings

 local politicians, councils and relevant community groups will be consulted and kept informed on all aspects of the project.

Responses must be submitted to INRG Solar (Little Crow) Ltd on or before 4th March 2019 using the contact information overleaf. INRG Solar (Little Crow) Ltd will have regard to all relevant responses to consultation and will demonstrate this in a publicly available Consultation Report to be submitted in support of the application for the project.

PUBLIC EXHIBITIONS

The following events will be held at the locations and times shown below. The SoCC, PEIR and the NTS will be available to view (free of charge), as well as other materials, and INRG Solar and their Planning Consultants will be available to answer questions.

- Tuesday 11th December 2018, 2.30pm 7.00pm: Appleby Village Hall, School Lane, Scunthorpe, DN15 0AS.
- Wednesday 12th December 2018, 2.30pm 7.00pm: Scunthorpe Civic Centre, Ashby Road, Scunthorpe, DN16 1AB.
- Monday 17th December 2018, 2.30pm 7.00pm: Broughton Village Hall, 59 High Street, Broughton, North Lincolnshire, DN20 0JX.

INRG Solar (Little Crow) Ltd will also present the latest scheme to the local Parish Councils early in the New Year:

- Tuesday 8th January 2019, 7.00pm: Appleby Parish Council, Appleby Village Hall, School Lane, Appleby, DN15 0AS.
- Monday 28th January 2019, 7.30pm: Broughton Parish Council, Phil Grundy Community & Sports Centre, Scawby Road, Broughton, Brigg, DN20 0AF.

All events have disabled access, however for specific mobility or access requirements please contact us (see page 10 for contact details).

HARD COPY REFERENCE LOCATIONS

In order to ensure the information is accessible locally, INRG Solar (Little Crow) Ltd community materials, maps, technical reports and plans will be available to view at the following locations:

Location	Address	Standard Opening Hours
Scunthorpe Central Library	Carlton Street, Scunthorpe, North Lincolnshire, DN15 6TX	Monday: 9am – 5pm Tuesday: 9am – 5pm Wednesday: 9am – 7pm Thursday: 9am – 5pm Friday: 9am – 5pm Saturday: 9am – 4pm Closed on Bank Holidays
Park Library	Avenue Vivian, Scunthorpe, North Lincolnshire, DN15 8LG	Monday: 2pm – 7pm Tuesday: closed Wednesday: 10am – 1pm Thursday: closed Friday: 1pm – 5pm Saturday: 10am – 1pm Closed on Bank Holidays
Bottesford Library	Cambridge House, Cambridge Avenue, Bottesford, Scunthorpe, North Lincolnshire, DN16 3LG	Monday: 1pm – 5pm Tuesday: closed Wednesday: 1pm – 7pm Thursday: 10am – 1pm Friday: 2pm – 5pm Saturday: 10am – 1pm Closed on Bank Holidays
North Lincolnshire Council Civic Centre	Development Management Team, North Lincolnshire Council Civic Centre, Ashby Road, Scunthorpe, North Lincolnshire, DN16 1AB	Monday: 9am – 5pm Tuesday: 9am – 5pm Wednesday: 9am – 5pm Thursday: 9am – 5pm Friday: 9am – 4.30pm Closed on Bank Holidays

Opening times have been checked, but they are dependent on the organisation itself and may be subject to change

THE SIZE AND COVERAGE OF THE PROPOSED CONSULTATION

In order to create as many opportunities as possible for people to become involved, the consultation exercise is designed to encompass a wide geographic area which reasonably includes any person who might be affected by the development proposals. There are two distinct elements to the area of consultation; a 'Primary Consultation Zone' and 'Wider Consultation Zone', a newsletter will be mailed to all residents and business addresses within the Primary Consultation Zone, and consultation events will take place in the main communities in both zones. A map of the consultation area is provided below and includes approximately 2,500 addresses. This covers the villages of Broughton, Wressle, Santon, Appleby, High Risby and Low Risby.

Consultation for the 'Wider Consultation Zone' will predominantly involve advertisements in the local press. The advertisements will announce the dates and venues for the three public exhibitions scheduled for December 2018.



06 Submitting Feedback and What Happens Next

There are several ways to submit feedback and you can contact INRG Solar (Little Crow) Ltd in any of the ways set out below. When responding, please state who you are, or on whose behalf you are making the response; the grounds of your response; and an address where we can respond back to you.

- By email to: info@littlecrowsolar.co.uk
- In writing to: Little Crow Solar Park, C/O Pegasus Group, First Floor, South Wing, Equinox North, Great Park Road, Almondsbury, Bristol, BS32 4QL
- By phone: 01454 625 945
- Through the website: www.littlecrowsolar.co.uk
- Twitter: @littlecrowsolar

PINS website provides an alternative way for you to follow the key project stages. You can also register with PINS for project updates via: https://infrastructure.planninginspectorate.gov.uk/projects

WHAT HAPPENS NEXT

At the close of consultation, all responses received will be carefully considered and taken into account in the development of the project. If, as a result of the feedback, the project changes to such an extent that it is necessary to undertake further consultation, then this further consultation will be undertaken in accordance with the principles set out in this SoCC. If we are in position to finalise the application, then we aim to move forward and submit the application by Spring 2019. When the application has been accepted by PINS, INRG Solar (Little Crow) Ltd will advertise that the application has been submitted and accepted.

The wider project timeline is set out below:



07 Consultation in Addition to Community Consultation

In addition to the statutory requirements that have informed the preparation and publication of this SoCC, the 2008 Act requires that a number of additional groups are consulted in addition to the community consultation. These prescribed persons include relevant local authorities, persons with an interest in the land, technical stakeholders, transport authority and emergency services.

We have identified the list below and will consult with these bodies directly, inviting them to comment on the project proposal. We are happy to consider any additions you feel should be included.

Anglian Water	North East Lincolnshire Council
Appleby Parish Council	North Lincolnshire Clinical Commissioning Group
Bassetlaw District Council	North Lincolnshire Highways Authority
Broughton Parish Council	North Lincolnshire Local Flood Authority
Cadent Gas Ltd	Northern Power Grid
Campaign to Protect Rural England	Ofgem
Design Council	Robin Hood Airport
Doncaster Council	Selby District Council
East Midlands Council	Shire Internal Drainage Board
East Riding of Yorkshire Council	Stagecoach
Equality and Human Rights Commission	The Civil Aviation Authority
Forestry Commission	The Coal Authority
Highways England	The Environment Agency
Humberside Airport	The Forestry Commission
Humberside Fire and Rescue	The Health and Safety Executive (Midlands Office)
Humberside Police and Crime Commissioner	The Historic Buildings and Monuments Commission for England (Historic England)
Kingston upon Hull City Council	The Mayor of North Lincolnshire
Lincolnshire Wildlife Trust	The Secretary of State for Transport
MP for Brigg and Goole (Andrew Percy)	TransPennine Express
MP for Scunthorpe (Nic Dakin)	Transport for the North
NATS	West Lindsey District Council
Natural England	









Phone: 01454 625 945



Twitter: **@littlecrowsolar**

This document is available in large text or braille upon request

Technical Appendix 3.1

FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY



National significant infrastructure project in the Energy Sector Little Crow Solar Park, Scunthorpe

FLOOD RISK ASSESSMENT AND DRAINAGE STRATEGY

On behalf of INRG Solar (Little Crow) Ltd

November 2018

Contents

- 1 Introduction
- 2 Site Location and Setting
- 3 Existing Site and Ground Conditions
- 4 Proposed Development
- 5 Hydrology and Flood Risk
- 6 Surface Water Drainage
- 7 Construction Process
- 8 Management and Maintenance
- 9 Conclusions and Recommendations

Report prepared by Sam Rice – BSc (Hons) Report approved by Clive Onions - BSc CEng FICE FCIWEM MIStructE MCIHT

Version history

Version	Date	Prepared by	Approved by	Comment
D1	31.08.17	SR	СО	Issued for approval
D2	25.09.17	SR	СО	Extended site included
V1	20.07.18	со	СО	Final layout inserted
V2	26.07.18	со	СО	Minor amendments
V3	16.11.18	SR	IJ	Updated with revised layout

Issue history

Version	Date	Issued to	Method
D1	31.08.17	Pegasus Group	Email pdf
D2	25.09.17	Ditto	Ditto
V1	20.07.18	Ditto	Ditto
V2	26.07.18	Ditto	Ditto
V3	16.11.18	Ditto	Ditto

1. Introduction

INRG Solar (Little Crow) Ltd proposes to develop an energy scheme comprising up to 150MWp ground mounted solar arrays and up to 90MW of battery store on land to the east of the British Steel site at Scunthorpe.

This Flood Risk Assessment and Drainage Strategy (FRADS) has been prepared to consider the impact of the solar farm on the existing hydrology in the area, to show that flood risk is not increased off-site and that the solar farm is safe to operate for its lifetime. It considers the construction and operation stages.

The assessment shows that water quality entering the environment will be improved, infiltration will improve and runoff rates will be reduced, bring overall benefit to the environment.

2. Site Location and Setting

The site is located on land to the east of British Steel, Scunthorpe DN16 1XP.



Fig 1 Site location to the east of Scunthorpe (Streetmap).

The site is in the following setting:

- North of the site is Santon Wood, beyond which is mainly arable farmland, on land generally falling to the west.
- East of the site is woodland, a poultry farm and the town of Broughton on land falling gently to the east

- South of the site is strip of woodland, beyond which is arable farmland, solar farm, covered reservoirs, golf course, further woodland, etc., on land which falls to the west.
- West of the site is an access track, a narrow strip of green land containing a small arable field, beyond which is a deep excavation resulting from open cast mining, containing standing water some 20m below the level of the site boundary. Beyond this is Bottlesford Beck, at similar level to the site boundary, which drains the adjacent steel works and industrial estate.

In summary, the site is to the west of an important industrial area, within an area of woodland, arable farmland to the north and mixed uses to the south.



Fig 2 Oblique view of land between the industrial land and site, showing the 20m (approx.) deep excavation and standing water (Google Earth image by Getmapping plc).

3. Existing Site and Ground Conditions

The site occupies approx. 20 fields separated by hedgerows with occasional trees and fences. The fields are predominantly used for arable farming. The site excludes two strips of woodland in the southeast.

The site includes watercourses which are described later, but tend to flow eastwards from a spring line, which runs along the north-south axis of the site.

The shape of the site is irregular and is approx. 1,850m north-south and 1,550m east-west. There are no buildings shown within the site, although pylons carrying two main overhead electrical circuits cross north-south through the site.

The site is on land which slopes from approximately 60m AOD in the east to 25m AOD in the west, giving a slope of about 1 in 25. The northwestern part of the site is generally level at about 60m AOD, with a gentle 1 in 100 slope to 55m AOD along the north-eastern boundary.



Fig 3 Satellite view showing predominantly arable use within the site (Getmapping Plc.).



Fig 4 More detailed view of site showing steel works to the west, Bottlesford Beck, opencast steelworks and then the site, with an oil well to the northeast and a poultry farm to the east. Within the site are the power lines running north-south and the watercourses flowing westwards from the spring line (Streetmap).

A separate geotechnical report has been prepared by Integrale, but in summary the British Geological Survey Viewer shows sand above mudstone in the west and mudstone and limestone in the east. The Cranfield University Soilscapes Viewer shows the soil within the site to be free draining. This assessment suggests that the site is likely to be permeable, with limited runoff from rainfall.

It is however likely that in autumn and winter high levels of runoff and silt occur after ploughing, and before the vegetation/crops have established. These characteristics would cause high rates of runoff in autumn, and low rates in the growing seasons lading to high variations of flow in the receiving watercourses and potentially increasing the risk of silting given the shallow gradients.



Fig 5 The superficial geology, noting none is recorded (British Geological Survey).



Fig 6 The bedrock geology, showing the variety of permeable limestones on the higher (eastern) ground and less permeable mudstones on the lower (western) ground (British Geological Survey).

Lov	v Santor
MANY AN	Soilscape 10: Freely draining slightly acid sandy soils
High Santon	Texture: 2
istane	Coverage: England: 2.8% Wales: 0.3% England & Wales: 2.5%
	Selected area: 22.0km ²
Tata Steel	Drainage: Freely draining
Site	Soilscape 7: Freely draining slightly acid but base- rich soils
Jueensway	Texture: 🕜
Estate	Coverage: England: 3.1% Wales: 3.1% England & Wales: 3.1%
Antip Antip	Selected area: 24.6km ²
	Prainage: Freely draining
ne Il 1km	

Fig 7 Soilscapes Viewer showing the soil throughout the site to be free-draining (Cranfield University Soilscapes Viewer).

4. Proposed Development

The proposed development comprises the installation of a solar farm with battery storage area and associated 132 KV Substation. The works also include transformers and cables within the site to manage and convey the power.

The solar arrays will be aligned east-west, to collect sun from the south, with the low edge 800mm off the ground, and the high (northern) edge up to 3.5m off the ground; the dimensions vary with the local topography. The solar arrays incorporate gaps along the array, and several gaps up the slope, which are fundamental for thermal movement. These gaps avoid encourage rainwater to disperse along the array and avoid concentrated flows from the lower edge.



Fig 8 Typical section through solar array. Height dimensions will vary with undulations in the ground.

The arrays are positioned to provide access space between the arrays, and between the arrays, fence and hedge, to allow for maintenance. These dimensions also allow access for maintenance of the hedge outside the fence, and camera surveillance within the fence.

The site will be enclosed within deer fences, with open mesh and set 100mm above the ground to allow movement of wildlife and surface water. The fences will cross watercourses in such a way to reduce the risk of blockage, spanning the channel.

Vehicular access will be from an unnamed existing track to the northeast of the site, connected to the B1207 along an existing track serving the oil well etc.



Fig 9 Existing track from B1207 along the north of the site.



Fig 10 Existing rack running to the east and north of poultry farm.

Another track will also serve the solar farm which leads to the poultry farm and north into the site.

These tracks which run to and into the site will be retained – new tracks to key equipment on site will be formed in permeable material; the tracks tend to green over due to low usage which helps manage runoff and provides further varied habitat.

The fields on which the solar arrays are located will be prepared on completion of the solar farm, to loosen compacted ground, and then seeded where necessary to encourage a vegetated surface throughout with native grasses, and vegetation restored where construction has caused damage. The area within the fence will become a haven for invertebrates, reptiles, amphibians, small mammals and birds, as has been observed on other completed solar farm sites.

The site will be grazed at low density by sheep and inspected seasonally so that tall plants can be trimmed and avoided from shading the panels. Bare areas of earth will be prepared, seeded and protected to encourage growth.



Fig 11 Proposed site layout with key features highlighted.

5. Hydrology and Flood Risk

The site is located in Flood Zone 1, at low risk of flooding, according to the Environment Agency (EA) Flood Map for Planning, consistent with its elevated location, and is therefore appropriate development in terms of fluvial flood risk in accordance with the National Planning Policy Framework (NPPF).



Fig 12 The EA Flood Risk Map for Planning showing the site to be in Flood Zone 1.

The EA Surface Water Flood Risk Map shows isolated ponding within a few areas in the site – indicative of the generally free-draining nature of the soil. In the west of the site the water is shown to issue from a spring line and flows westwards. The spring line is shown below, in an image which has been extracted from the Geotechnical Report.

Localised areas up to 50m wide appear to have a very gentle fall to the east, and, leading through woodland. There are no evident watercourses or signs of surface water flows to the east, indicating that the rainfall infiltrates into the ground where it lands, ie the shallow gradient allows infiltration.

The site contains a number of watercourses, generally running north south along the slope, and linked by watercourses flowing down the slope, which are shown on the maps. A detailed topographic survey has been undertaken of the site and shows that the channels are well-defined and approximately 1m deep.



Fig 13 Extract from the EA Surface Water Flood Risk Map showing isolated areas of the site at risk from surface water ponding in the 1 in 1000 year event, and an area of shallow streaming in the northwest.



Fig 14 Extract from Integrale's Phase 1 Ground Conditions Desk Study, showing the spring line and proposed battery store to the east (uphill) of the spring line.

6. Surface Water Drainage

The soil is shown to be free-draining, and the underlying soil is naturally drained by the springs which issue along the spring line. The mechanism would therefore be that rainfall infiltrates into the soil, and then follows a layer with low permeability and issues at a generally low rate over a prolonged period from the ground, forming a watercourse. It is proposed to retain the watercourses which issue from the spring line, and provide a minimum 8m buffer from top of bank with no development. The boundary fence will cross the watercourses where they flow across the western boundary and special measures might be required to limit blockages.

Swales will be formed on the uphill side of the main watercourses as a precautionary measure especially to manage runoff and silt during the construction period.

A swale is also proposed along the west and north of the poultry farm to reduce the risk of runoff nuisance.

The swales will be formed by excavating a 300mm deep valley and placing the soil on the downhill slope, and about 3m wide.



Fig 15 Plan showing site shaded to highlight existing watercourses. All structures such as fences, tracks, solar arrays and infrastructure will be more than 8m from illustrated watercourses, but fences will cross where watercourses cross the site boundary. The red circles represent locations where fences will cross watercourses.



Fig 16 Typical form of swale formed with ridge and furrow technique and vegetated on completion.

Transformer units etc will be positioned on legs with 300mm permeable gravel bed below to provide attenuation and infiltration into the underlying and adjacent soil.

The battery units, which will be containerised, will also be formed over a similar gravel bed to encourage infiltration and allow attenuation.

The fields will no longer be applied with pesticides and fertilizers, thus the water quality entering the environment will be improved. The fields will not be bare and compacted in the autumn and winter, thus improving infiltration and eliminating silt runoff.



Fig 17 Typical transformer unit on legs over permeable gravel bed.



Fig 18 Typical containerised batteries on legs with permeable gravel base below.



Fig 19 Typical expanded view showing retention of green corridors with vegetation and zones with watercourse and swales. The arrays are 6m wide, given a scale for the watercourse zones, which are in the order of 20m wide.

7. Construction Process

To minimise damage to the soil structure within the solar farm site, the contractor should manage the work appropriate to the prevailing weather conditions and use appropriate machinery for the circumstances.

Existing watercourses will be protected by silt fences if there is a risk of silt runoff occurring during the works, dependent on weather and prevailing characteristics

Machinery used within the solar farm should have low earth pressure tyres or tracks, such as is typical with farm machinery, to minimise compaction of the ground.

A delivery sequence by vehicles should be devised which minimises repeated journeys over the pasture to reduce rutting and damage to the pasture and soil structure.

On completion of the works the pasture should be restored using light farming machines and the soil prepared appropriately for seeding to encourage early growth, restoration of the soil structure and natural creation of meadow grass.

8. Management and Maintenance

The general solar farm, watercourses, permeable tracks, permeable beds below units etc within the site will be maintained by the site operator.

The watercourses should be inspected at the start of the autumn and in late spring, and at other times if prevailing conditions suggest, and the following steps taken:

- Any blockages from branches, intense bramble growth etc. should be removed so that the swales can be readily inspected to confirm their clear operation.
- Any raised bed due to animal activity etc. which may hinder water flow should be removed to restore performance.
- Trees and shrubs should be removed before they can establish.
- Grass and wild flowers should be inspected and strimmed back from time to time.
- Bare earth areas should be inspected, prepared and seeded to re-establish grass and wildflower growth as appropriate.
- If water ponds for prolonged periods inspections should be made and the bed treated to restore performance and aid infiltration.

9. Conclusions and Recommendations

INRG Solar (Little Crow) Ltd proposes to develop an energy scheme comprising up to 150MWp ground mounted solar arrays and up to 90MW of battery store, with associated infrastructure, surrounded by a deer fence, on land to the east of Scunthorpe.

In summary:

- The site is entirely in Flood Zone 1 according to the EA Flood Map for Planning and appropriate development in this area.
- The local area to the site is not sensitive in terms of surface water flood risk.
- The site is currently used for arable farming which causes compaction, reduces absorption of rainwater by the soil and increases soil runoff, particularly after harvesting.
- The soil within the site is recorded as being free-draining.
- Swales are proposed to reduce the risk of runoff affecting the watercourse flows and the poultry farm.
- The proposal will eliminate compaction, allow the soil and vegetation properties to improve and contain the rainfall within the site, by infiltration into the ground.
- Runoff quality entering the environment will improve through ceasing the application of pesticides and fertilizers.

- Tracks will be formed in permeable construction.
- Transformer and battery units will be formed with permeable gravel beds to encourage infiltration.
- A management programme is described which ensures the soil and watercourse conditions will remain favourable for the lifetime of the development.

The proposal therefore brings significant benefit to the management of surface water, a reduction in runoff leaving the site and the improvement in water quality entering the environment. The development does not increase the risk of flooding to the local area or lower in the catchment.

Technical Appendices 3.2

PHASE 1 GROUND CONDITIONS DESK STUDY


National significant infrastructure project in the Energy Sector Little Crow Solar Park, Scunthorpe

PHASE 1 GROUND CONDITIONS DESK STUDY

On behalf of INRG Solar (Little Crow) Ltd

November 2018



Phase I Ground Conditions Desk Study Little Crow Solar Farm Scunthorpe Lincolnshire DN16 IXP

Client: INRG Solar (Little Crow) Limited

Intégrale Report No. 1844, Version 5, November 2018

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CONFIDENTIALITY STATEMENT

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Integrale Limited has prepared this report solely for the use of the client named above. Should any other parties wish to use or rely upon the contents of this report, written approval must be sought from Integrale Limited. An assignment fee may then be charged.

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LIST OF CONTENTS

- EXECUTIVE SUMMARY -

1.0	INT	RODUC	TION	2
2.0	THE	SITE		3
	2.1	Locatio	on and Description	3
	2.2	Publish	hed Geology and Mining	3
		2.2.1	British Geological Survey Mapping	3
		2.2.2	BGS Previous Investigation Records	4
		2.2.3	Soils Information	4
		2.2.4	Past Mining	4
		2.2.4	I Historical Mapping Evidence	4
		2.2.4	.2 Humberside Minerals Resources (2006)	5
		2.2.4	.3 TerraSearch Assess Report (August 2017)	5
		2.2.4	.4 Conventional Oil Well	5
	2.3	Outlin	le History	6
	2.4	Hydro	geology, Hydrology & Groundwater Vulnerability	7
	2.5	Enviro	nmental Information	8
		2.5.I	Pollution Information and Licencing	8
		2.5.2	Geological Information	8
		2.5.3	Background Soils Chemistry	9
		2.5.4	Contemporary Trade Directories	9
		2.5.5	Groundsure Radon Risk Information	9
	2.6	Conce	eptual Exposure Model	9
		2.6.1	Proposed Redevelopment	9
		2.6.2	Potential Sources of Contamination	10
		2.6.3	Potential Receptors	11
		2.6.4	Potential Pathways	
		2.6.5	Conceptual Site Model with Respect to Human Health	
		2.6.6	Conceptual Site Model with Respect to Controlled Waters	12
3.0	ANT	ICIPATI	ed ground & groundwater conditions	13
	3.1	Antici	pated Strata	13
	3.2	Anticip	pated Groundwater and Leachate	14
	3.3	Anticip	pated Ground Gas Regime	14
4.0	100		JATED LAND CONSIDERATIONS	15
	4	Gener		15
	42	Qualit	ative Risk Assessment	15
	4.3	Conclu	usions	15
				. –
5.0	GEC	FECHN	JICAL CONSIDERATIONS	17
APPE	NDICE	S		

- A. Site Location & Layout Plans
- B. Site PhotographsC. Geological Information
- D. Terrafirma Mining Report
- E. Groundsure Data Report



EXECUTIVE SUMMARY

Little Crow Solar Farm – Phase I Ground Conditions Desk Study Report No. 1844, November 2018

A Phase I Desk Study on ground conditions, geotechnical and contamination aspects for this proposed solar energy scheme has been completed.

The approximate 227 hectare site comprises a higher eastern area of level or gently eastward sloping arable land, a central zone moderately sloping down to the west, and a lower western area of very gentle to level ground. Agricultural soils predominate, with small areas of woodland & vegetation. To the west of the site are opencast ironstone workings and steel works

Geological records indicate the lower slopes overlain by Blown Sand comprising up to 7m of fine-grained silty sand. The bedrock beneath forms a sequence of north-south outcrops. The higher eastern area comprises Jurassic limestones; the central area is underlain by Jurassic mudstones and locally limestones; the middle and lower slopes are blanketed in the Blown Sand, underlain by mudstones and marls, including the commercially important Pecten Ironstone. The complete site area is classified as freely draining slightly acid sandy soils.

There are potentially small-scale surface ironstone workings in the lower western area. Northeast of the site is the Broughton B1 conventional oil well, sunk to 1.9km depth. Available data suggests it is not active.

Historically the majority of site has remained agricultural, with Gokewell Priory Farm in the north. Overhead power cable routes cross the site and mapping indicates periodic expansion of the ironstone workings and steel plant to the west. A former WWII anti-aircraft battery in the eastern area is reported removed.

In the higher area, the regional strata dip to the east directs surface water and moderate depth groundwater flow to the east, forming a Principal Aquifer. Midslope surface water and shallow groundwater flow within the Blown Sand is to the west, forming a Secondary A Aquifer, with a discontinuous springline midslope. Very shallow groundwater is anticipated in the lower western area where drainage ditches are frequent, with hummocky marshy areas.

Potential contaminant sources are considered limited to remnant metals in soils within any localised backfilled ironstone pits, and air-borne particulates from the industrial complex to the west, within topsoil. Potential receptors comprise construction workers and maintenance staff. Drainage ditches and the groundwater within the Principal and Secondary A aquifers are controlled waters receptors. For the limited groundworks, risk to groundworkers is considered negligible with standard protection.

The shallow groundworks will have negligible potential to cause or increase leaching. Run-off during construction works will need to be controlled and managed, as standard practice. Future run-off is unlikely due to predominant topsoil cover and anticipated infiltration characteristics, but requires consideration.

Combined geotechnical and contaminated land assessment should concentrate on specific features from historical maps to confirm ground conditions within solar array zones, occurrence of small scale ironstone working, typical gas regime, infiltration and permeability of near surface soils and identify any specific areas of concern.

There is no current evidence of ground conditions that would preclude development.



I.0 INTRODUCTION

INRG Solar (Little Crow) Limited are considering development of a 150MWp energy scheme comprising ground mounted solar PV modules and battery storage. Their planning consultants are Pegasus Planning Group.

Integrale Limited are commissioned to undertake a Phase I Desk Study, concentrated on ground conditions, geotechnical and contamination aspects. The desk study is also to inform drainage considerations by Clive Onions Limited.

This desk study report describes the geological setting, mining risk and historical and environmental data reports. The ground and groundwater conditions are anticipated and used to establish a conceptual model of potential pollutant linkages. Implications for the development are discussed and recommendations for further investigation or potential remedial works or design measures given.



2.0 THE SITE

2.1 Location and Description

As shown in Appendix A, the site is located to the east of Scunthorpe and north of Ravensthorpe. It has a central Ordnance Survey Grid Reference of 494000 410000 and postcode DN16 IXP. A slightly smaller site area was initially considered, and has subsequently been extended to comprise the area shown bounded in red in Appendix A.

No site reconnaissance visit has been completed by Integrale Limited, and the typical photographs included in Appendix B have been provided by the client. The main features and pertinent aspects on the site and immediately adjacent land are summarised below:

Current Use	Predominantly arable agricultural land.	
Site Area & Plan Shape	226.81 Hectares (2.268 km²).	
Maximum Dimensions	1700m N-S by 1100-1500m E-W.	
Ground Slopes & Topography	Higher eastern half at 60-67mAOD, level or with very gentle slopes down to east. Central quarter at 40-60mAOD, with moderate slopes (1:15 to 1:20) down to west. Western zone at 30-40mAOD, with moderate slope (1:12) down to west. Extreme western zone at 25-30m, with very gentle slope (1:50 to 1:60).	
Buildings & Condition	None significant.	
Surfacings & Condition Vegetation & Trees	Agricultural soils predominate, with small areas of woodland & vegetation. Three large plantations of trees (Gokewell Strip & Icehouse Strip in SE quadrant, and Little Crow Covert in northwest) do not form part of proposed development area.	
Water Courses	Mapping shows numerous drainage ditches within western zone run down to west, feeding into north-south drains. Pond at site of former Gokewell Priory may feed into stream flowing northwest into a lower pond adjacent to Santon Wood.	
Site Boundary Features	Agricultural fencing & hedges predominantly.	
Contamination Issues	None noted from photographs. Beyond to west is area of opencast ironstone workings and steel works. Google Earth imagery shows substantial mound in SW from 2003 and centrally from 2008 (see below).	
Geotechnical Issues Former ironstone workings etc. – see below. Former Oil Well off-site to northeast – see historical maps and below.		

2.2 Published Geology and Mining

2.2.1 British Geological Survey Mapping

BGS geological maps indicate the following strata beneath and adjacent to the site:

Map / Scale	Sheet 89 at 1:50,000 scale (Solid & Drift Sheets).	
BGS On-Line Viewer	BGS Maps Portal Accessed 8th August 2017.	
Artificial Ground	None mapped on site. Frodingham Ironstone Backfilled Opencast Workings immediately beyond western boundary.	
Superficial Deposits	Lower slopes overlain by Sutton Sand (Devensian Blown Sand): up to 7m of fine grained silty sand. Further area of Blown Sand mapped at high level beyond eastern site boundary is likely to form a thin cover in parts of the eastern zone.	



	Sequence of north-south outcrops from:
	I. Kirton Cementstones of Lower Lincolnshire Limestone Formation (LLLS) of
	Middle Jurassic period forming higher eastern area, including Scawby Limestone
Solid Geology	and Santon Oolite, overlies;
	2. Lower Estuarine Series and Northampton Sands (10-20m thickness), overlies;
	3. Coleby Mudstones with Marlstone Rock of Lias Group of Lower Jurassic
	period on middle and lower slopes, including Pecten Ironstone.
	None mapped other than superficial Blown Sand masking Jurassic bedrock. No
Geological Features	dip arrows, however cross-section & more remote data indicates regional dip
_	down to east at 1-3°.

Summary drawings of the geological formations and potential groundwater zones are included in Appendix C.

2.2.2 BGS Previous Investigation Records

Previous investigation records available on the BGS website under the Open Government Licence include 5 boreholes sunk across the northern area. These are also included in Appendix C and indicate:

- Higher Eastern half of site, at or above 55mAOD Topsoil over Weathered oolitic limestone of Lincolnshire Limestone Formation;
- Central northern area between 40-50mAOD Blown Sand to 2-4m depth, overlying Middle & Lower Lias mudstones and locally limestones;
- Lower northwestern area at 36mAOD yellow and grey clays of Coleby Mudstones (with thin veneer of Blown Sand likely).

No details of groundwater levels are included in these records.

2.2.3 Soils Information

Data available on the LandIS Soilscapes Viewer and within a Soil Site Extended Report is included in Appendix C and indicates:

- The complete site area is classified as underlain by freely draining slightly acid sandy soils. These have typically low fertility arable land cover, and drain to groundwater.
- The complete site area is underlain by Newport I Type Soils. These are deep well drained sandy and coarse loamy soils. They are free draining and permeable in unconsolidated sands or gravels, which have a relatively high permeability and high storage capacity. They have a very low potential for ground movement (shrinkage or swelling).
- These soils will, by nature of their high permeability, readily transmit a wide range of pollutants because of the rapid drainage and low attenuation potential.
- The uppermost 300mm of the soil profile is sandy and 'light'.
- Newport I Soils have typically an upper 250mm of dark brown slightly stony sandy loam or loamy sand, overlying brown slightly stony loamy sand or sand, with a weak fine subangular blocky structure. Below 500-550mm depth, these develop into yellowish red or brownish yellow slightly stony sand of single grain structure.

2.2.4 Past Mining

2.2.4.1 Historical Mapping Evidence

Historical maps are discussed in more detail below and are included in Appendix E. There is evidence for potential small scale near surface workings in the lower western area, where small pit features, some ponds and a hummocky area in the extreme southwest are shown.



A summary plan of such historical features has been included after those maps at the end of Appendix E. It is assumed that if these are evidence for surface working or mining, they represent ironstone extraction. It is noted that several such features align north-south, potentially reflecting the geological trend of ironstone outcrops. Google Earth imagery shows a substantial vegetated mound with approximate maximum dimensions of 70m by 45m in the southwest area between 20-26mAOD from 2003 onwards, which could relate to such workings. From 2008 a mound of material approximately 50m diameter appears centrally, south of the main access track to Gokewell Priory Farm, perhaps more likely to be agricultural in origin or related to the demolition of farm buildings.

The opencast workings to the west include a linear excavation, with steep side slopes and apparently extending well below 5mAOD, based on Google Earth spot heights.

2.2.4.2 Humberside Minerals Resources (2006)

The Humberside Minerals Resources plan obtained from the BGS website (an extract of which is included in Appendix C) indicates the complete site area as having "Underground planning permission (valid and expired)". This suggests that the Minerals Planning Authority had granted permission for (assumed) ironstone working by underground mining, presumably as an extension to the opencast area to the west, but that this has now expired. Whether any workings beneath the site area did in fact occur, remains undetermined to date.

2.2.4.3 TerraSearch Assess Report (August 2017)

A Terra Search Assess report was therefore obtained from TerraFirma Mine Searches Limited and is included in Appendix D. The report is based on the original slightly smaller site area (as shown on the maps) however, it includes information from a larger surrounding 'buffer zone' and therefore covers the complete current boundaries. This indicates:

- Negligible to low risk from past coal mining, evaporate working, brine extraction, or metalliferous mining for tin, lead etc.
- Moderate risk of past limestone or other stone extraction.
- Moderate risk of planned or future mineral extraction (of ironstone).

For ongoing current site use, TerraFirma therefore conclude:

- A Moderate risk from past ironstone extraction, due to a number of suspected extraction features (see hazard map within report).
- A Moderate risk due to a hydrocarbon well off-site to the northeast. TerraFirma have confirmed that DECC (Dept. of Energy & Climate Change) data indicates the hydrocarbon field area extends within the site boundary. "Therefore associated extraction features such as underground workings and shafts could be present and have the potential to impact ground stability in the area". See also Section 2.3.

For future development of the site, TerraFirma therefore conclude:

• "...prior to any site works or future development activity, it is considered prudent to commission a full Site Survey by a qualified mining geologist/engineer."

2.2.4.4 Conventional Oil Well

Immediately northeast of the site at Top Wood is the site of a conventional oil well, known as Broughton B1. This was sunk in 1984 by BP Petroleum Development Limited. Details have been obtained from the UK Onshore Geophysical Library open-access resource and is included in Appendix C.



This indicates:

- Well was sunk at 63.1mAOD and taken to 1920m depth, as a vertical boring;
- The well is cased to 1909m depth, casing decreasing from 340mm to 140mm down its length;
- The Upper, Middle and Lower Lias strata were proven from surface to 100m depth. The underlying Triassic, Penarth and Mercia Mudstone Groups, and Upper Permian strata occur to 800m. Beneath, the Lower Permian marl/shale and Rotliegendes Sandstone reservoir were found to 1120m, with Carboniferous strata below to the base of the well. It is tentatively assumed that the oil shales or sandstones being targeted are those below 800m depth.

On-line searches for details of this oil well found that Egdon Resources plc have stated: "The two prospects are located along an oil productive trend with the Crosby Warren producing oil field at one end and the Brigg oil discovery at the other. The Broughton-BI well drilled by BP in 1984 flowed on test at up to 40 barrels of oil per day before being abandoned". This does not suggest that the well is currently active, and no further detail of the likelihood of future exploitation is readily available at this time

2.3 Outline History

Historical maps obtained from a Groundsure report are included in Appendix E, together with a summary plan of pertinent features. The Groundsure report is based on the original slightly smaller site area (as shown on the maps) however, it includes information from a larger surrounding 'buffer zone' and therefore covers the complete current boundaries. These indicate the following pertinent information:

Map Date	Site Features / Land Use	Adjacent Features (distance from site)
1885- 1906	Majority of site agricultural fields with drainage ditches in lower area. Gokewell Priory Farm with pond in N area. Hummocky /marshy area in extreme lower SW with pond. Several small scale excavations or pits in lower W area may indicate surface diggings for ironstone.	Icehouse and Gokewell Strip woodlands present as existing. Redbourne Hill and Appleby Iron Works 2kms W and NW respectively. Small excavations (surface ironstone workings?) beyond SW corner near Gorse Covert. Larger ironstone quarries 1.5kms SW at Emmanuel Bridge
1948-55	No significant changes apparent within site	Ironstone quarries extended to within 800m of W boundary. Iron & Steel Works extended to within 750m NW.
1968-80	Overhead powerlines constructed crossing SW to NE from substation within Iron & Steel Works to SW. Possible new drainage ditches (and small pond?) within hummocky area in extreme NW near Crow Covert. Clearance of Sodwall Plantation (possible ironstone workings?)	Iron & Steel Works expanded to within 500m W. Opencast Ironstone Workings mapped to within 500m NW. Emanuel Air Strip West and East within 500-750m SW of site. Drainage ditches apparently expanded just beyond site to SW, around Bottesford Beck. By 1979 Iron & Steel Works had expanded to SW site corner across former Air Strips and opencast ironstone workings typically to within 100m W. In extreme SW corner, opencast extended to site boundary, and two parallel drainage ditches constructed at cutting face.
1994 - 2002	Gokewell Priory Farm buildings demolished – exact date unclear from mapping. Opencast ironstone workings annotated in extreme SW site extension area.	Poultry Farm constructed beyond central E boundary near Heron Holt woodland.



2002 - 14	No significant changes apparent.	Oil Well mapped at Top Wood c. 100m NE*.
	Maximum elevation of drainage ditches /	Opencast workings to W marked as Disused.
	surface water courses on this mapping at	Linear water feature c. 100-200m W of site
	36mAOD in N, 43mAOD centrally,	reflects flooded workings (also shown on Google
	35mAOD central southern, and 30mAOD	Earth imagery from 2003). Tree planting beyond
	in southern area.	SW corner on former opencast area.

* See 2.2.4.4 above.

A Built Heritage Assessment by Cotswold Archaeology has identified a WWII Heavy Anti-Aircraft Battery in the upper eastern area (north of Gokewell Strip). They report it de-armed in 1942 and conclude that remains are unlikely to survive below ground.

2.4 Hydrogeology, Hydrology & Groundwater Vulnerability

BGS groundwater data available on-line indicates that a hydrometric area boundary runs north-south across the higher slopes of the eastern area. Upslope of the highest main extent of the Devensian Blown Sand (Sutton Sand) is approximately 45-55mAOD, the regional geological dip of the bedrock strata at 1-3° to the east directs both any surface water flows and groundwater flow direction eastwards. (The nearest surface water course to the higher eastern boundary is 600-800m remote). Downslope of 45-55mAOD, where the bedrock is overlain by the Blown Sand, both surface water and shallow groundwater flow within the Sand is to the west. The contours on the estimated minimum groundwater level or pressure surface within the Lincolnshire Limestone was also at c. 45mAOD (based on mid 1960's data).

From the published geological strata and topographic maps showing surface water courses, the following can be anticipated at this site:

Shallow Soils	Permeable with intergranular flow in superficial deposits. High fracture/fissure		
Permeability	permeability in limestone bedrock.		
Anticipated	Very Shallow (<3m below ground level) in lowest western area.		
Groundwater Table	Shallow (3-5m below ground level) centrally.		
Depth	Moderate (5-10m below ground level) in higher eastern area.		
Anticipated Groundwater Flow Direction	Extreme western boundary zone with opencast & ironworks, flow direction may be controlled by drainage ditches and likely low flow rate. Western zone and up to 45-55mAOD, flow direction to west. Eastern boundary and down to 45-55mAOD, down dip to east.		
Surface Water Courses and Flow Direction	Unnamed drainage ditches (unnamed Tertiary Rivers) on site in western area, typically flow west and north-south. Springs & stream in Far Wood/ Heron Holt c. 600m east of site at c. 42mAOD flow east northeast.		
Aquifer Type	Secondary A Permeable layers in superficial deposits. Bedrock strata from east to west: Principal Aquifer in higher limestones. Secondary Aquifer in lower Coleby Mudstones and Marlstone Rock. Unproductive Strata formed by upper Coleby Mudstones. (See page 33 of Groundsure Environmental Data for details).		
Environment Agency Soils Classification	High leaching potential.		
Hydraulic Continuity of Groundwater and Water Courses	Likely throughout site.		

A summary plan has been included in Appendix C to indicate:

- Western area below 30mAOD has the likely shallowest groundwater table draining westwards;
- Likely hydraulic continuity with artificial drainage ditches also flowing north-south;
- There is a potential discontinuous springline at 40-43mAOD;



- The upper eastern area drains to east and water table is likely below 45-55mAOD;
- This causes spring issues at c. 40-45mAOD remote from the site to the east;
- Shallow depth soils in complete area are classed as being well drained.

2.5 Environmental Information

The following pertinent information on activities within 250m of the site has been extracted from the Groundsure report included in Appendix E.

2.5.1 Pollution Information and Licencing

	Number	Distance from Site
Surface Water Abstractions	0	
Groundwater Abstractions	0	
Contaminated Land Register	0	
Entry/ Enforcement / Prohibition	0	
Known Pollution to Controlled Waters	0	
Integrated Pollution Control	0	
Fuel Station Entry	0	
Registered Radioactive Substances	0	
Discharge Consent	1	Revoked (1997) effluent discharge
Discharge Consent		Cokewell Priory
		190mW Crosby North Landfill Waste
		landfilling (excluding Inert) Current
Known Landfills / Waste Management /	2	144m VV Scunthorpe Concast
Transfer Sites within 250m		Surrendered Licence for Industrial, liquid,
		sludge, British Steel Corporation, last
		recorded 1992.
Source Protection Zones	None	
Eleadelain Area / Elead Warning Status	None	Potential for groundwater flooding at
Thoughain Area / Thoughaining Status		surface locally

2.5.2 Geological Information

Hazard Type	Hazard Rating	
Natural and Mining Cavities	Possible small scale mining within site boundaries for	
	ironstones (see historical maps also)	
Potential for Ground Dissolution	Very Low	
Stability Hazard	very Low	
Potential for Landslide Ground Stability	Madarata	
Hazard	moderate	
Potential for Shrinking/Swelling Clay	L ou	
Ground Stability Hazard	LOW	
Potential for Compressible Deposits	Madarata	
Ground Stability Hazard	rioderate	
Potential for Collapsible Deposits Ground	Very Low	
Stability Hazard		
Potential for Running Sands Ground		
Stability Hazard		



2.5.3 Background Soils Chemistry

The Groundsure report includes BGS estimated background soil chemistry for 5 metals within shallow soils. This indicates that naturally occurring chromium marginally raised in this area. However interpretation suggests that at these levels, such metals would be unlikely to exceed generic assessment criteria for commercial use. Current National Planning Policy guidance does not consider naturally occurring metals as evidence of contamination.

2.5.4 Contemporary Trade Directories

Potentially Contaminative Activities on Site	No additional activities other than the overhead power supply pylons are given in the Groundsure data.
Potentially Contaminative Business Activities within 250-300m of Site	No additional significant activities other than the oil well detailed above and the steel works westwards are given in the Groundsure data.

2.5.5 Groundsure Radon Risk Information

The Groundsure report indicates that the specific site lies in a Radon Affected Area, requiring Full protection measures, for new buildings and dwellings.

2.6 Conceptual Exposure Model

This section draws together desk study information, outlines an initial conceptual exposure model, and provides a qualitative assessment of potential contamination via a source-pathway-receptor framework for the proposed redevelopment.

2.6.1 Proposed Redevelopment

Outline details of the proposed redevelopment are shown in Appendix A and can be summarised as:

Buildings	None anticipated
Car Parking	Minimal
Access Roads	Main access from northeastern area to centre and former Gokewell Priory area. Smaller access roadways to each solar PV module area and inverter stations
Landscaping	Not considered substantial
Development Level	As existing
Drainage	Watercourses to be retained with 8m buffer zone alongside. Swales (c. 300mm depth by 3m width) to run N-S across central lower and extreme southwest areas to limit overland flows into watercourses.
Substations and Battery Storage	Battery Storage Zone, Inverter & Transformer stations for each area of solar PV modules

- The proposed solar arrays comprise photo voltaic panels laid in rows approximately east west across the field enclosures. Arrays are typically mounted on a metal framework, fixed onto steel pins driven between 0.5-0.75m depth into the ground, depending on the ground conditions. Alternatively, a system of installing small 'foot pads' for the arrays may be adopted, again to a maximum of 0.5-0.75m depth. It is assumed that the east-west alignment across these gentle to moderate westerly facing slopes will require either very minor cutting into the slope, or more likely design of the metal frameworks to incorporate any more critical slope angles.
- In addition there will be a requirement for shallow depth cable trenches, assumed no deeper than 0.5m below existing ground level. Gravel filled drainage trenches of up to 0.5m depth are also assumed.
- The transformer and containerised battery units will be placed on a 300mm permeable gravel bed to allow attenuation and infiltration of rainfall and surface run-off into the underlying soil.



- Structures are limited to inverter and transformer stations, which typically site on reinforced concrete foundation slab, on sub-base aggregate, with a drain surrounding if required. Fencing and CCTV cameras are generally required around the boundary.
- The proposed layout shows the area of the former Gokewell Priory Farm, its associated pond and stream course remaining as existing. There are to be no solar modules within the overhead power cable and pylon corridor.

2.6.2 Potential Sources of Contamination

The desk study has been used to identify the likely remnant contaminant sources and distribution. The potential current and historical on- and off-site sources and the contaminants associated with these, derived using CLR8 Potential Contaminants for the Assessment of Land, and through experience of industrial land use, are detailed below.

Potential Contaminants Associated with On-Site Sources			
Description	Metals, semi-metals, non-	Organic chemicals	Ground Gases
	metals, inorganic chemicals	-	& Vapours
	and others		-
Localised small	Range of metals possible,	Unlikely given age of likely	Unlikely given age of likely
ironstone pits, if	given age	backfilling	backfilling
backfilled		_	
Recent	Unlikely significant given usage	and historical development	
Agricultural Use			
& Maintenance			

Potential Relevant Contaminants Associated with Off-Site Sources			
Description	Metals, semi-metals, non-	Organic chemicals	Ground Gases
	metals, inorganic chemicals		& Vapours
	and others		
Opencast	Range of contaminants	Range of contaminants	Unlikely given distance,
Ironstone	possible, although unlikely	possible, although unlikely	topography and ground
Workings, if	mobile in site direction	mobile in site direction	conditions
backfilled			
Electricity	Unlikely to impact within site	boundaries due to distance, to	pography and ground
Substation and	conditions		
overhead			
cables/pylons			
infrastructure			
Iron & Steel	Air borne dust & particulate	Unlikely given distance, topog	raphy and ground conditions
Works	contamination possible for		
	range of metals		
Oil Well	Unlikely given land usage and ;	ground conditions, depth of dri	illing and date of operational
Infrastructure at	use (1980's?)		
Top Wood			
(95m remote)			

The potential relevant contamination sources are therefore considered to be limited to remnant metals in soils within any localised backfilled ironstone pits, and air borne derived particulates from the extensive industrial complex to the west and southwest, remaining within shallow depth site topsoil. The Gokewell Priory Farm building area has been demolished since 1994-2002, and no specific development in that area is proposed. The hummocky areas west of this (near Crow and Little Crow Coverts) may relate to either this demolition or drainage works, or less likely to ironstone working.



2.6.3 **Potential Receptors**

A future solar farm end use and known neighbouring agricultural land uses have been used to develop an understanding of the likely sensitive human receptors. In view of the very limited ground intrusion needed to install the panels, and the shallow depth of any service runs, or access track/roadways, it is envisaged that potential receptors to contamination (if present within the soils on-site, or via migration from adjacent sites) are limited to:

- Construction Workers during installation or maintenance. The most critical receptor would therefore be a female adult.
- Future maintenance staff or neighbouring workers.

Information gathered during the site research has been used to develop an understanding of the likely sensitive controlled waters receptors. These are considered to be the drainage ditches, streams and ponds on-site, and the groundwater within the Principal and Secondary A aquifers.

2.6.4 Potential Pathways

The presence of Blown Sand superficial deposits beneath both the site and adjacent areas creates a direct potential pathway for cross-migration of ground gases, leachate or mobile contaminants. The presence of drainage water courses indicates a potential pathway for leachate or other mobile contaminants within the site to locally impact on water receptors.

To develop further an understanding of the potential risks posed by the contaminants to human receptors, the pathways through which contaminants may impact sensitive receptors need to be identified. The CLEA model indicates potential exposure routes for assessing risks to human health for a solar array use to be limited to:

- Dermal exposure if contaminated soil exposed during groundworks;
- Inhalation of particulates if contaminated soil exposed during groundworks.

It is considered that the potential pathways with respect to controlled waters will be limited to:

- Lateral migration of perched groundwater or leachate to surface water (drainage ditches or ponds) during construction.
- Surface run-off to water courses if uncontrolled drainage allowed.

2.6.5 Conceptual Site Model with Respect to Human Health

The conceptual site model has been developed based upon the following potential source-pathwayreceptor linkages:

SOURCE		PATHWAY		RECEPTOR
Contaminated soils	÷	Dermal exposure (if exposed during groundworks).	\rightarrow	On-site female adult construction worker.
Contaminated soils	\rightarrow	Outdoor inhalation of soil dust/particulates.	\rightarrow	On-site female adult construction worker.

The construction of foundations for the solar arrays typically comprises driving a short pre-formed steel pin into the ground, without production of spoil, or installation of a small diameter 'foot-pad' to support the steel legs. In view of the very limited groundworks required, and the minimal interaction with existing soils, it is considered that the actual risk to groundworkers, should contaminated soils be present within the topsoil and subsoil, is negligible.



2.6.6 Conceptual Site Model with Respect to Controlled Waters

The conceptual site model has been developed, based upon the following potential source-pathway-receptor linkages:

SOURCE		ΡΑΤΗΨΑΥ		RECEPTOR
Contaminated soils (if present within construction depth)	→	Leaching from soils or migration of liquid contaminants through the unsaturated zone by means of new man-made or natural pathways	>	Surface Water Courses & Groundwater
Contaminated soils (if present within construction depth)	→	Run-off from disturbed surface soils	\rightarrow	Surface Water Courses

The very limited groundworks required to install the solar arrays is considered to have negligible potential to cause or increase leaching, should any contaminated soils be present within the shallow depth of penetration. Run-off during construction works will need to be controlled and managed, as is standard practice. During future use, run-off is unlikely due to the predominant topsoil and turf cover and anticipated infiltration characteristics, but requires consideration.



3.0 ANTICIPATED GROUND & GROUNDWATER CONDITIONS

3.1 Anticipated Strata

In view of the above, the following ranges of ground conditions are anticipated:

Higher Eastern Area at or Above 60m AOD

Weathered Oolitie	c Limestones (Lincolnshire Limestone Formation of Inferior Oolite Group)
<u>Depth (m)</u>	Description
GL to 0.5/0.75	TOPSOIL and SUBSOIL (brashy/stony and sandy with limestone gravel)
0.5/0.75 to 1.0/3.0	Medium dense silty SAND with increasing gravel and sandy GRAVEL with a variable (loamy) silty binder, clayey in parts (WEATHERED INFERIOR OOLITE GROUP)
Below 1.0/3.0	Cream oolitic LIMESTONE, highly fractured with brown sandy SILT infilling (INFERIOR OOLITE GROUP)

Central Area between 50-60m AOD

Sandy Ironstone and Sandstones (Grantham Formation & Northampton Sand) or Coleby Mudstones)

<u>Depth (m)</u>	Description
GL to 0.5/0.75	TOPSOIL and SUBSOIL (slightly stony and very sandy)
0.5/0.75 to 1.0/2.0	Medium dense silty SAND and SILT (WEATHERED OOLITE OR LIAS GROUP)
1.0/2.0 to 2.0/4.0	Dense gravel becoming weathered bedrock of SILTSTONE, sandy IRONSTONE and SANDSTONE (NORTHAMPTON SAND) or Firm yellow or grey CLAY, highly weathered laminated MUDSTONE/ SILTSTONE OR SANDSTONE (LIAS GROUP)

Central & Western area between 30-50m AOD

Blown Sand overlying Lias mudstones and locally limestones

<u>Depth (m)</u> GL to 0.5/0.75	Description TOPSOIL and SUBSOIL (slightly stony and very sandy)
0.5/0.75 to 2.0/4.0	Loose or medium dense yellow brown silty SAND with some gravelly sand (SUTTON SAND / DEVENSIAN BLOWN SAND)
Below 2.0/4.0	Dense sandy IRONSTONE and SANDSTONE (NORTHAMPTON SAND) or

Firm yellow or grey CLAY, highly weathered laminated MUDSTONE/ SILTSTONE OR SANDSTONE (LIAS GROUP)

Lower Western area at or below 30m AOD Blown Sand overlying Lias Mudstones

Diowii Sanu overiyi	
<u>Depth (m)</u>	Description
GL to 0.5/0.75	TOPSOIL and SUBSOIL (slightly stony and clayey, very sandy)
0.5/0.75 to 2.0/4.0	Loose or medium dense yellow brown slightly clayey silty SAND with some gravelly sand (SUTTON SAND / DEVENSIAN BLOWN SAND)
Below 2.0/4.0	Firm dark grey CLAY, highly weathered laminated shaley MUDSTONE/ SILTSTONE (LIAS GROUP) (includes Pecten Ironstone)



3.2 Anticipated Groundwater and Leachate

It is anticipated that rainfall infiltration will rapidly move down through the free-draining topsoil and into the superficial granular deposits in the central and western area, and into the fissured predominant limestones in the higher eastern area. The potential groundwater conditions, springline and drainage directions are shown on an annotated plan included in Appendix C.

The groundwater table within the higher Lincolnshire Limestone Formation will be controlled by regional dip direction, which here is predominantly eastwards at 1-3°. The likely groundwater elevation is between 45-55mAOD, ie at least 5m below ground level in this higher area.

Below 50mAOD the occurrence of Blown Sand deposits appears to promote good drainage of the shallow depth soils, and the moderate slopes within the central area at 1 in 10 to 1 in 20, are likely to have an unconfined groundwater table within the basal layers of these sands.

Below 30mAOD on the lowest western area, the Blown Sands may well become more clayey or silty, and the underlying Coleby Mudstone of the Upper Lias, with a shallow surface slope of 1 in 50 to 1 in 60 appears to promote a shallower water table. Spring issues are noted on the historical mapping at around 40-43mAOD and drainage ditches are prevalent below this elevation. Below 30mAOD the extreme western area may well have more poorly draining shallow soils, with frequent drainage ditches required. In addition, any backfilled ironstone workings could create localised poorly drained surface soils.

Nevertheless, the soils throughout the complete site area are classified as well drained or free draining.

3.3 Anticipated Ground Gas Regime

There is a substantial industrial area downslope to the west and major opencast ironstone workings, which may have been partially backfilled. It is not anticipated that an abnormal ground gas regime will be present beneath the majority of the site, in view of the topography, distance and apparent lack of continuity within the Blown Sand deposits.

However there remains a potential for abnormal ground gas development beneath the more level and closer western zone, and locally where small scale ironstone workings may have been backfilled.



4.0 CONTAMINATED LAND CONSIDERATIONS

4.1 General

The desk study has indicated that the current site has a prolonged history of agricultural usage. There is no specific evidence of significant large-scale ironstone extraction or landfilling within the boundaries proven to date, with the exception of the extreme southwestern zone, where opencast workings are annotated on the 1994 map. There appears also to have been small scale extraction via pits and near surface digging in the lower western area. Adjacent to the west and northwest boundaries, where there has been substantial ironstone working off-site, both opencast and underground mining areas may well be backfilled with unknown materials. There has been prolonged heavy industry immediately beyond the site boundaries.

4.2 Qualitative Risk Assessment

The currently proposed solar farm is likely to involve construction activity within the uppermost 500-1500mm of ground level. The likelihood of solar array construction creating an adverse, or worsening impact on the contaminant exposure model given above, is therefore considered negligible for most of the site and low for potential backfilled features.

There is a negligible risk of a new controlled waters pollutant linkage being created due to the very shallow depth of construction activity, and the non-polluting nature of the development.

It is not currently anticipated that shallow depth soils will include significant remnant contamination, however this will need to be confirmed in view of the proximity of industrial sites and suggested small scale pit extraction in the extreme western boundary area, and recent 1990's opencast working in one small area. The majority of proposed construction however involves minimal ground intrusion, and it is considered that the pathway for exposure of groundworkers during construction is unlikely to create a significant contaminant linkage, with standard practice.

The overall ground gas regime beneath the site is likely to be normal or near normal. The proposed construction of solar arrays will not have any overall adverse impact on that ground gas regime. In the lower western area there is potential for an abnormal ground gas regime, due to any backfilled workings, and requires further consideration in view of the proposal for buried electrical plant and cabling.

4.3 Conclusions

In view of the above low levels of risk and proposed change of use, it is advisable that limited investigation/assessment be completed. It is concluded that for contaminated land assessment:

- Confirmatory intrusive contamination investigation is recommended, concentrated on the western boundary, targeted at specific features shown on historical maps. This will provide data on the occurrence and variation in shallow depth soils conditions (typically between ground level to Im depth, and with deeper investigation at limited locations). The most technically appropriate method of investigation would be with shallow open-drive sampling boreholes.
- If these boreholes confirm the absence of significant extraction or landfilling in the western boundary zone, it seems unlikely to be necessary to undertake further investigation for this aspect across the remainder of the site. However where other geotechnical or drainage investigations are to be undertaken to provide data for design and construction, the opportunity to inspect and sample at those locations can be taken, to confirm deeper ground conditions and obtain additional soils samples for confirmatory analyses.
- Near surface and deeper gas monitoring should confirm the typical gas regime, particularly in the lower western area. This can be achieved by gas measurements within the borehole standpipes, which should have a variety of response zone depths. A sufficient programme of gas and groundwater monitoring would be I- 2 visits initially during low or rapidly falling atmospheric pressure periods. That would identify whether any further monitoring is required.



• Assuming groundwater is proven within the standpipe installations, sampling can provide analyses of water quality and confirm any contaminant impact on controlled waters beneath the current site.

Following intrusive investigations the conceptual model can be updated and a quantitative risk assessment made. That will identify any specific areas of concern and the need for any further investigation, risk assessment or design measures.



5.0 GEOTECHNICAL CONSIDERATIONS

The anticipated ground conditions indicate predominantly granular superficial deposits or over-consolidated mudstones beneath the majority of the western and central area, and limestone derived soils in the higher eastern area. Under the anticipated minor loading changes due to solar array construction, these soils are unlikely to prove problematic.

If confirmation of shallow depth soils characteristics suggests it is merited, for instance in any shallow backfilled ironstone pits or backfilled workings, consideration could either be given to use of geogrid reinforcement in specific areas to increase soil stability and tensile strength, or shallow vibro compaction simply to produce a uniform formation and limit differential movement of solar arrays to within acceptable limits. The stability of the proposed anchoring / foundation system should provide adequate resistance to self-weight, wind and snow loadings.

The construction of the arrays should ensure that enhanced surface run-off, or erosion does not occur. Across the majority of the proposed array areas this is not considered likely, in view of the granular soils, described as being well-drained or free-draining. However where transformer and battery units are proposed, these should be sat on a permeable gravel bed to promote attenuation and infiltration to the underlying soils.

Intrusive geotechnical investigation will therefore be required to confirm the following aspects:

- The typical thickness of topsoil, subsoil and superficial deposits and their material, grading and strength properties;
- Description and classification of shallow depth soils, along with field infiltration trials via soakaway testing, to measure in situ permeability of near surface soils, and to compare against design permeability, drainage assumptions and design;
- Evidence for past shallow ironstone working or backfilling of such features, perhaps by 'bell pit' extraction or similar, in the lower western area, specifically investigating features indicated on historical mapping, where they occur within proposed solar array zones.

It would be prudent to take specialist advice on the need for Unexploded Ordnance supervision during any works close to the former WWII anti-aircraft battery identified by the heritage consultant in the eastern area.

It would also be prudent for the project team to obtain further details of the nearby oil well permissions, reservoir depth(s) and potential zone of influence, should future exploitation be proposed.

The geotechnical investigation should be combined with contamination assessments discussed above. Machine excavated trial pitting will be the most appropriate technique for investigation and soakaway trials on this large area.



Appendix A

Site Location

GEOLOGICAL • GEOTECHNICAL • ENVIRONMENTAL • ENGINEERING

Integrale Limited, Suite 7, Westway Farm Business Park, Wick Road, Bishop Sutton, Somerset, BS39 5XP United Kingdom Tel: 01275 333 036 www.integrale.uk.com

Registered Office: The Granary, Chewton Fields, Ston Easton, Somerset, BA3 4BX United Kingdom VAT Reg. No. 609 7402 37

KEY: SITE LOCATION PLAN

APPLICATION BOUNDARY



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LITTLE CROW SOLAR PARK - SITE LOCATION PLAN Pegasus

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Appendix B

Site Description/Photographs

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Integrale Limited, Suite 7, Westway Farm Business Park, Wick Road, Bishop Sutton, Somerset, BS39 5XP United Kingdom Tel: 01275 333 036 www.integrale.uk.com

Registered Office: The Granary, Chewton Fields, Ston Easton, Somerset, BA3 4BX United Kingdom VAT Reg. No. 609 7402 37

Santon Solar/Battery Site survey photos











View 3













View 8





View 9 Fox tbc





View 10 Badger tbc



View 12 Track to Raventhorpe



















View 16



View 17 Sub









View 19 Sub

View 21





View 22 Badger set











View 26













View 30







View 32



View 33








View 36

















View 42



























View 54





Appendix C

Geological Information

GEOLOGICAL • GEOTECHNICAL • ENVIRONMENTAL • ENGINEERING

Integrale Limited, Suite 7, Westway Farm Business Park, Wick Road, Bishop Sutton, Somerset, BS39 5XP United Kingdom Tel: 01275 333 036 www.integrale.uk.com

Registered Office: The Granary, Chewton Fields, Ston Easton, Somerset, BA3 4BX United Kingdom VAT Reg. No. 609 7402 37





British Geological Survey BGS ID: 134225 : BGS Reference: SE91SW141 British National Grid (27700) : 493859,410390 Report an issue with this borehole

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Page 1 of 1 ▼ Next >

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Soil Site Report

Extended Soil Report

Santon 1844

Easting: 493973 Northing: 409748 Site Area: 1km x 1km

Prepared for: Kay Boreland, Integrale Ltd Date: 08 Aug 2017





Citation

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National Soil Resources Institute (2017) Soils Site Report for location 493973E, 409748N, 1km x 1km, National Soil Resources Institute, Cranfield University. Accessed via: https://www.landis.org.uk/sitereporter

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