Appendix 9.3

Technical Photography,
3D Modelling and Verified Visualisations

Fair Oaks Renewable Energy Park

Ruddington

for

Fair Oaks Renewable Park Ltd

April 2023

End Barn . 58 Shaw Lane . Oxenhope . West Yorkshire . UK . BD22 9QL . www.msenvironmental.co.uk

Contents

Introduction

Mike Spence BA (Hons), MLD, CMLI, REIA, FRGS is a one of the UK's leading independent exponents of technical photography, verified photomontages and visualisations. Since 2013 Mike has been a technical advisor to the Landscape Institute on 'photography and photomontage in landscape and visual impact assessment', and has been undertaking this work for over 25 years. He is one of the main authors of the Landscape Institute's TGN 06/19 and provided technical support to Scottish Natural Heritage on their windfarm visualisation guidance. His background as a Chartered Landscape Architect, Registered EIA Practitioner and Fellow of the Royal Geographic Society working on strategic infrastructure projects has meant that the accuracy of the visualisation work is paramount, and technical photography, together with extensive surveying experience and detailed 3D modelling using real world co-ordinates ensures that the visualisations produced follow a clear and transparent methodology to ensure they are as accurate as possible.

Recent projects include the UNESCO World Heritage Sites at Kew Royal Botanic Gardens, Fountains Abbey for The National Trust, and Derwent Valley Mills for Amber Valley Borough Council. Mike has also been working closely with Bath City Council on proposed development in the UNESCO World Heritage City of Bath. Mike's work and objective technical checks have been used at numerous Public Inquiries and Planning Hearings, on behalf of both local authorities and developers.

In November 2021 Fair Oaks Renewable Energy Park Ltd contacted MSE to request Technical Photography, GNSS/RTK Surveying, 3D Modelling and Visualisation support for the proposed Fair Oaks Renewable Energy Park, near Ruddington.

Verified Photography and 3D Modelling

The photographs were taken with a full frame camera (Canon EOS 5D Mark III) and 50mm lens combination consistent with Landscape Institute's TGN 06/19, GLVIA3 and the emerging understanding of the requirement for technical photography for visualisation work. As part of the work 9 viewpoints were identified providing views of the site and visited on 17 & 23 November 2021 and 17 February 2022. The weather was good with clear visibility.

Technical Photography

The camera was mounted on a Manfrotto 303 SPH panoramic tripod head, levelled using a Manfrotto Leveller, supported on a Manfrotto Tripod. The tripod head was levelled using a spirit level, to avoid pitch and roll. The camera was set with the centre of the lens 1.60m above ground level. Photographs were taken in Manual mode with an aperture of f/8 or f/11 and a fixed focal length throughout. The panoramic tripod head was set with increments to give approximately 50% overlap between frames. Photographs were taken in both landscape and portrait format. From each photograph location a full 360 degree field of view was taken centred around a nodal point. The nodal point was set to avoid any problems of foreground parallax. A Sigma 50mm f/1.4 lens was used for all viewpoint photographs.

Single Frame 50mm photograph is insufficient to capture the wide spread of a solar farm in the view. Instead a panorama is created by stitching multiple 50mm images together:

50mm lens full 360 degree panorama

Extracted 90 degree portion

For each 360 degree panorama the images were cylindrically corrected and stitched together. This allowed an accurate 90, 180 or 270 degree cylindrical view to be extracted from the full panorama, to illustrate the wider 'landscape setting' of the development.

Technical information for the camera locations is provided for each viewpoint in Appendix 9.3.1.

Surveying

The position of each camera location was surveyed using Spectra Precision GNSS equipment with Real Time Kinematic Correction (RTK) which achieves an accuracy down to 1cm in eastings, northings and height (metres Above Ordnance Datum). The equipment included Spectra Precision SP80 GNSS smart antennae with Panasonic Toughpad data recorder. Points were saved using DigiTerra software. A photograph of the camera location was taken.

3D Modelling

MSEnvironmental constructed a geo-referenced 3D model using Rhino 3D from a 3D DWG and PDFs supplied by Ridge Clean Energy together with LIDAR 2m DTM data. The model was geo-referenced and placed in the correct geographic coordinate system (OSGB36) using ground heights to correspond wth the survey and site layout.

Camera locations surveyed on site were added to the geo-referenced 3D model.

LIDAR DSM data and target points were taken from the existing features in the view and built into the 3D model. This allowed the horizontal and vertical alignment of the photograph and 3D model to be checked, cross-referenced and verified.

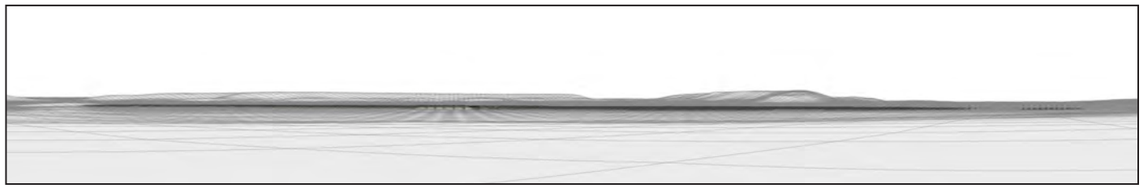
Cylindrical renders generated using VRay for Rhino were exported from the 3D modelling software and used to overlay the single frame planar images.

Target points from both the photograph and the model view were aligned to ensure a precise fit between the two images.

The results are presented as a sequence of visualisations as follows:

1. Existing View

2. 3D Model View



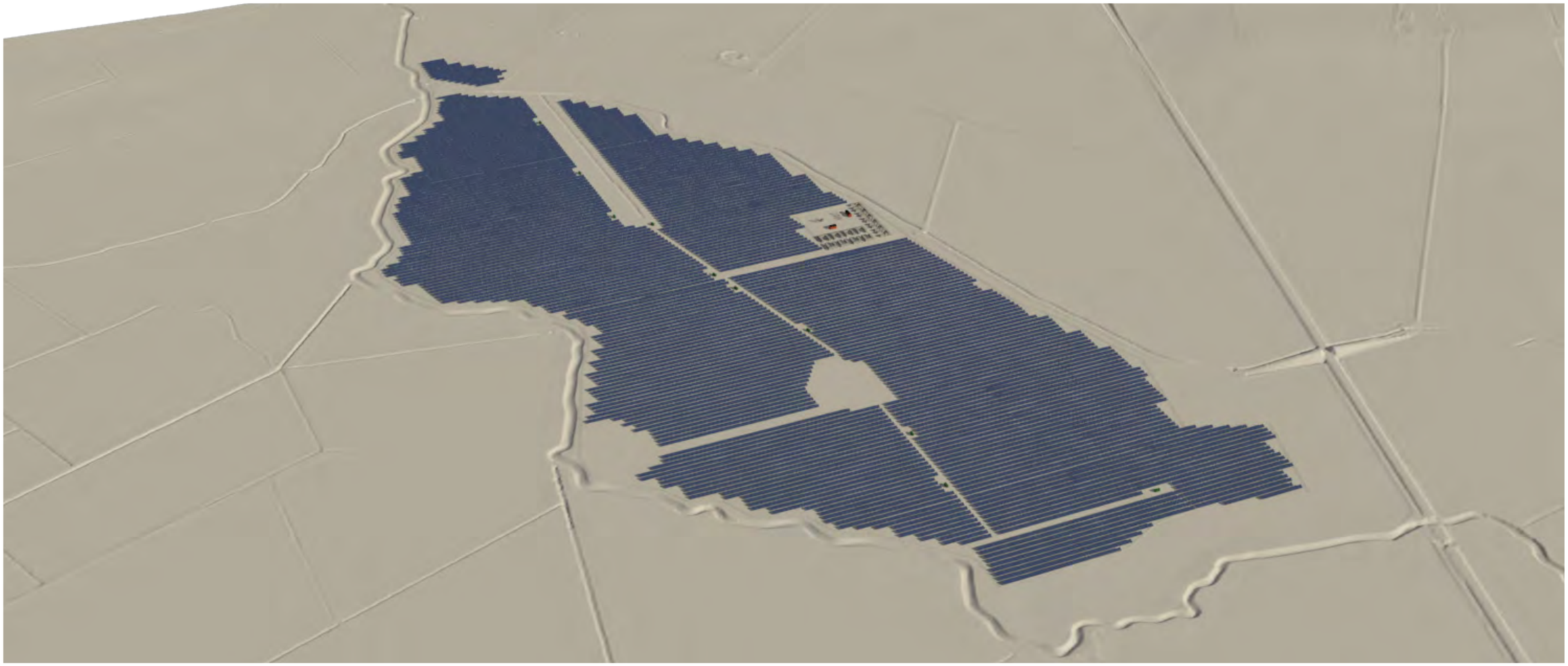
3. Composite 3D Model Photo-Overlay View

4. Photomontage

The topography of the site has been generated from a site topographical survey supplied by Engena. The surrounding landform has been created using 2m LIDAR DTM data, with triangulated surfaces generated using Rhinoterrain.

The 3D Model was built in Rhino 3D by MSE. The model is fully geo-referenced and positioned to correspond with the site layout and elevations supplied in the planning application drawings:

Proposed Fair Oaks Layout Model (April 2023) on the LIDAR DTM



Planar vs Cylindrical Projection

All photographs are taken as a series of single frame planar images. A planar image is a single frame image which has a single point of perspective lying centrally in the image. The limitation of single frame images is that they have a limited horizontal field of view. To allow a wider field of view we stitch the individual planar images using software, such as PTGUI which automatically corrects the geometry to give a cylindrical panoramic image. To undertake this accurately the use of a levelled tripod and panoramic tripod head set up to avoid foreground parallax is necessary.

A full 360 degree panorama is taken with overlapping images. These images are stitched together and cylndrically projected, as if the panorama was being located in the inner face of a cylinder.

The 3D model views are rendered out in cylindrical projection to allow the precise image re-mapping to match the cylindrical photograph.

3D Modelling software

The work has largely been undertaken using Rhino 3D. All 3D modelling has been undertaken in metres and geo-referenced to align with OSGB36. RESOFT Windfarm was also used which is a 3D modelling package which we use to check on vertical alignment of the 3D model. This is also set up to OSGB36. RESOFT Windfarm has been used to generate the geometric grid from LIDAR DTM data present in all 3D model visualisations.

VRay for Rhino has been used for rendering. The use of a sunlight sytem adds a 3 dimensional effect with shadow, to understand the form and materials of the proposed solar panels, fencing and ancilliary development.

Viewing Printed Images

The visualisations have been prepared to be printed at A1 wide by A4 high (841mm x 297mm), to fully show the limts of the proposed solar farm development within its local landscape context.

Calculation of Visibility (ZTVs)

GIS viewshed software has been used to calculate visibility of the proposed development. A landform model has been constructed using Environment Agency 2m LIDAR Digital Terrain Model (DTM) data. 200 target points have been set at points along the panels at a height of 3m. An observer's eye height of 1.6m has been used.

A second calculation has been made of the substation, using the same landform data and eye height. The results illustrate maximum theoretical visibility, and do not include the screening effects of buildings or vegetation.

Summary

This work has been undertaken in accordance with the Landscape Institute TGN 06/19 and the developing understanding of visualisation work. The accuracy of camera locations and 3D modelling conforms with Type 4 (the highest level of accuracy). The 3D modelling has been produced to AVR3 (photo-realistic).

The photography has been undertaken in a robust manner, using professional full frame sensor DSLR and 50mm lens with panoramic head and tripod. The camera position has been surveyed using highly accurate GNSS equipment, giving high levels of accuracy of camera location. The 3D model has been built in Rhino 3D. An additional check on the vertical scaling has been undertaken using RESOFT Windfarm. The resultant visualisations are highly accurate,

The sheets are set up to be printed at the true monocular viewing distance of 50cm. So the images will appear true to scale when viewed on site with one eye.

The photography, surveying and 3D modelling have followed a transparent methodology, and the resultant visualisations are considered robust and fit for purpose to illustrate the positioning, and scale and massing of the proposed scheme in its local context.

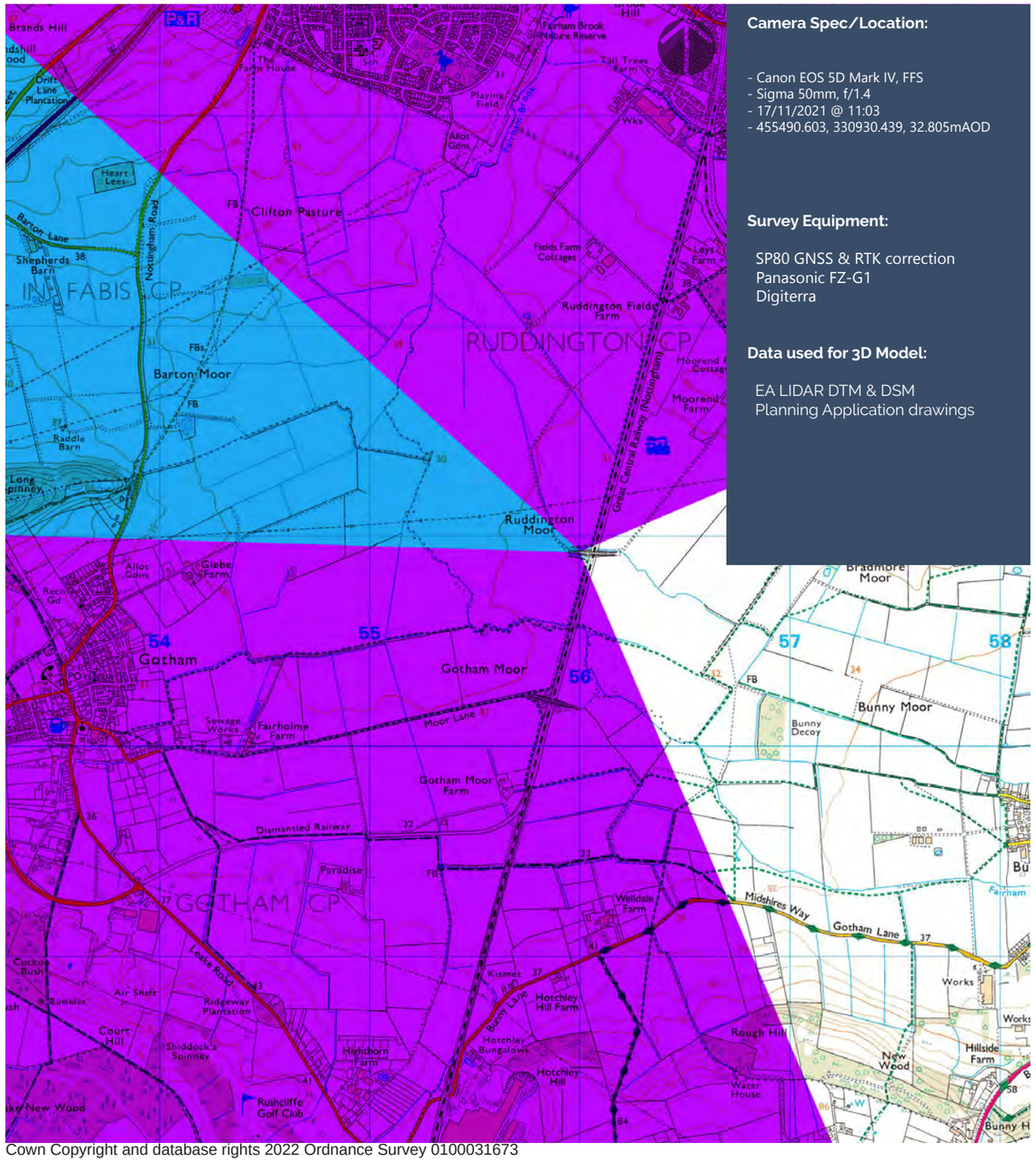
The visibility calculations use highly detailed LIDAR DTM data and helpful in understanding maximum theoretical visibility, without visual buffers.

M.A.Spence BA(Hons), MLD, CMLI, REIA, FRGS 26 April 2023
Principal, MSEnvironmental

APPENDIX 9.3.1: VIEWPOINT DETAILS

Viewpoint 1

Camera Location:



Camera Spec/Location:

- Canon EOS 5D Mark IV, FFS
- Sigma 50mm, f/1.4
- 17/11/2021 @ 11:03
- 455490.603, 330930.439, 32.805mAOD

Survey Equipment:

SP80 GNSS & RTK correction
Panasonic FZ-G1
Digiterra

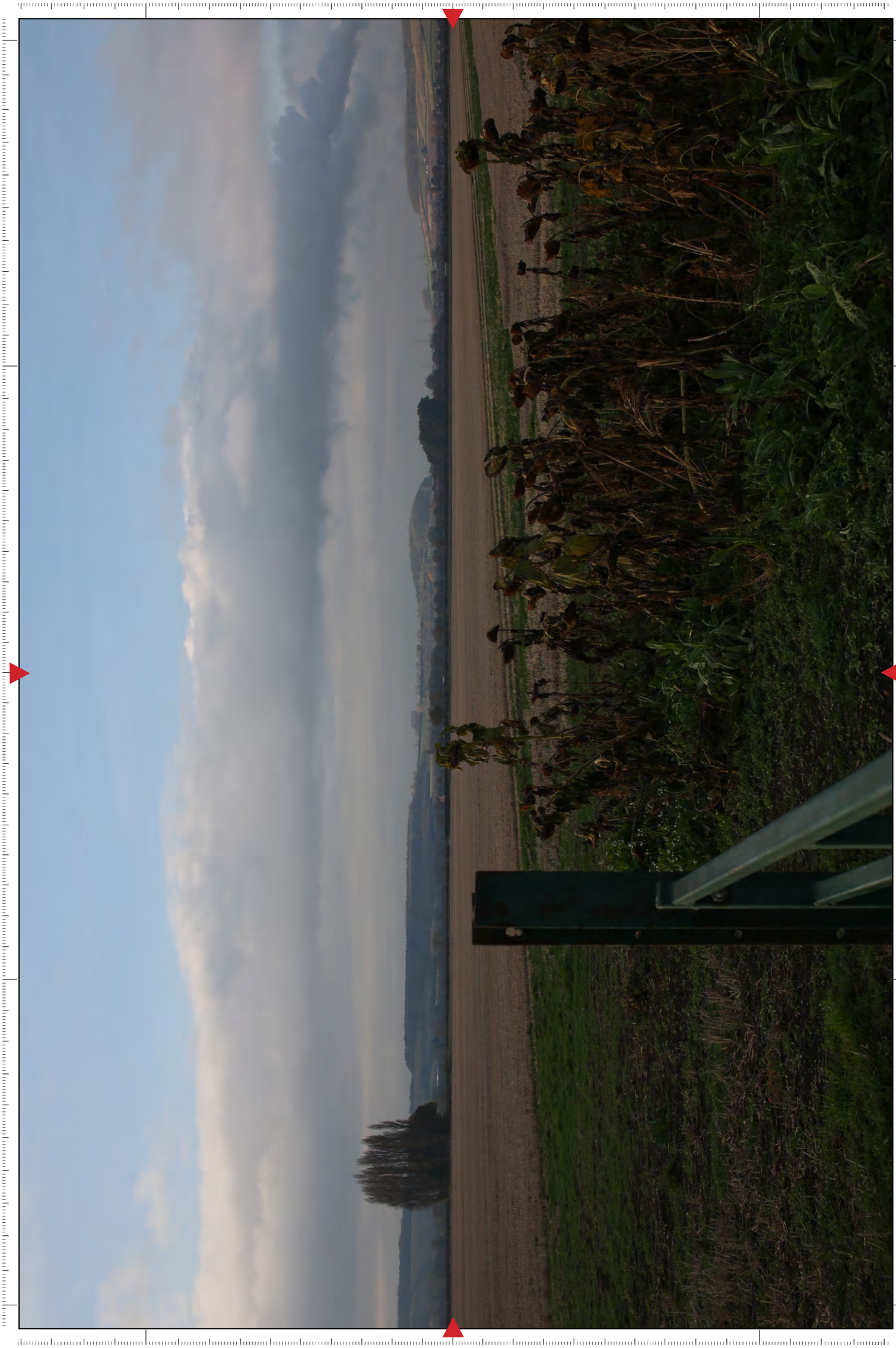
Data used for 3D Model:

EA LIDAR DTM & DSM
Planning Application drawings

Tripod:

50mm Lens Planar Projection (actual 49.7mm; 39.9 deg HFoV)

Point of Perspective



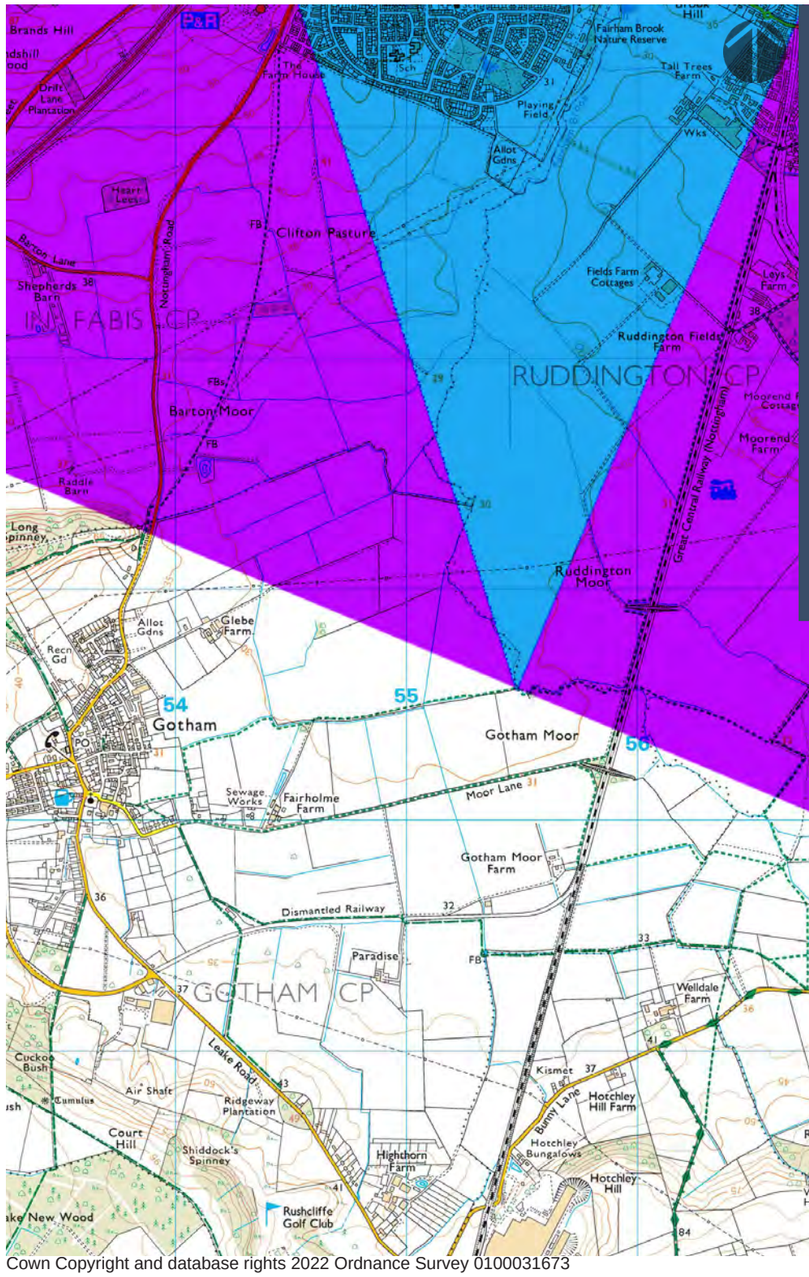
Point of Perspective

Point of Perspective

Viewpoint 1 Single Frame 50mm image

Viewpoint 2

Camera Location:



Cown Copyright and database rights 2022 Ordnance Survey 0100031673

Camera Spec/Location:

- Canon EOS 5D Mark IV, FFS
- Sigma 50mm, f/1.4
- 17/2/2022 @ 10:33
- 455469.932, 330579.627, 32.373mAOD

Survey Equipment:

SP80 GNSS & RTK correction
Panasonic FZ-G1
Digiterra

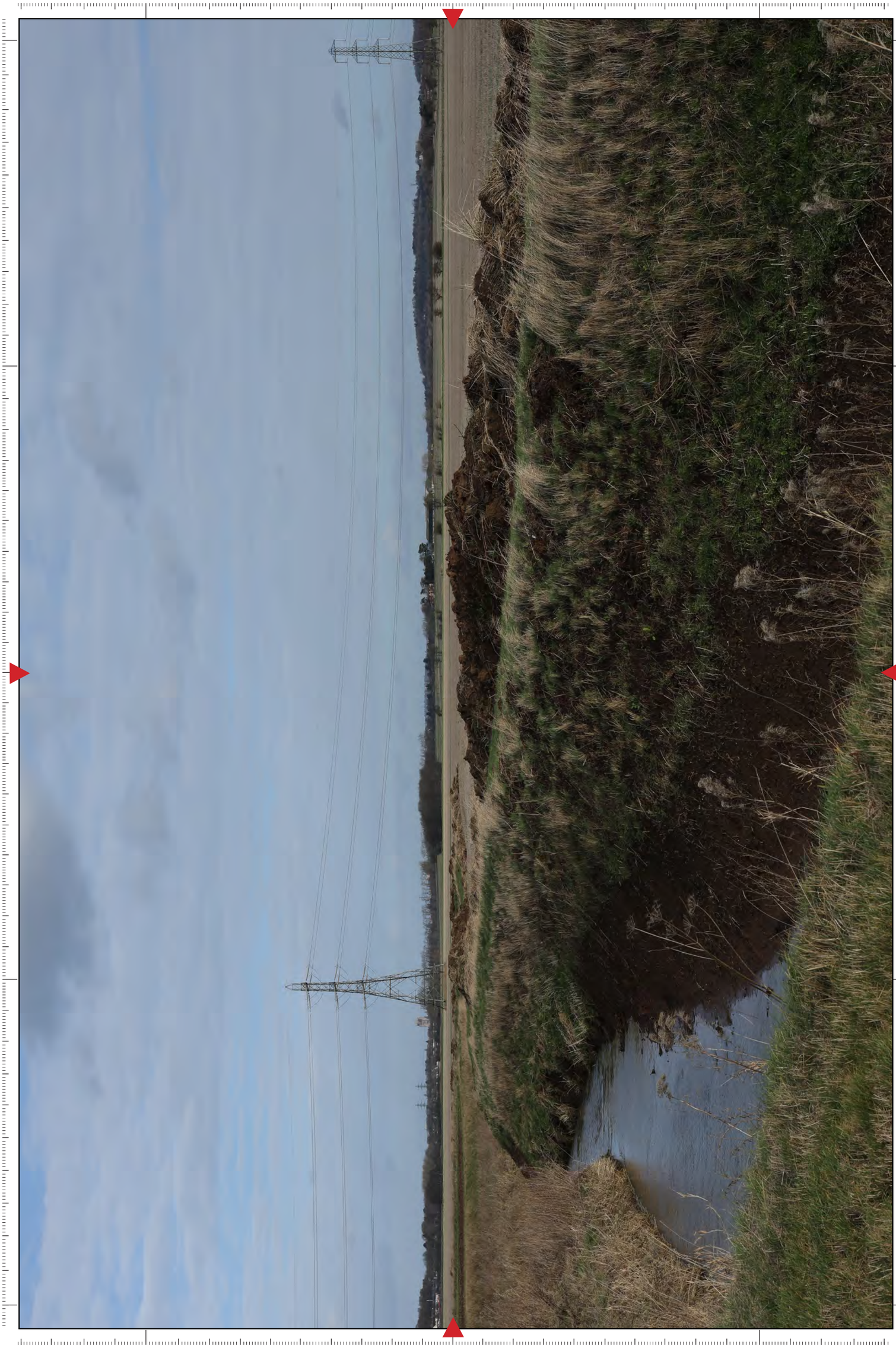
Data used for 3D Model:

EA LIDAR DTM & DSM
Planning Application drawings

Tripod:

50mm Lens Planar Projection (actual 49.7mm; 39.9 deg HFoV)

Point of Perspective



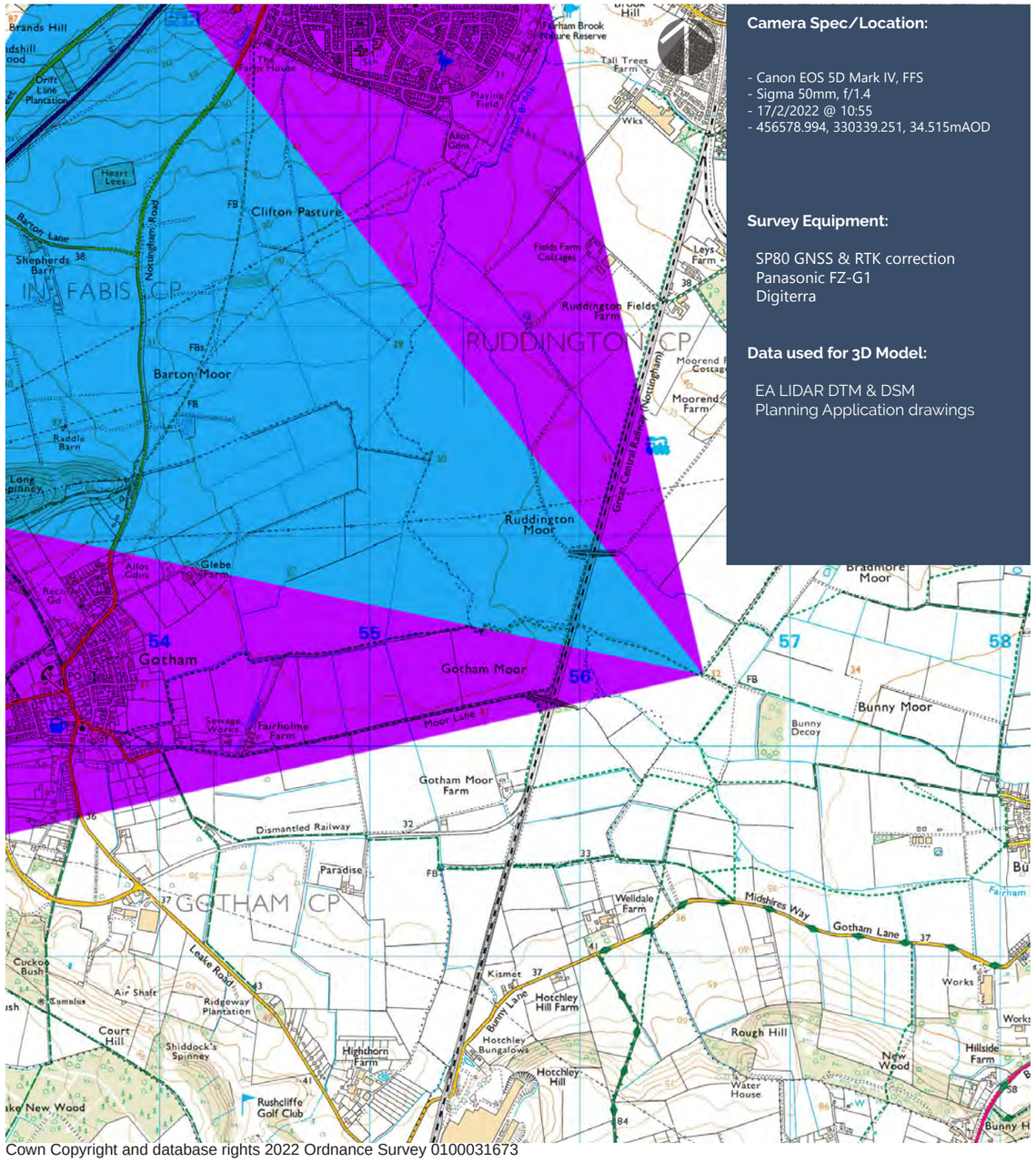
Point of Perspective

Point of Perspective

Viewpoint 2 Single Frame 50mm image

Viewpoint 3

Camera Location:



Camera Spec/Location:

- Canon EOS 5D Mark IV, FFS
- Sigma 50mm, f/1.4
- 17/2/2022 @ 10:55
- 456578.994, 330339.251, 34.515mAOD

Survey Equipment:

SP80 GNSS & RTK correction
Panasonic FZ-G1
Digiterra

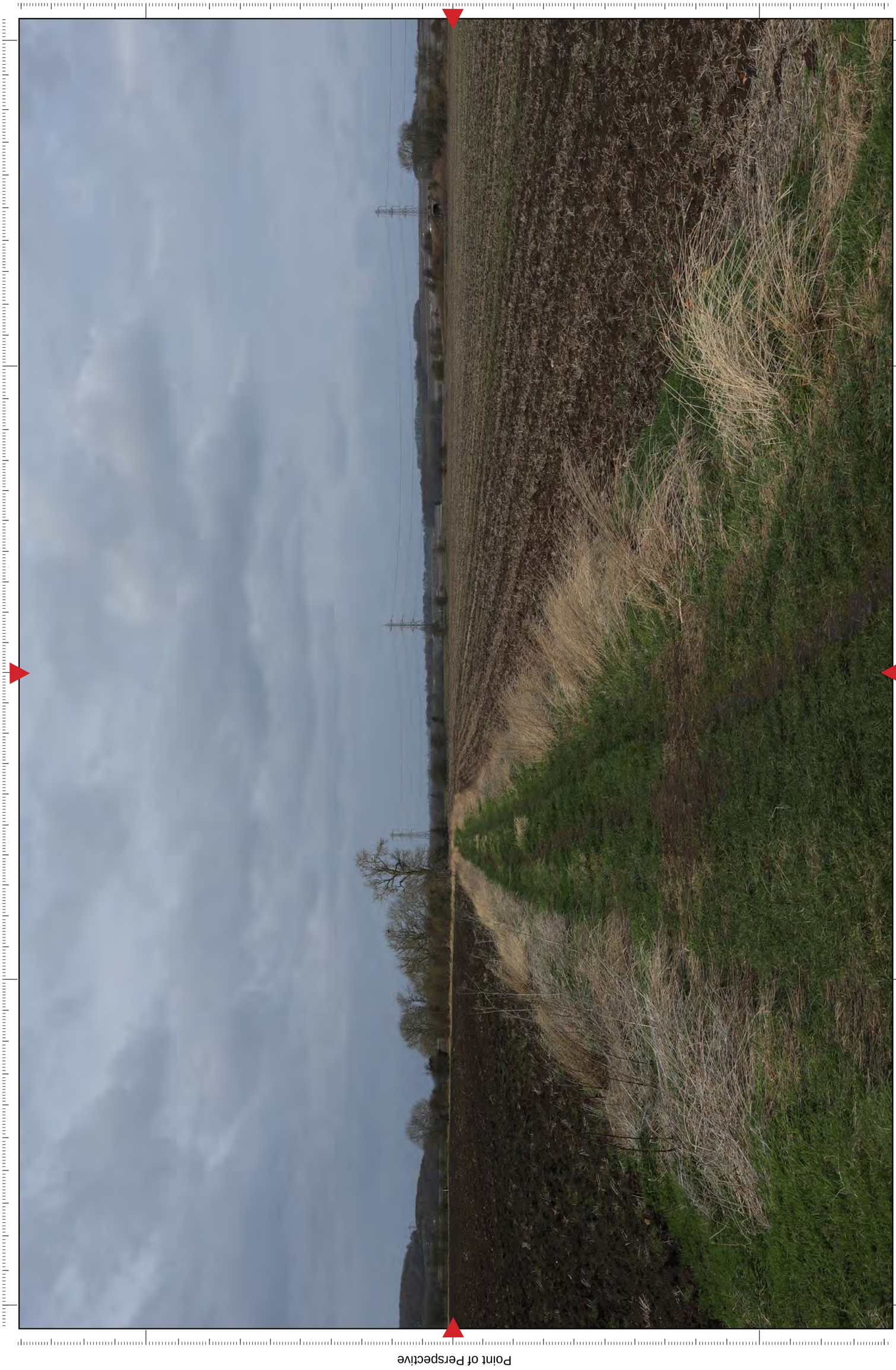
Data used for 3D Model:

EA LIDAR DTM & DSM
Planning Application drawings

Tripod:

50mm Lens Planar Projection (actual 49.7mm; 39.9 deg HFoV)

Point of Perspective



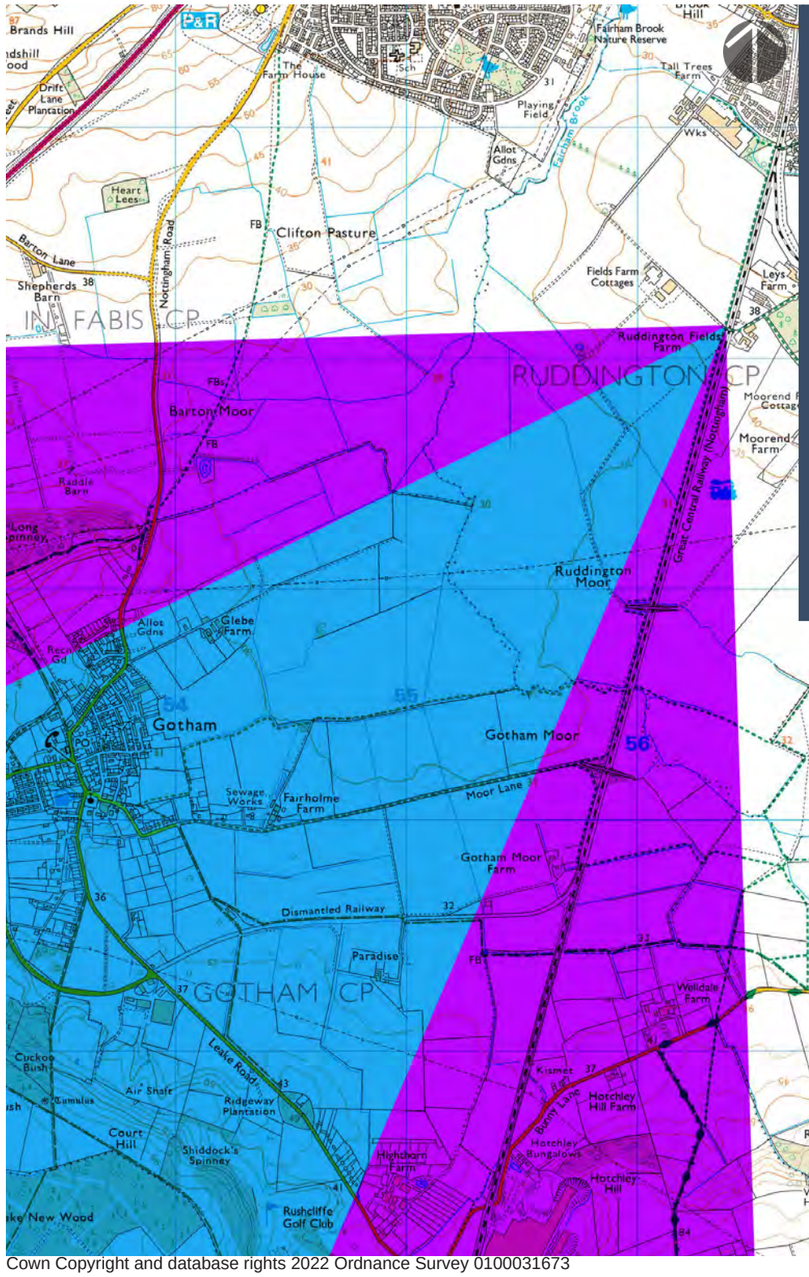
Point of Perspective

Point of Perspective

Viewpoint 3 Single Frame 50mm image

Viewpoint 4

Camera Location:



Camera Spec/Location:

- Canon EOS 5D Mark IV, FFS
- Sigma 50mm, f/1.4
- 17/2/2022 @ 08:34
- 456379.009, 332129.519, 40.015mAOD

Survey Equipment:

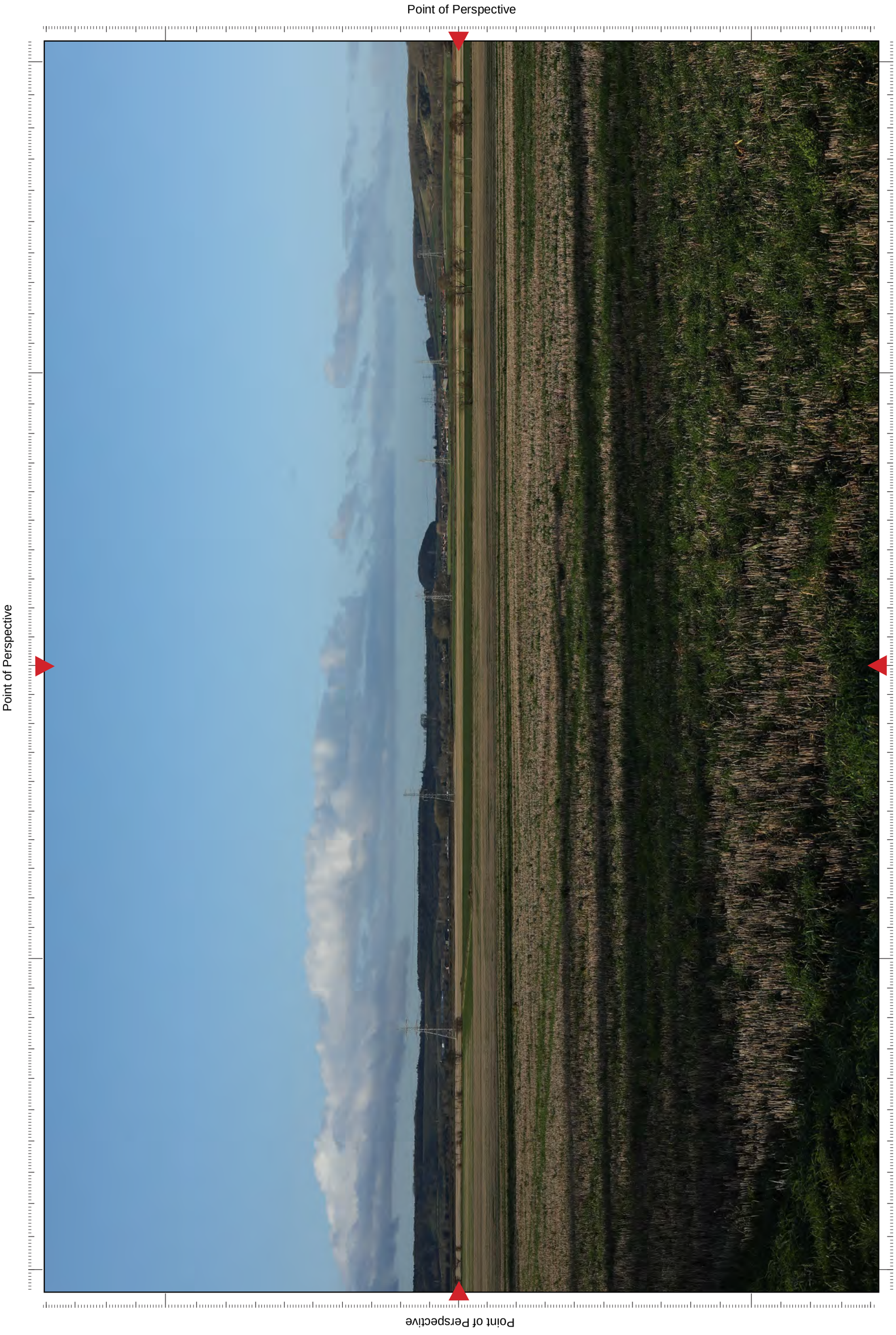
SP80 GNSS & RTK correction
Panasonic FZ-G1
Digiterra

Data used for 3D Model:

EA LIDAR DTM & DSM
Planning Application drawings

Tripod:

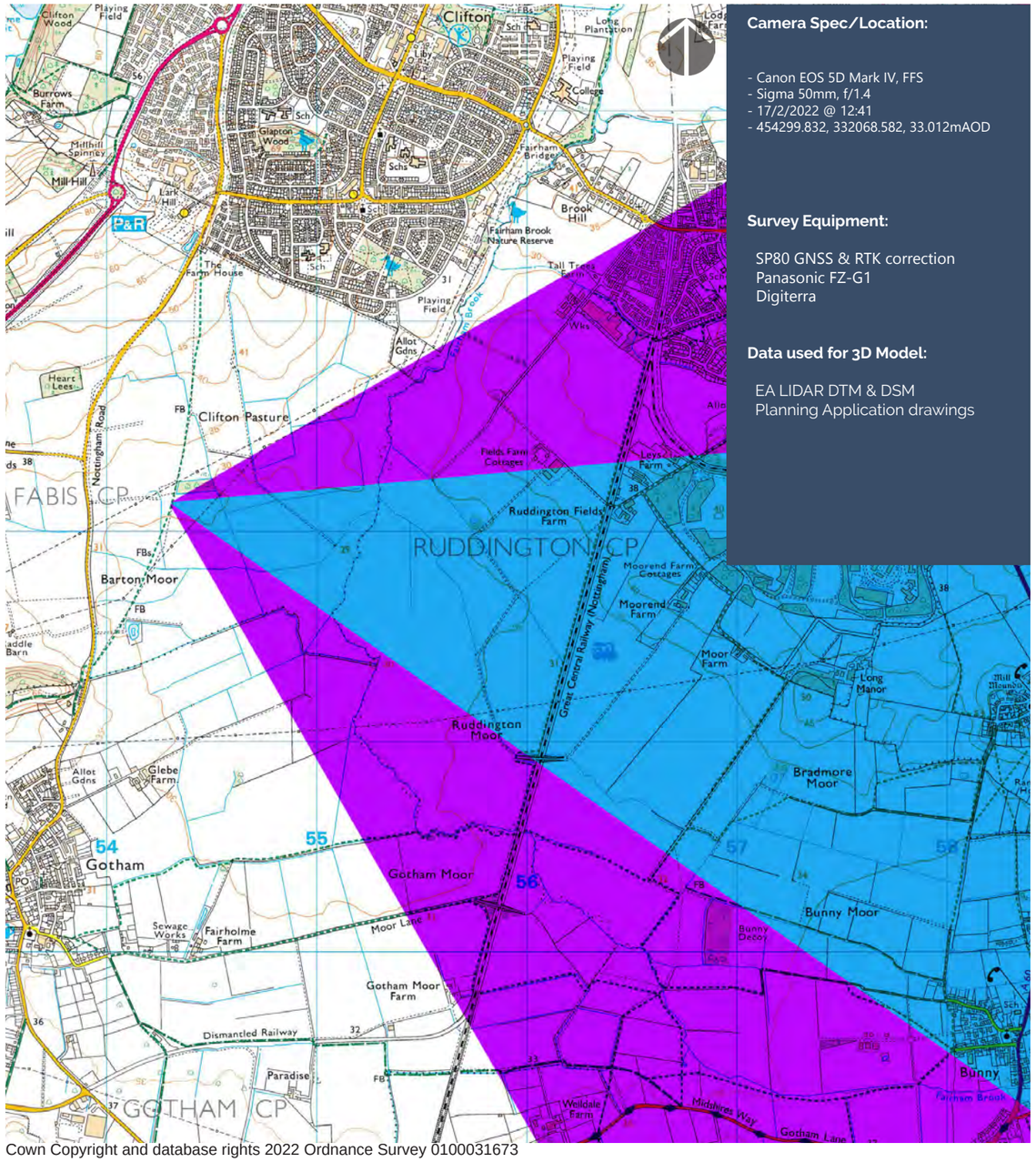
50mm Lens Planar Projection (actual 49.7mm; 39.9 deg HFoV)



Viewpoint 4 Single Frame 50mm image

Viewpoint 5

Camera Location:



Camera Spec/Location:

- Canon EOS 5D Mark IV, FFS
- Sigma 50mm, f/1.4
- 17/2/2022 @ 12:41
- 454299.832, 332068.582, 33.012mAOD

Survey Equipment:

SP80 GNSS & RTK correction
Panasonic FZ-G1
Digiterra

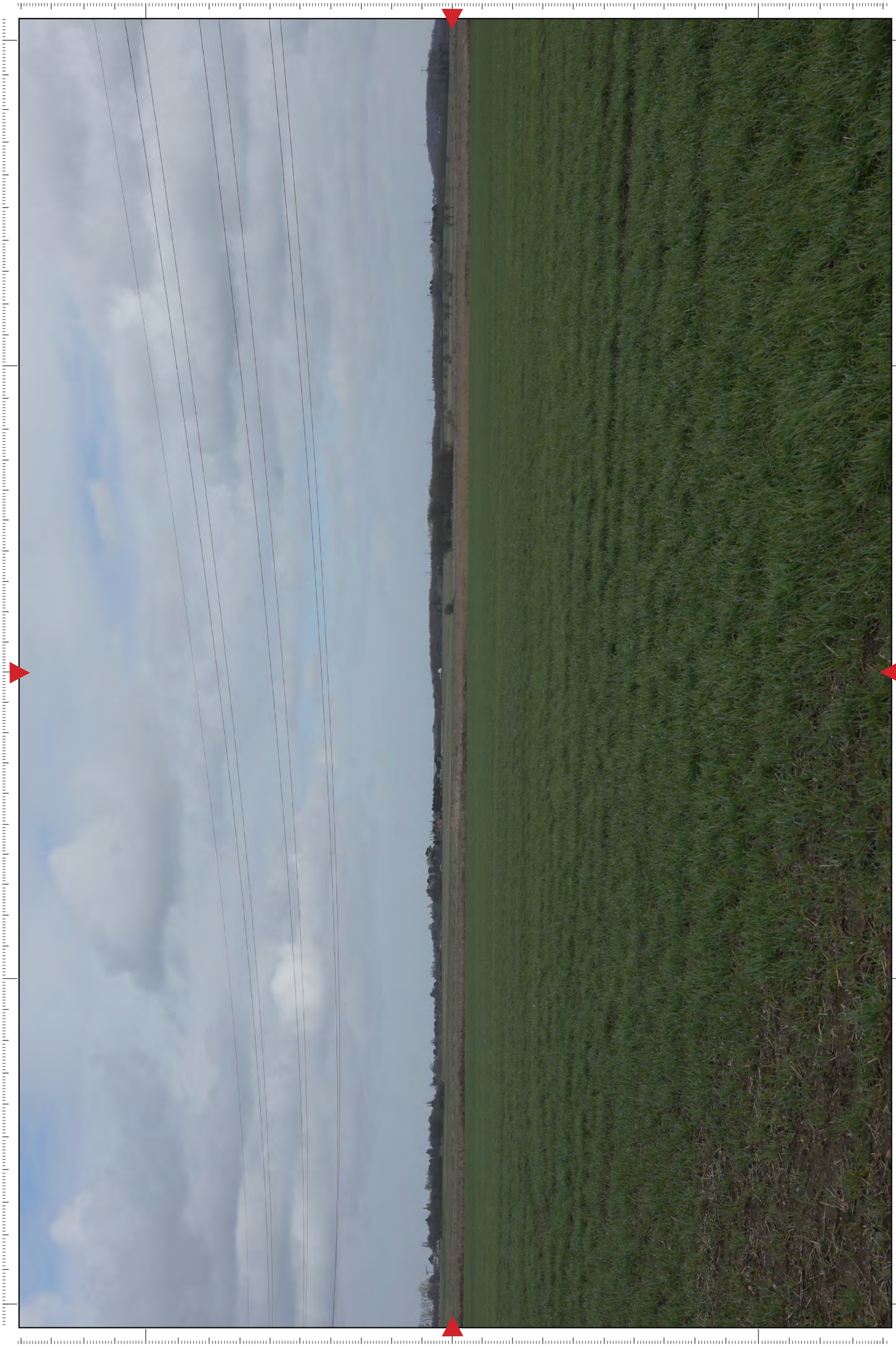
Data used for 3D Model:

EA LIDAR DTM & DSM
Planning Application drawings

Tripod:

50mm Lens Planar Projection (actual 49.7mm; 39.9 deg HFoV)

Point of Perspective



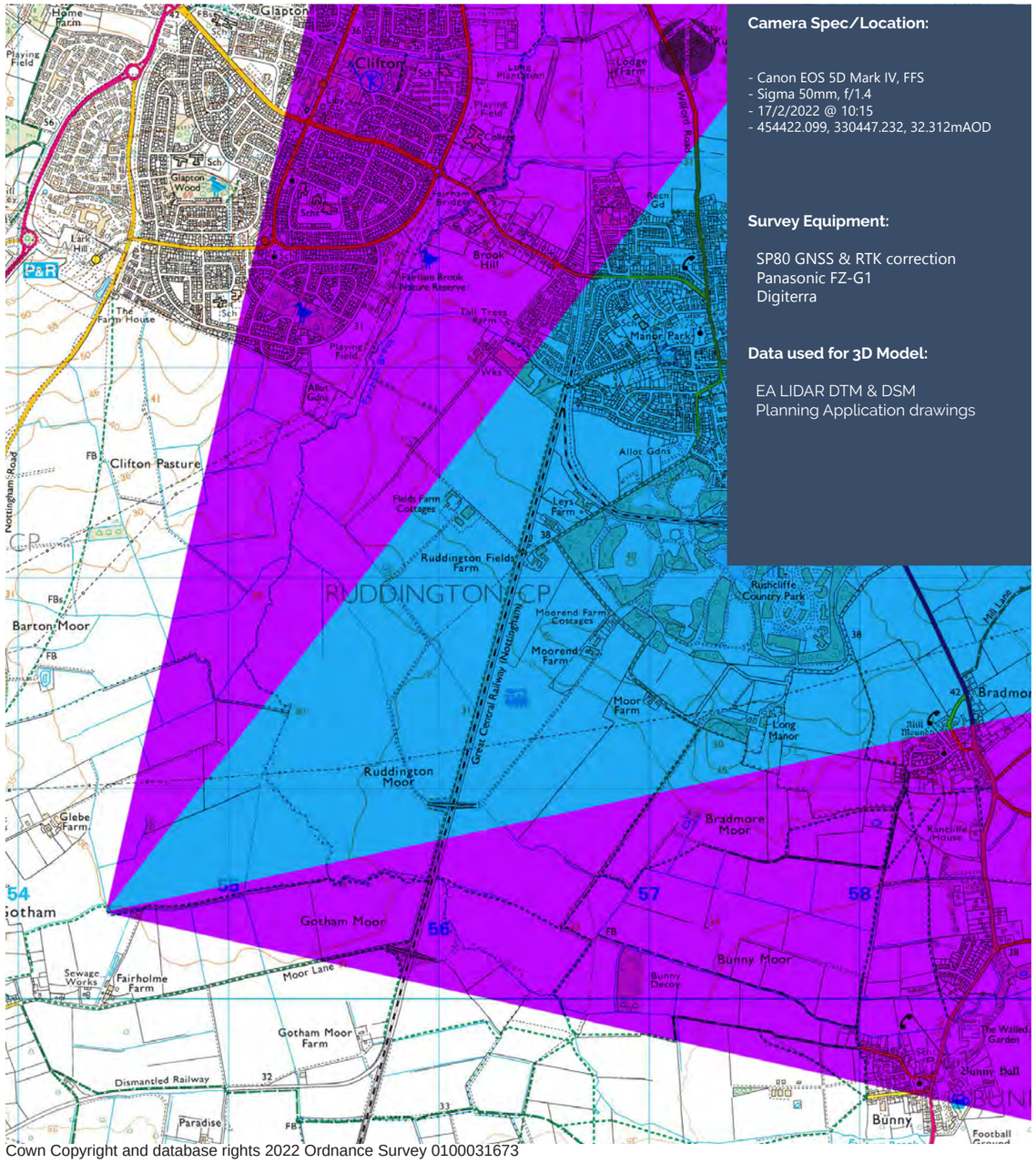
Point of Perspective

Point of Perspective

Viewpoint 5 Single Frame 50mm image

Viewpoint 6

Camera Location:



Camera Spec/Location:

- Canon EOS 5D Mark IV, FFS
- Sigma 50mm, f/1.4
- 17/2/2022 @ 10:15
- 454422.099, 330447.232, 32.312mAOD

Survey Equipment:

SP80 GNSS & RTK correction
Panasonic FZ-G1
Digiterra

Data used for 3D Model:

EA LIDAR DTM & DSM
Planning Application drawings

Tripod:

50mm Lens Planar Projection (actual 49.7mm; 39.9 deg HFoV)

Point of Perspective

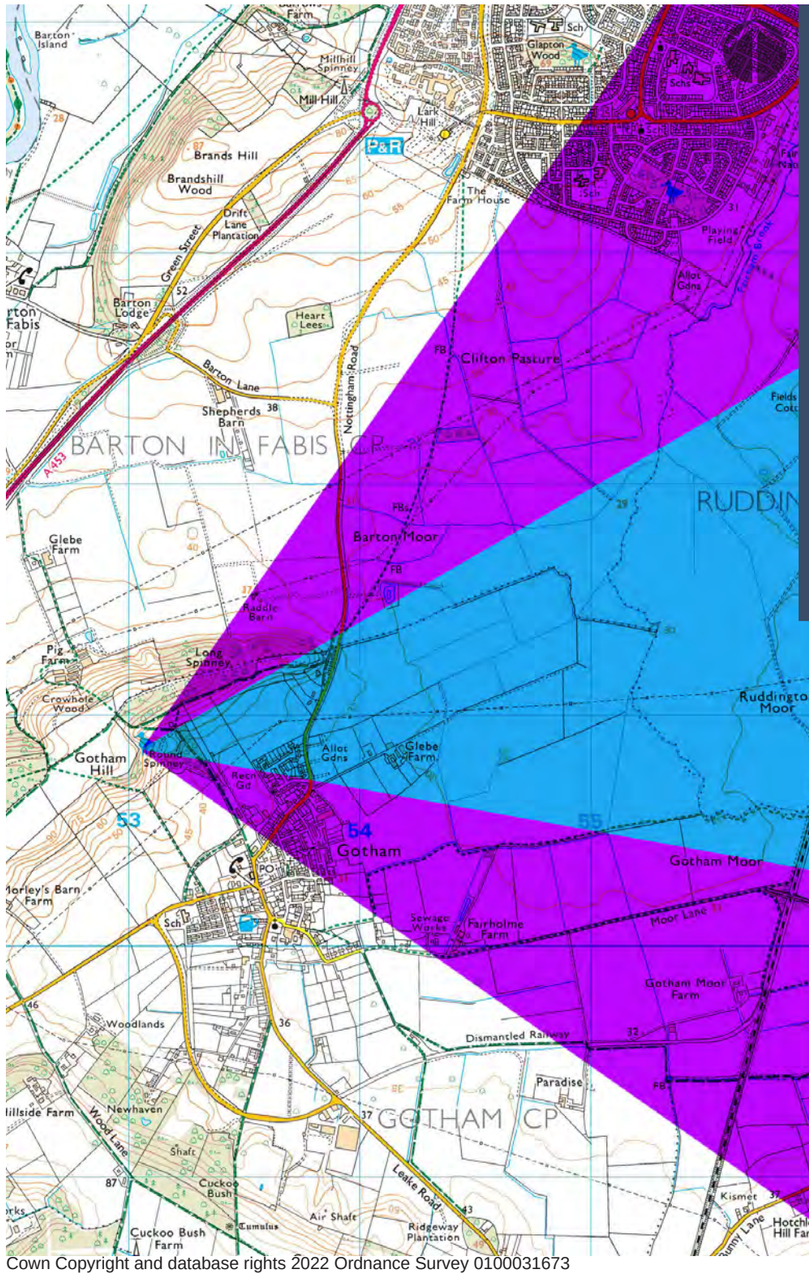
Point of Perspective

Point of Perspective

Viewpoint 6 Single Frame 50mm image

Viewpoint 7

Camera Location:



Camera Spec/Location:

- Canon EOS 5D Mark IV, FFS
- Sigma 50mm, f/1.4
- 17/2/2022 @ 12:12
- 453059.332, 330863.434, 82.406mAOD

Survey Equipment:

SP80 GNSS & RTK correction
Panasonic FZ-G1
Digiterra

Data used for 3D Model:

EA LIDAR DTM & DSM
Planning Application drawings

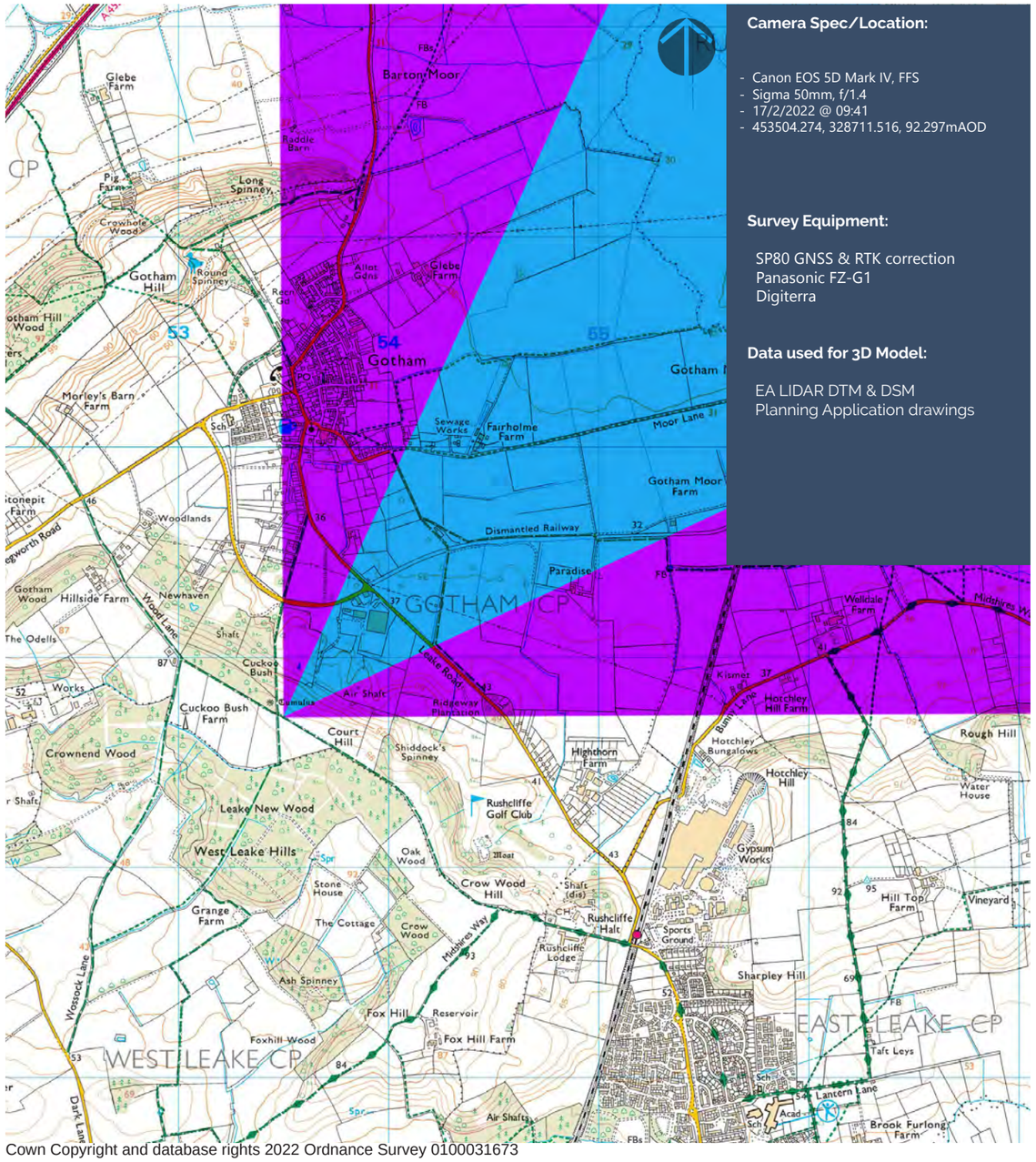
Tripod:

50mm Lens Planar Projection (actual 49.7mm; 39.9 deg HFoV)

Viewpoint 7 Single Frame 50mm image

Viewpoint 8

Camera Location:



Camera Spec/Location:

- Canon EOS 5D Mark IV, FFS
- Sigma 50mm, f/1.4
- 17/2/2022 @ 09:41
- 453504.274, 328711.516, 92.297mAOD

Survey Equipment:

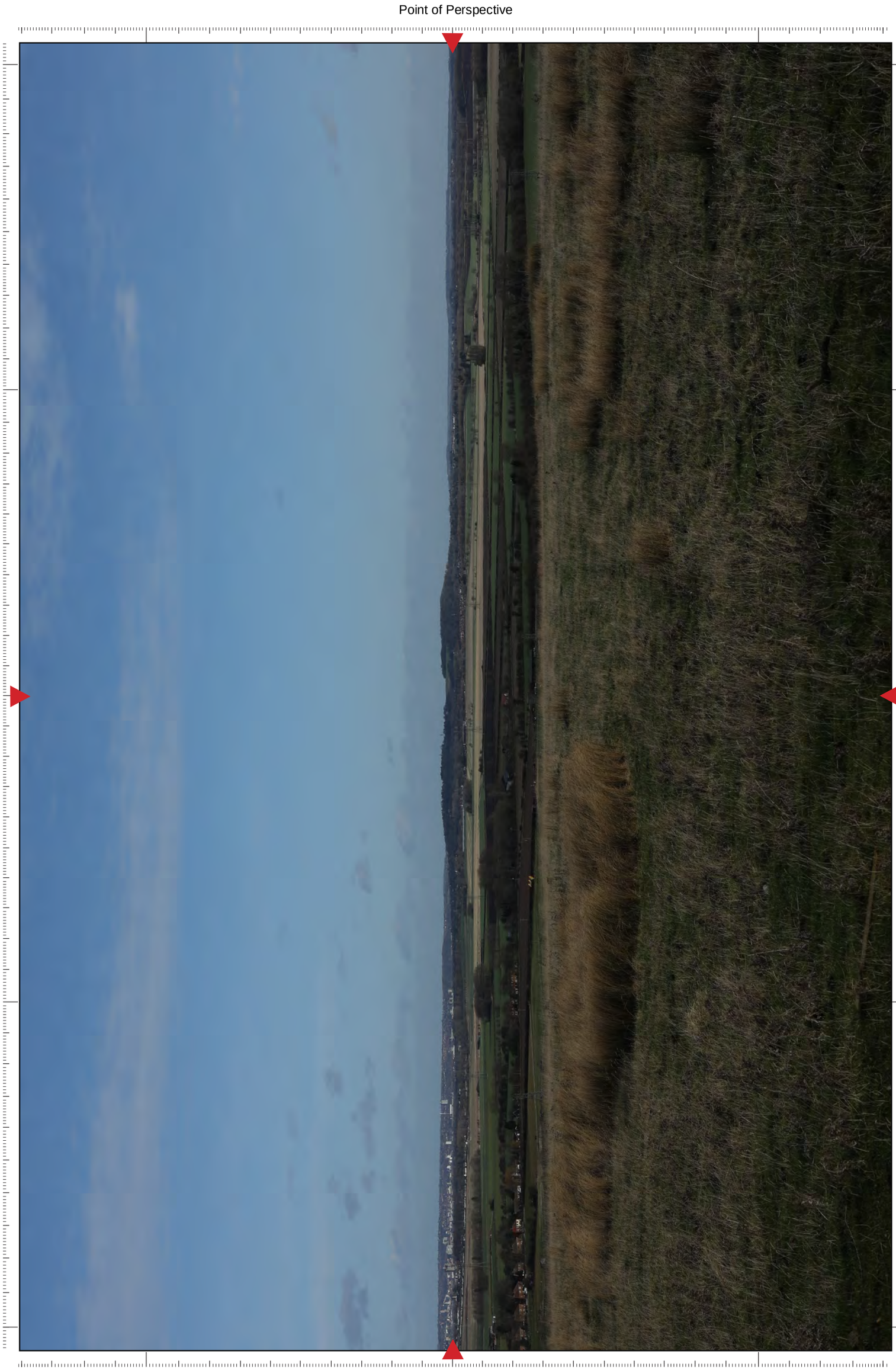
SP80 GNSS & RTK correction
Panasonic FZ-G1
Digiterra

Data used for 3D Model:

EA LIDAR DTM & DSM
Planning Application drawings

Tripod:

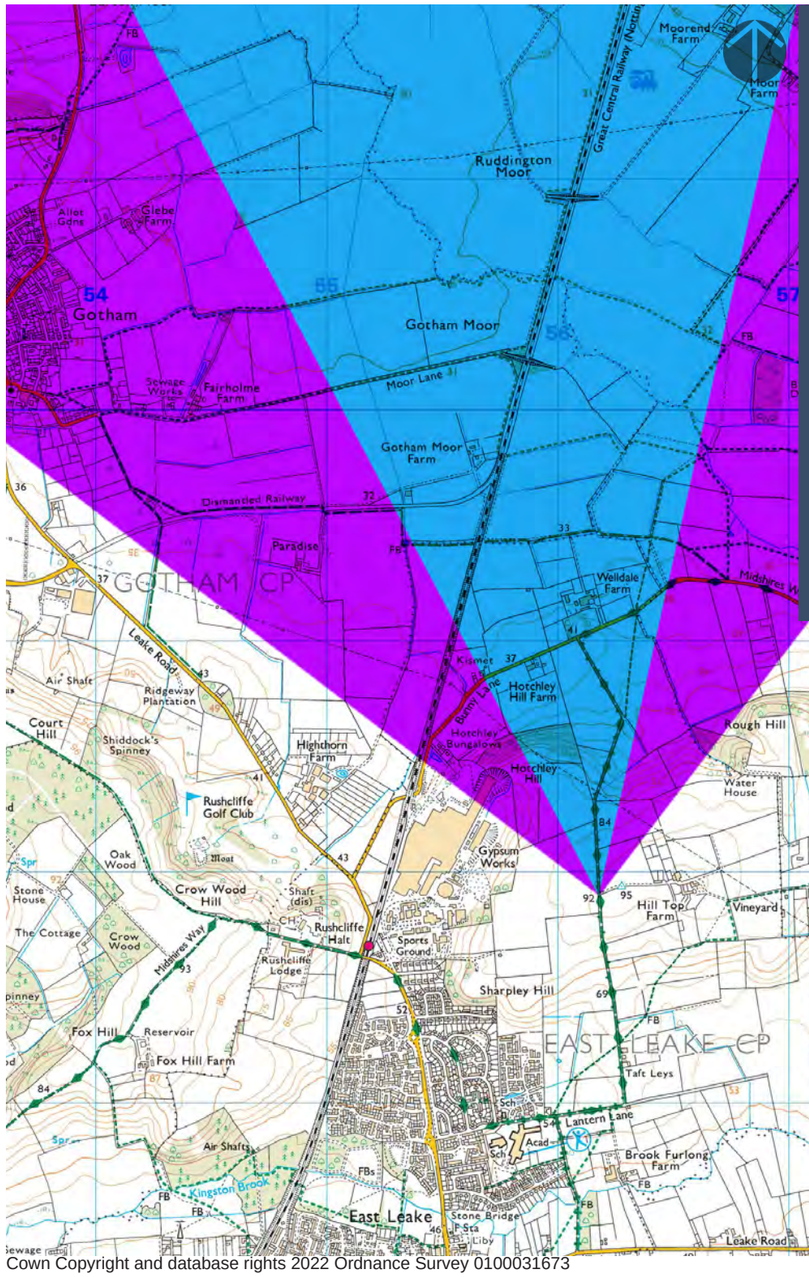
50mm Lens Planar Projection (actual 49.7mm; 39.9 deg HFoV)



Viewpoint 8 Single Frame 50mm image

Viewpoint 9

Camera Location:



Camera Spec/Location:

- Canon EOS 5D Mark IV, FFS
- Sigma 50mm, f/1.4
- 17/2/2022 @ 09:08
- 456176.813, 327903.411, 94.331mAOD

Survey Equipment:

SP80 GNSS & RTK correction
Panasonic FZ-G1
Digiterra

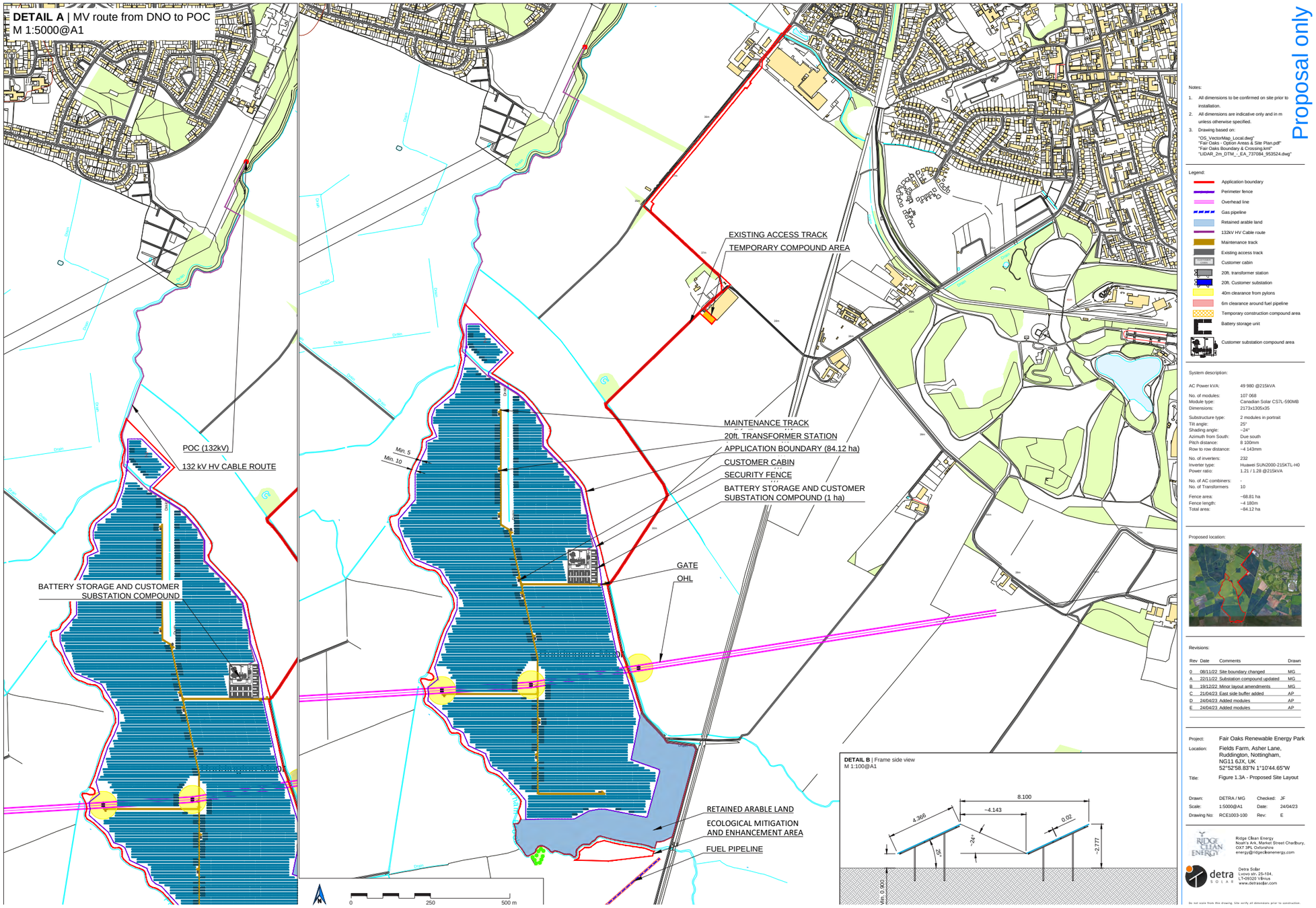
Data used for 3D Model:

EA LIDAR DTM & DSM
Planning Application drawings

Tripod:

50mm Lens Planar Projection (actual 49.7mm; 39.9 deg HFoV)

Viewpoint 9 Single Frame 50mm image



Proposal only

Notes:

1. All dimensions to be confirmed on site prior to installation.
2. All dimensions are indicative only and in m unless otherwise specified.
3. Drawing based on:
   "OS_VectorMap_Local.dwg"
   "Fair Oaks - Option Areas & Site Plan.pdf"
   "Fair Oaks Boundary & Crossing.kml"
   "LIDAR_2m_DTM_-_EA_737084_953524.dwg"

Legend:

- Application boundary
- Perimeter fence
- Overhead line
- Gas pipeline
- Retained arable land
- 132kV HV Cable route
- Maintenance track
- Existing access track
- Customer cabin
- 20ft. transformer station
- 20ft. Customer substation
- 40m clearance from pylons
- 6m clearance around fuel pipeline
- Temporary construction compound area
- Battery storage unit
- Customer substation compound area

System description:

AC Power kVA:	49 980 @215kVA
No. of modules:	107 068
Module type:	Canadian Solar CS7L-590MB
Dimensions:	2173x1305x35
Substructure type:	2 modules in portrait
Tilt angle:	25°
Shading angle:	~24°
Azimuth from South:	Due south
Pitch distance:	8 100mm
Row to row distance:	~4 143mm
No. of inverters:	232
Inverter type:	Huawei SUN2000-215KTL-H0
Power ratio:	1.21 / 1.28 @215kVA
No. of AC combiners:	-
No. of Transformers	10
Fence area:	~68.81 ha
Fence length:	~4 180m
Total area:	~84.12 ha

Proposed location:

Revisions:

Rev	Date	Comments	Drawn
0	08/11/22	Site boundary changed	MG
A	22/11/22	Substation compound updated	MG
B	15/12/22	Minor layout amendments	MG
C	21/04/23	East side buffer added	AP
D	24/04/23	Added modules	AP
E	24/04/23	Added modules	AP

Project: Fair Oaks Renewable Energy Park

Location: Fields Farm, Asher Lane, Ruddington, Nottingham, NG11 6JX, UK
52°52'58.83"N 1°10'44.65"W

Title: Figure 1.3A - Proposed Site Layout

Drawn: DETRA / MG Checked: JF
Scale: 1:5000@A1 Date: 24/04/23
Drawing No: RCE1003-100 Rev: E

Ridge Clean Energy
Noah's Ark, Market Street Charlbury, OX7 3PL Oxfordshire
energy@ridgecleanenergy.com

Detra Solar
Lvovo str. 25-104, LT-09320 Vilnius
www.detrasolar.com

Do not scale from this drawing. Site verify all dimensions prior to construction.

Spectra Precision SP80 GNSS Receiver

The Most Connected GNSS Receiver

CONNECTED
RELIABLE
RUGGED
INNOVATIVE

TECHNOLOGY INSIDE

SP80
GNSS Receiver

The Spectra Precision SP80 is a next generation GNSS receiver that combines decades of GNSS RTK technology with revolutionary new GNSS processing. Featuring the new 240-channel "6G" chipset, the SP80 system is optimized for tracking and processing signals from all GNSS constellations.

In addition, SP80 is the most connected GNSS receiver in the industry. It is the first to offer a unique combination of integrated 3.5G cellular, Wi-Fi and UHF communications with SMS, email and anti-theft features.

These powerful capabilities, packaged in an ultra-rugged and cable-free housing with unlimited operation time (hot-swappable batteries), make SP80 an extremely versatile turnkey solution.

Key Features

- New 240-channel 6G ASIC
- Z-Blade GNSS-centric
- 3.5G cellular modem
- Internal TRx UHF radio
- Built-in WiFi communication
- SMS and e-mail alerts
- Anti-theft protection
- Hot-swappable batteries

Patented inside-the-rod mounted UHF antenna design

Unique 6G GNSS-centric Technology

Exclusive Z-Blade processing technology running on a next-generation Spectra Precision 240-channel 6G ASIC fully utilizes all 6 GNSS systems: GPS, GLONASS, BeiDou, Galileo, QZSS and SBAS. The unique GNSS-centric capability optimally combines GNSS signals without dependency on any specific GNSS system; this allows SP80 to operate in GPS-only, GLONASS-only or BeiDou-only mode if needed. In addition, SP80 supports the recently approved RTCM 3.2 Multiple Signal Messages (MSM), a standardized definition for broadcasting all GNSS signals from space, regardless of their constellation. This protects the surveyor's investment well into the future by providing superior performance and improved productivity as new signals become available.

SMS and Email Messaging

SP80 has a unique combination of communication technologies including an integrated 3.5G GSM/UMTS modem, Bluetooth and Wi-Fi connectivity, and optional internal UHF transmit radio. The cellular modem may be used for SMS (text message) and e-mail alerts as well as regular Internet or VRS connectivity. Likewise, SP80 can use all available RTK correction sources and connect to the Internet from the field using WiFi hotspots, where available. The internal UHF transmit/receive radio allows for quick and easy setup as a local base station. This saves time and increases the surveyor's efficiency.

Anti-Theft Protection

ANTI-THEFT TECHNOLOGY

A unique anti-theft technology secures SP80 when installed as a field base station in remote or public places and can detect if the product is disturbed, moved or stolen. This technology allows the surveyor to lock the device to a specific location and make it unusable if the device is moved elsewhere. In this case, SP80 will generate an audio alert and show an alert message on its display. Furthermore, an SMS or e-mail will be sent to the surveyor's mobile phone or computer and provides the receiver's current coordinates allowing tracking of its position and facilitating recovery of the receiver. SP80's anti-theft technology provides surveyors with remote security and peace of mind.

The Most Powerful Tool for Reliable Field Use

The SP80's rugged housing, created by Spectra Precision's engineering design lab in Germany, incorporates a host of practical innovations. Dual hot-swappable batteries can be easily exchanged in the field as a one hand operation for an interruption-free working day, ensuring surveyors remain productive until the job is done. The impact-resistant glass-fiber reinforced casing, designed to withstand 2m pole drops and waterproof to IP67, ensures that SP80 can handle the toughest outdoor conditions. The patented UHF antenna, set inside the rugged carbon fiber rod, extends the range of RTK radio performance at the same time as armoring protection. The sunlight-readable display offers instant access to key information like the number of satellites, RTK status, battery charge and available memory. These powerful design features combine to make SP80 the most capable, most reliable GNSS receiver, backed by a comprehensive standard 2 year warranty.

The Spectra Precision Experience

With the most advanced and rugged field data collectors from Spectra Precision, surveyors get maximum productivity and reliability every day. Spectra Precision Survey Pro or FAST Survey software is specifically tailored for the SP80 GNSS receiver providing easy-to-use, yet powerful GNSS workflows, letting the surveyor concentrate on getting the job done. Spectra Precision Survey Office Software provides a complete office suite for post-processing GNSS data and adjusting survey data, as well as exporting the processed results directly back to the field or to engineering design software packages. Combined with Spectra Precision field and office software, SP80 is a very powerful and complete solution.

TOUGHPAD FZ-G1

Panasonic recommends Windows.

SOFTWARE
- Windows 10 Pro 64 bit
- Panasonic Utilities (including Dashboard), Recovery Partition

DURABILITY
- MIL-STD-810G certified (4' drop, shock, vibration, rain, dust, sand, altitude, freeze/thaw, high/low temperature, temperature shock, humidity, explosive atmosphere)
- IP65 certified sealed all-weather design
- Optional class I division 2, groups ABCD certified model
- Solid state drive heater
- Magnesium alloy chassis encased with ABS and elastomer corner guards
- Optional hand strap or rotating hand strap
- Port covers
- Raised bezel for LCD impact protection
- Pre-installed replaceable screen film for LCD protection

CPU
- Intel® Core™ i5-6300U vPro™ Processor
  - 2.4 GHz up to 3.0 GHz with Intel® Turbo Boost Technology
  - Intel Smart Cache 3MB

STORAGE & MEMORY
- 8GB DDR3L SDRAM[4,5]
- 256GB solid state drive (SSD) with heater[4,5]
- Optional 512GB
  - up to 64GB additional storage with optional microSDXC card slot

DISPLAY
- 10.1" WUXGA 1920 x 1200 with LED backlighting
- 10-point capacitive multi touch + Waterproof Digitizer pen daylight-readable screen
  - 2-800 nit
  - IPS display with direct bonding
  - Anti-reflective and anti-glare screen treatments
  - Ambient light sensor, digital compass, gyro and acceleration sensors
  - Automatic screen rotation
  - Intel® HD Graphics 520 (Built-in CPU) video controller
- Concealed mode (configurable)

AUDIO
- Integrated microphone
- Realtek high-definition audio
- Integrated speaker
- On-screen and button volume and mute controls

KEYBOARD & INPUT
- 10-point gloved multi touch + digitizer screen
  - Supports bare-hand touch and gestures and electronic waterproof stylus pen
  - Supports glove mode and wet-touch mode
- 7 tablet buttons (2 user-definable)
- Integrated stylus holder
- On-screen QWERTY keyboard

CAMERAS
- 720p webcam with mic
- 8MP rear camera with autofocus and LED light

EXPANSION
- Optional MicroSDXC3

INTERFACE

Docking connector	24-pin
HDMI	Type A
Headphones/speaker	Mini-jack stereo
Optional Serial Dongle[3]	D-sub 9-pin
USB 3.0 (x 1)[2]	4-pin
Optional second USB 2.0[3]	4-pin
Optional 10/100/1000 Ethernet[3]	RJ-45

WIRELESS
- Optional integrated 4G LTE multi carrier mobile broadband with satellite GPS
- Optional GPS (u-blox NEO M8N)[3]
- Intel® Dual Band Wireless-AC 8260 (IEEE802.11a/b/g/n/ac)
- Bluetooth v4.1, Classic mode/ Low Energy mode, Class 1 (Windows 10 pro 64-bit)
- Security
  - Authentication: LEAP, WPA, 802.1x, EAP-TLS, EAP-FAST, PEAP
  - Encryption: CKIP, TKIP, 128-bit and 64-bit WEP, Hardware AES
- Dual high-gain antenna pass-through

POWER SUPPLY
- Li-Ion battery pack:
  - Standard battery: Li-ion 11.1 V, 4200 mAh (typ.), 4080 mAh (min.)
  - Optional long life battery[7]: Li-ion 10.8V, 9300mAh(typ.), 8700mAh (min.)
- Battery operation[1]:
  - Standard battery: 14 hours
  - Optional long life battery[7]: 28 hours
- Battery charging time[1]:
  - Standard battery: 2.5 hours off, 3 hours on
  - Optional long life battery[7]: 3 hours off, 4 hours on
- Optional bridge battery[8] (1 minute swap time)

POWER MANAGEMENT
- Suspend/Resume Function, Hibernation, Standby

SECURITY FEATURES
- Password Security: Supervisor, User, Hard Disk Lock
- Kensington cable lock slot
- Trusted platform module (TPM) security chip v.2.0[12]
- Computrace® theft protection agent in BIOS8
- Optional Insertable SmartCard reader[2,3]
- Optional Contactless SmartCard/HF RFID reader[2]
  - ISO 15693 and 14443 A/B compliant

WARRANTY
- 3-year limited warranty, parts and labor

DIMENSIONS & WEIGHT[9]
- 10.6"(L) x 7.4"(W) x 0.8"(H)
- 2.4 lbs. (standard battery)
- 3.0 lbs. (optional long life battery)[7]

INTEGRATED OPTIONS[10]
- 4G LTE multi carrier mobile broadband with satellite GPS
- Choice of 1D/2D barcode reader (EA11 or EA21), GPS, Serial Dongle, Ethernet, MicroSDXC or second USB 2.0 port[2]
- Choice of bridge battery, magstripe reader, insertable SmartCard reader, insertable SmartCard reader with bridge battery, contactless SmartCard/RFID HF reader or UHF 900MHz RFID reader (EPC Gen 2)[2,7]

ACCESSORIES[10]

AC Adapter (3-prong)	CF-AA6413CM
Standard Battery Pack	FZ-VZSU84A2U
Long Life Battery Pack[7]	FZ-VZSU88U
Long Life Battery Bundle (includes rotating hand strap and corner guard set)	FZ-BNDLG1LL1ST1CG4
Single Battery Charger Bundle	FZ-BNDLG1BATCHRG
LIND 3-Bay Battery Charger	FZ-LND3BAYG1
LIND Car Adapter 120W	CF-LNDDC120
LIND Car/AC Adapter 90W (with USB port)	CF-LNDACDC90
LIND Car Adapter 90W MIL-STD	CF-LNDMLDC90
Tall Corner Guard Set	FZ-WCGG111
Rotating Hand Strap and Tall Corner Guard Set Bundle	FZ-BNDLG1ST1CG4
ToughMate G1 Always-On Case (with hand strap)	TBCG1AONL-P
ToughMate G1 Professional Portfolio	TBCG1PFLIO-BLK-P
ToughMate G1 "X" Hand Strap	TBCG1XSTP-P
Desktop Cradle	FZ-VEBG11AU
Vehicle Docks (no pass-through)	
– Gamber-Johnson	7160-0486-00-P
– Havis with LIND power supply	CF-H-PAN-702-P
Vehicle Docks (dual pass-through)	
– Gamber-Johnson	7160-0486-02-P
– Havis with LIND power supply	CF-H-PAN-702-2-P
Cradlepoint Router	
– Verizon	CP-IBR1100LPE-VZ
– AT&T	CP-IBR1100LPE-AT
Replacement Digitizer Pen Waterproof	FZ-VNPG11U-S
Tether	FZ-VNTG11U
10.1" LCD Protective Film	FZ-VPFG11U

Please consult your reseller or Panasonic representative before purchasing.

Caution: Do not expose bare skin to this product when handling this unit in extreme hot or cold environments.

[1] Approximate time. Battery operation and recharge times will vary based on many factors, including screen brightness, applications, features, power management, battery conditioning and other customer preferences. Battery testing results from MobileMark 2007.

[2] Bridge battery, magstripe reader, insertable SmartCard reader, insertable SmartCard reader with bridge battery, contactless SmartCard reader and UHF RFID reader are mutually exclusive. Please note, USB 3.0 port cannot be accessed when the unit is equipped with the magstripe reader, but optional USB 2.0 port can be accessed.

[3] GPS, Serial Dongle, Ethernet, MicroSDXC and second USB port are mutually exclusive options.

[4] 1GB = 1,000,000,000 bytes.

[5] Total usable memory will be less depending upon actual system configuration.

[6] The size of the VRAM cannot be set by the user and varies by operating system as well as the size of the RAM. Windows 7 max. VRAM is 1555MB.

[7] Magstripe reader, insertable SmartCard reader, insertable SmartCard reader with bridge battery and UHF RFID reader include tall corner guards and rotating hand strap. Bridge battery (without SmartCard reader) includes medium corner guards and rotating hand strap.

[8] Requires software and activation to enable theft protection.

[9] Length measurements do not include protrusions. Weight varies with options and digitizer pen.

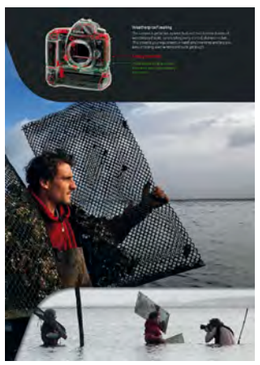
[10] Accessories and Integrated Options may vary depending on your configuration. Visit the Panasonic website for more accessories and details.

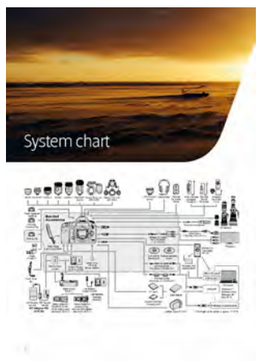
[11] Hazardous location certifications may not apply to all configurations. Consult your Panasonic representative for availability.

[12] TPM 1.2 available upon request - please contact your reseller or Panasonic representative.

1.800.662.3537
panasonic.com/toughpad/G1

APPENDIX 9.3.4: CAMERA EQUIPMENT (CANON 5D MARK III)

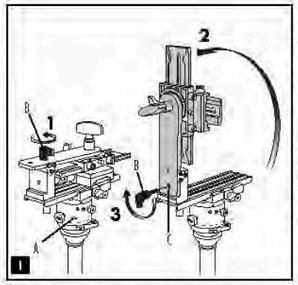





SIGMA
50mm 1:1.4 DG ø77

INSTRUCTIONS

303SPH
SPHERICAL "VR" HEAD



The spherical "VR" head is designed to allow virtual scenes to be created by Computer from a various panoramic sequences of digital or digitized photographs, taken at different vertical angles.

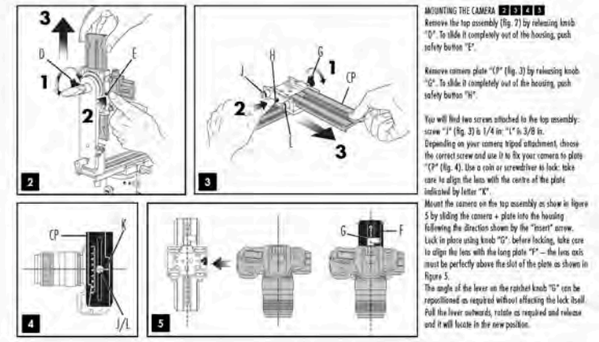
There are 4 requirements to achieve good panoramic sequence shots:
1. Accurately levelling of the panoramic axis
2. A Panoramic head that enables you to choose the angle of rotation between one shot and the next.
3. The ability to position the camera so the "Nodal Point" of the lens (the front lens) is exactly above the panoramic axis of rotation, to eliminate any parallax problems between the near and distant objects in the scene.
4. An additional rotating axis that enables you to shoot several panoramic sequences at different vertical angles in order to achieve a complete spherical scene

The spherical "VR" head comprises three main modules that perform the functions mentioned above in points 2, 3 and 4.

Unless your tripod has a built-in levelling device (such as the Manfrotto Alkbile tripod's 50mm half ball), you will need to use one of the levelling accessories available from the Manfrotto range to ensure accurate levelling of the head (see point 1).

SET UP 1
Fix the levelling device (not supplied) to the tripod, then fix the "VR" head on the levelling device via knurle attachment "A".
Completely remove knob "B", rotate the bracket into the vertical position as shown in fig. 1 and lock it in place by screwing the knob "B" into hole "C".

2

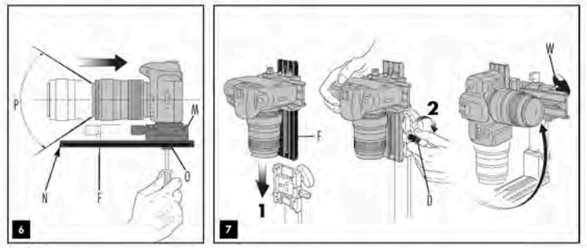


MOUNTING THE CAMERA 2 3 4 5
Remove the top assembly (fig. 2) by releasing knob "G". To slide it completely out of the housing, push safety button "E".

Remove camera plate "CP" (fig. 3) by releasing knob "G". To slide it completely out of the housing, push safety button "H".

You will find two screws attached to the top assembly: screw "I" (fig. 3) is 1/4 in "/" is 3/8 in.
Depending on your camera tripod attachment, choose the correct screw and use it to fix your camera to plate "CP" (fig. 4). Use a coin or screwdriver to lock: take care to align the lens with the centre of the plate indicated by letter "K".
Mount the camera on the top assembly as shown in figure 5 by sliding the camera + plate into the housing following the direction shown by the "insert" arrow.
Lock in place using knob "G". before locking, take care to align the lens with the long plate "F" — the lens axis must be perfectly above the slot of the plate as shown in figure 5.
The angle of the lever on the ratchet knob "G" can be repositioned as required without affecting the lock itself. Pull the lever outwards, rotate as required and release and it will locate in the new position.

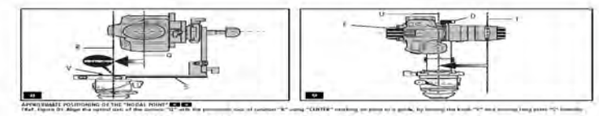
3



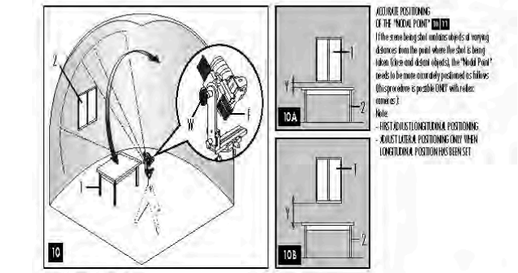
NOTE 6
The position of the housing "M" relative to the long plate "F" will need to be adjusted: loosen screw "O" to slide the housing. The ideal position is with the camera body as far back on the plate as it can go before the front edge "N" of the long plate "F" becomes visible in the camera's field of view "P".

MOUNT THE CAMERA ON THE HEAD 7
Mount the whole top assembly + camera on the head as shown in figure 7 by sliding the long plate "F" into its housing and locking it by screwing knob "D", then unscrew knob "W" and move the camera on the vertical plane.

4



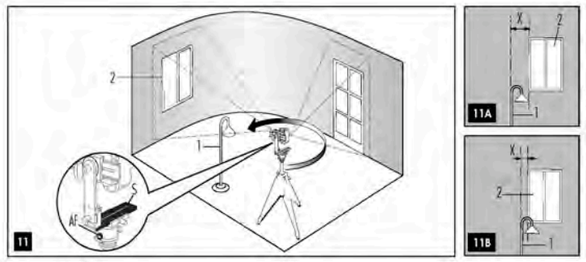
5



ACCURATE POSITIONING OF THE "NODAL POINT" 10 11
If the scene being shot contains objects at varying distances from the point where the shot is being taken (close and distant objects), the "Nodal Point" needs to be more accurately positioned as follows:
(this procedure is possible ONLY with roller: version F)
Note:
- FIRST ADJUST LONGITUDINAL POSITIONING
- ADJUST LATERAL POSITIONING ONLY WHEN LONGITUDINAL POSITION HAS BEEN SET

- LONGITUDINAL POSITIONING 10
(Ref. Figure 10): Choose a scene that contains both a near object "1" and a distant object "2" situated along the same vertical line of vision.
1. (See figure 10A and 10B) unscrew knob "W" and move the camera on the vertical plane to bring the two objects (1 to the top and then to the bottom of the frame, checking whether the height gap "Y" between the two objects varies in the two frames: the more constant the distance remains, the more accurately the "Nodal Point" has been positioned.
2. For optimum results, make minor adjustments by moving plate "F".
Once the right position is achieved it is VERY USEFUL to memorize it by noting the position of the plate "S" on the index on the graduated scale.

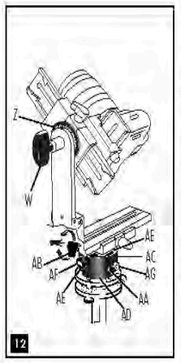
6



- LATERAL POSITIONING 11
(Ref. Figure 11): Choose a frame that contains both a near object "1" and a distant object "2" situated along the same horizontal line of vision.
1. (See figure 11A and 11B): unscrew knob "AF" and move the camera around the panoramic axis so that the two objects are first on the left hand side of the frame, then on the right. Check whether the horizontal gap "X" between the two objects varies in the two frames: the more constant the distance remains, the more accurately the "Nodal Point" has been positioned.
2. For optimum results, make minor adjustments by moving plate "S".

Once the right position is achieved it is VERY USEFUL to memorize it by noting the position of the plate "S" on the index on the graduated scale.

7



INSTRUCTIONS FOR SPHERICAL PANORAMIC SHOOTING 12
A special panoramic scene is obtained by adding together panoramic sequences taken at different angles from the horizontal. First you will need to choose the number of panoramic sequences you will need to complete the sphere depending on the angle of the lens you will be using.
Before starting with the panoramic sequence, choose the initial vertical angle using the round scale "Z" (fig. 12).
Unscrew locking knob "AF" or remove it completely if you do not need to use it to completely stop rotation when the head is used in non-vertical position, or to avoid any accidental movement of the head in any position).

Decide the number of shots or the angle of rotation between each shot for the first panoramic sequence (see the chart below):

Angle	90°	60°	45°	36°	30°	24°	20°	15°	10°	5°
n. shots	4	6	8	10	12	15	18	24	36	72

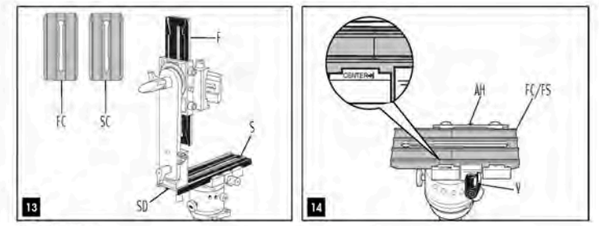
- Screw knob "AG" into the selected setting hole "AA".
- Release locking lever "AB" and rotate the camera on top plate "AE" to the position of the first shot.
- Hold the camera in position and rotate the central barrel "AC" until the first "click stop" is reached, then lock lever "AB"
- Take the first shot and then rotate the camera to the next "click stop" without releasing "AB" and take the next shot.
  Continue this process until the start position is reached.

Once you have completed the first complete panoramic sequence, you can start on the other panoramic sequences needed to cover the sphere: change the vertical angle using knob "W" and round scale "Z", and repeat the operations described above for each full sequence.

The base of the head "AD" has graduated scale markings from 0 to 360° and a reference index "AE" on the central barrel "AC". This is to be used to set angles not on the chart. To use the head in this way, unlock knob "AG" to disengage the "click stop" during rotation of central barrel "AC" and use the locking knob "W" to lock the position during shooting.

NOTE: The angle of the lever on the ratchet knob "AB" can be repositioned as required without affecting the lock itself. Pull the lever outwards, rotate as required and release and it will locate in the new position.

8



ADDITIONAL PLATES 13
If you have a very compact camera we suggest you try one the short plates "SC" (fig. 13) and "FC" (supplied with the head) instead of the two long plates "F" and "S" in order to reduce space and weight of the system.
To replace the plate "S" unscrew screw "SD" (fig. 13)
To replace the plate "F", please refer to fig. 6 and unscrew screw "O"

USE OF THE KIT AS AN OBJECT PANORAMA TURNTABLE 14
The head can also be used as a turntable, useful for shooting object panoramas. For this use, loosen knob "H" and push button "AH" to slide the lower plate "S" out of the housing on the panoramic rotation base unit. In place of the long plate and top assembly, mount one of the two shorter plates supplied as a base for your object. The plate housing has a "center" mark to help you position your object accurately above the center of panoramic rotation.

9