



## Appendix 8.6

Technical Methodology:  
Photography, 3D Modelling and Verified Visualisations



ALDERHOLT MEADOWS

November 2022





## Appendix 8.5

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ALDERHOLT MEADOWS

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## Introduction

**Michael Spence BA (Hons), MLD, CMLI, REIA, FRGS** is 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 technical 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 (NatureScot) on their windfarm visualisation guidance. His background as a Chartered Landscape Architect, Registered EIA Practitioner and Fellow of the Royal Geographical 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, use of GIS 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 Valletta (Malta), Royal Botanic Gardens at Kew, Fountains Abbey for The National Trust, and West Cumbria Coal Mine for Friends of the Earth. 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 April 2022 UIS contacted MSE to request Technical Photography, GNSS/RTK Surveying, 3D Modelling and Visualisation review and support for the proposed LVIA for Alderholt Meadows.

## Verified Photography and 3D Modelling

The photographs were taken with a full frame camera (Canon EOS 5D Mark IV) 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 15 viewpoints were identified providing views of the site and in accordance with best practice visited in April and July 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. Photographs were taken in landscape orientation. A Sigma 50mm f/1.4 lens was used for all viewpoint photographs.



A Single Frame 50mm photograph is insufficient to capture the extents of a wide, linear development. Each view was taken with a series of overlapping 50mm images, as shown above.



To ensure consistent geometry each image was cylindrically re-projected, as above. This ensures that a full 360 degree panorama can be created to match the 3D model view, as shown below:

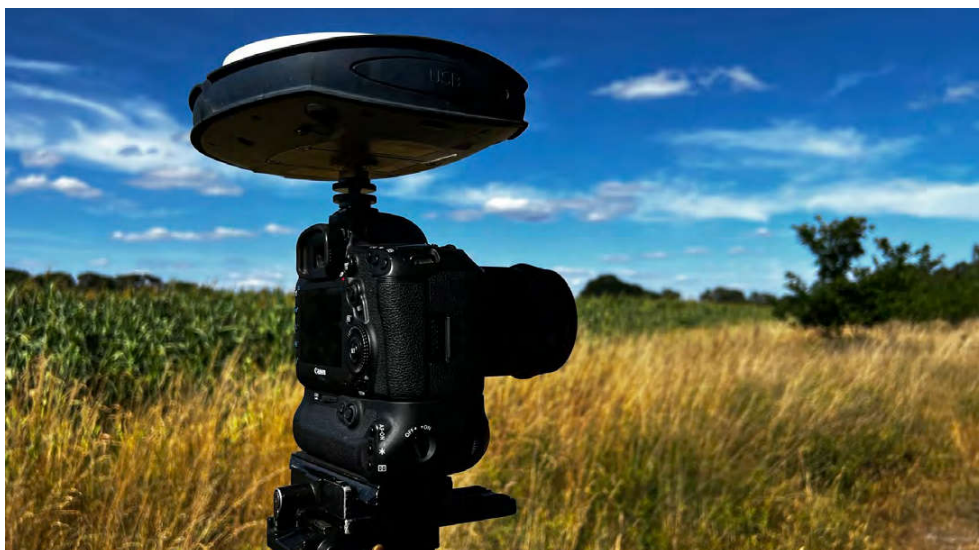


From the 360 degree panorama a 90 (or 180 degree) degree portion can be extracted to present the visualisations as shown below:



### 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 SP85 GNSS smart antennae with Panasonic Toughpad data recorder. Points were saved using Origin Geospatial software. A photograph of the camera location was taken.



### 3D Modelling

MSEnvironmental (MSE) constructed a 3D model using the planning applications drawings, OS MasterMap for geo-referencing and site topographic survey. 3D point data was used for checking horizontal and vertical alignment.

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

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 V-Ray for Rhino were exported from the 3D modelling software and used to overlay the cylindrical images. Target points from both the photograph and the model view were aligned to ensure a precise fit between the two images.

Visualisations are presented as either AVR 0, 1, 2 or 3. The differences are explained in the Landscape Institute's Technical Guidance Note 06/19: Visualisation of Development Proposals.

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



The topography of the site has been generated from a combination of a site Topographic survey and LIDAR 1m DTM data, with triangulated surfaces generated using Rhinoterrain.

The 3D Model was built and geo-referenced in Rhino 3D by MSE, using 2D CAD layouts supplied by the Scott Worsfield Associates, project architects, and landscaping proposals supplied by Urban Initiatives Studios.

A cumulative site has been added using planning application drawings supplied by UIS.

The model is fully geo-referenced and positioned to correspond with the site layout and elevations supplied in the planning application drawings.

The resultant visualisations are considered to fairly demonstrate the correct scale and massing of the development.

Cameras have been added to the model and the field of view rendered out to precisely match the panoramic cylindrical images using highly precise camera co-ordinates.



## 50mm lens on Full Frame Sensor Camera

For decades it has been accepted that a 50mm lens on a full frame sensor camera provides the optimum image to replicate what is seen by the human eye. There are important differences between the human eye (binocular) and the camera lens (monocular). These have been explored in research by The Highland Council & the University of Stirling, as well as by myself through the Landscape Institute. We know that a single frame 50mm image on an A3 sheet of paper provides the same view as that gained in the field by someone with one eye closed. As we are binocular, and normally use both eyes, a different size of image is required, and the reason why we have presented the images as effectively a 75mm image on A2 paper. This gives what The Highland Council, University of Stirling, Scottish Natural Heritage (NatureScot) and the Landscape Institute agree is the most representative size of image to understand the nature and scale of a development on a photograph.

## Planar or Cylindrical Projection

All photographs are taken as single frame planar images. Each single frame image has a single point of perspective lying at the centre of the image. To correctly match and align with the 3D modelling software the camera must be mounted on a levelled tripod, and directed towards the proposed development.

When a viewpoint is close to the development, or a development is wide such as this development, it is not always possible to fit the development on a single frame image. The alternative is to use a series of overlapping 50mm images and generate a 'cylindrical' perspective view.

The 3D model renders have been rendered out in cylindrical (multiple frame images) projection to allow the precise image re-mapping to match the photography.

## 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 and horizontal alignment of the 3D model against the precise image geometry. 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.

## Viewing Printed Images

The visualisations have been prepared to be printed in the Technical Methodology at A3 (420 x 297mm) and in the separate 'Verified Visualisations' document at A1 (841mm x 297mm), to show the scale of the proposed development.

The image size is considered to give a fair representation of the view for everyone, and the scale of the development in that view.

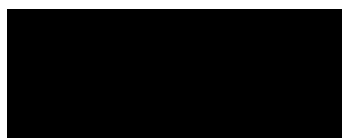
## Summary

This work has been undertaken in accordance with the the Landscape Institute TGN 06/19 and the developing understanding of visualisation work. The accuracy of camera locations and 3D modelling conforms with the Landscape Institute's Type 4 (the highest level of accuracy). The 3D modelling has been produced to AVR 2 (simple architectural form with no detail).

The photography has been undertaken in an extremely robust manner, using professional full frame sensor DSLR and 50mm lens with levelled 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 using detailed information contained in the planning application drawings. An additional check on the vertical scaling has been undertaken using RESOFT Windfarm.

The resultant visualisations are highly accurate.

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



M.A.Spence BA(Hons), MLD, CMLI, REIA, FRGS 19 November 2022  
**Principal, MSE Environmental**

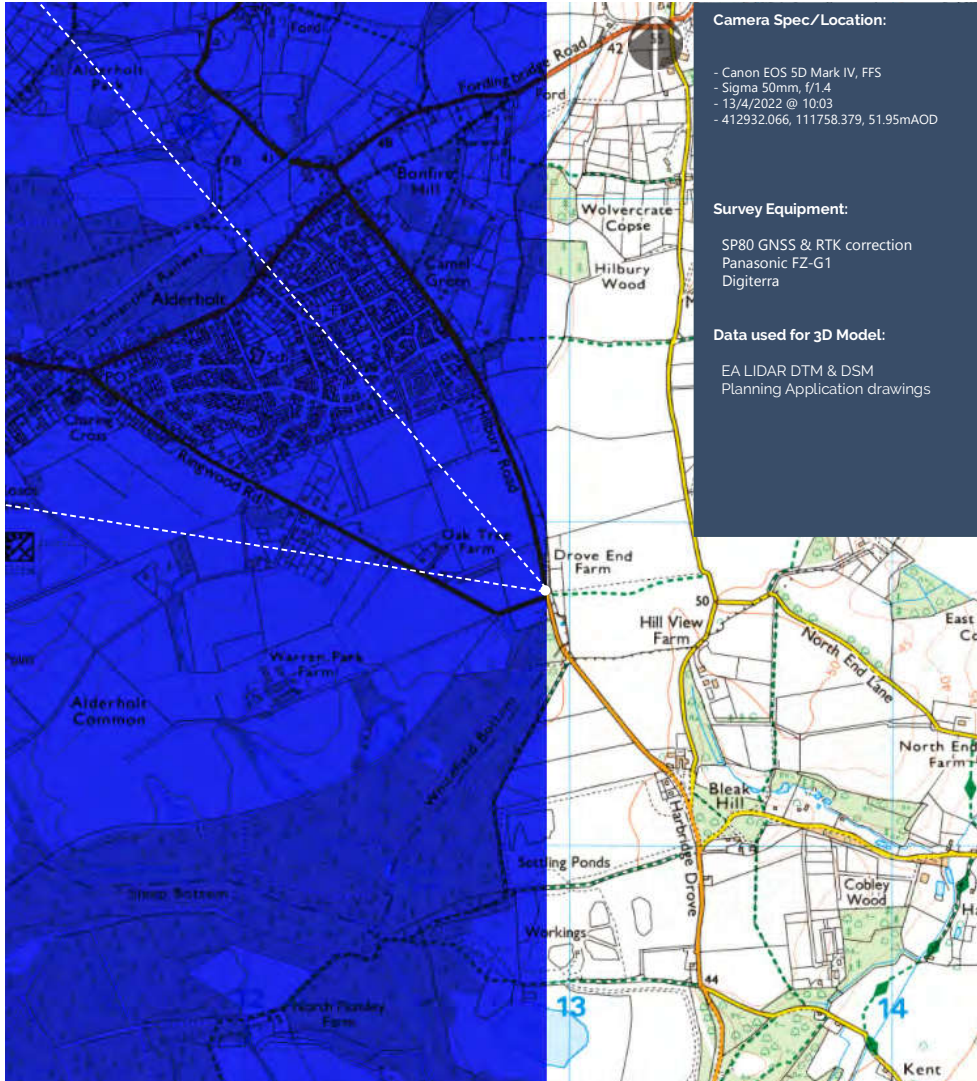




# Viewpoint 1 Winter Photography



## Camera Location:



**Camera Spec/Location:**

- Canon EOS 5D Mark IV, FFS
- Sigma 50mm, f/1.4
- 13/4/2022 @ 10:03
- 412932.066, 111758.379, 51.95mAOD

**Survey Equipment:**

- SP80 GNSS & RTK correction
- Panasonic FZ-G1
- Digiterra

**Data used for 3D Model:**

- EA LIDAR DTM & DSM
- Planning Application drawings

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## Tripod:



50mm Lens Planar Projection (actual 49.6mm; 39.9 deg HFOV)

Point of Perspective



Point of Perspective

Point of Perspective

Point of Perspective

Viewpoint 1 Winter Single Frame 50mm image



50mm Lens Planar Projection (actual 49.6mm; 39.9 deg HFOV)

Point of Perspective



Point of Perspective

Point of Perspective

Point of Perspective

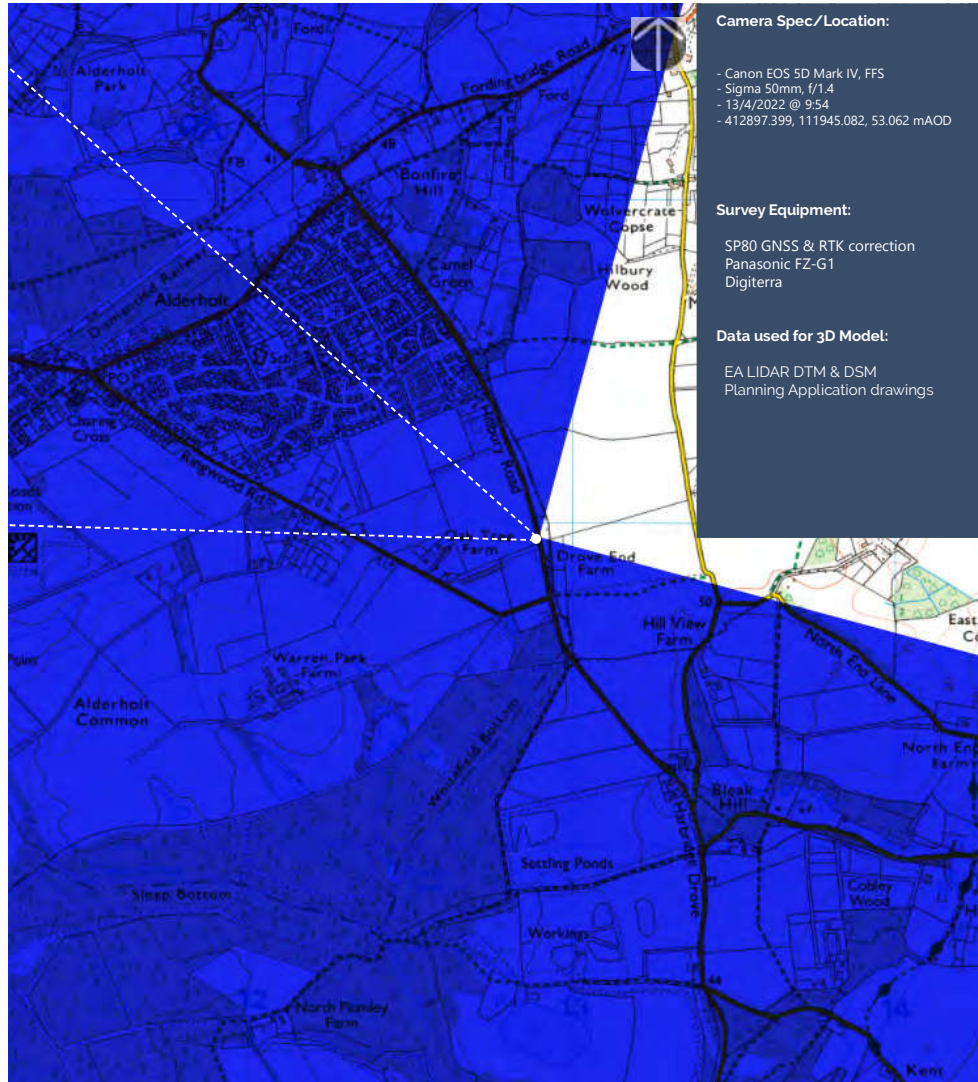
Viewpoint 1 Summer Single Frame 50mm image



# Viewpoint 2 Winter Photography



## Camera Location:



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## Tripod:



50mm Lens Planar Projection (actual 49.6mm; 39.9 deg HFOV)

Point of Perspective



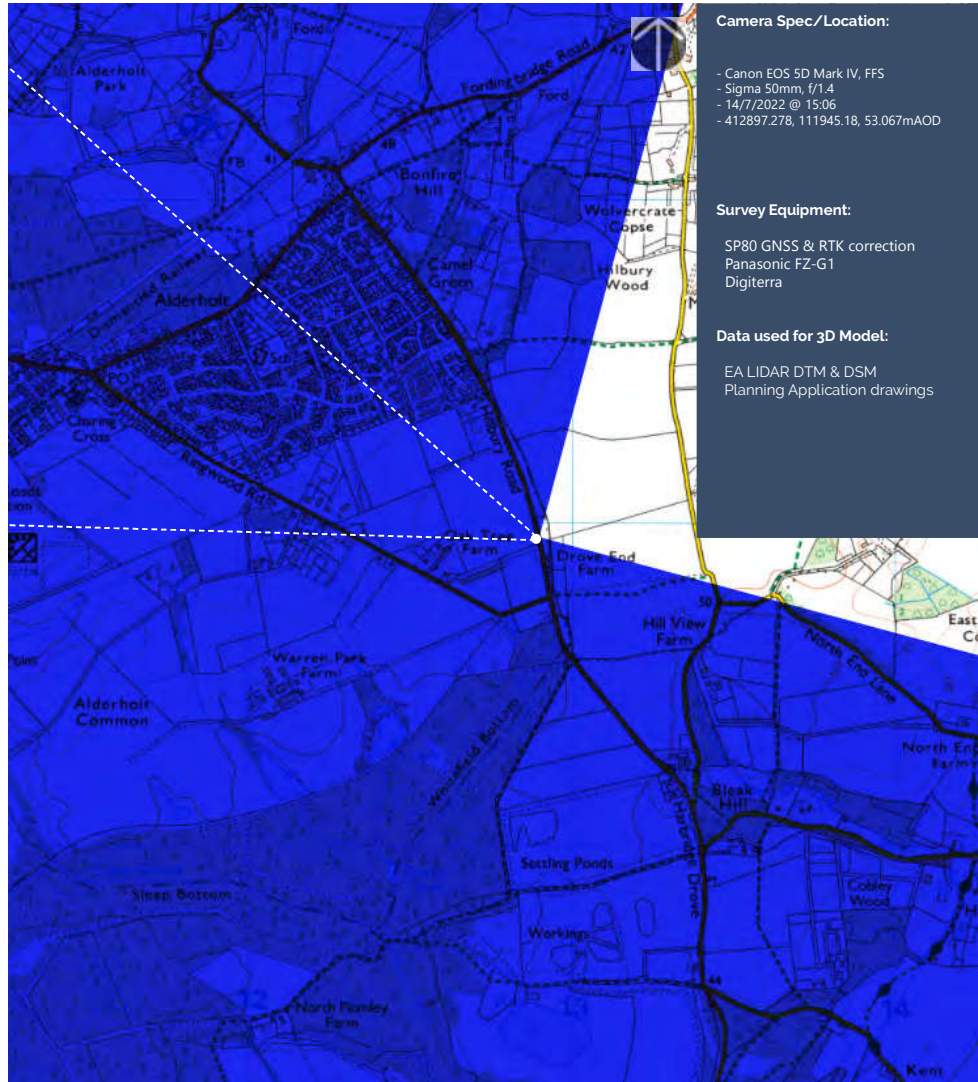
Point of Perspective

Point of Perspective

Point of Perspective

Viewpoint 2 Winter Single Frame 50mm image

## Camera Location:



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## Tripod:



50mm Lens Planar Projection (actual 49.6mm; 39.9 deg HFOV)

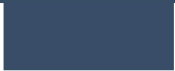
Point of Perspective



Point of Perspective

Point of Perspective

Viewpoint 2 Summer Single Frame 50mm image



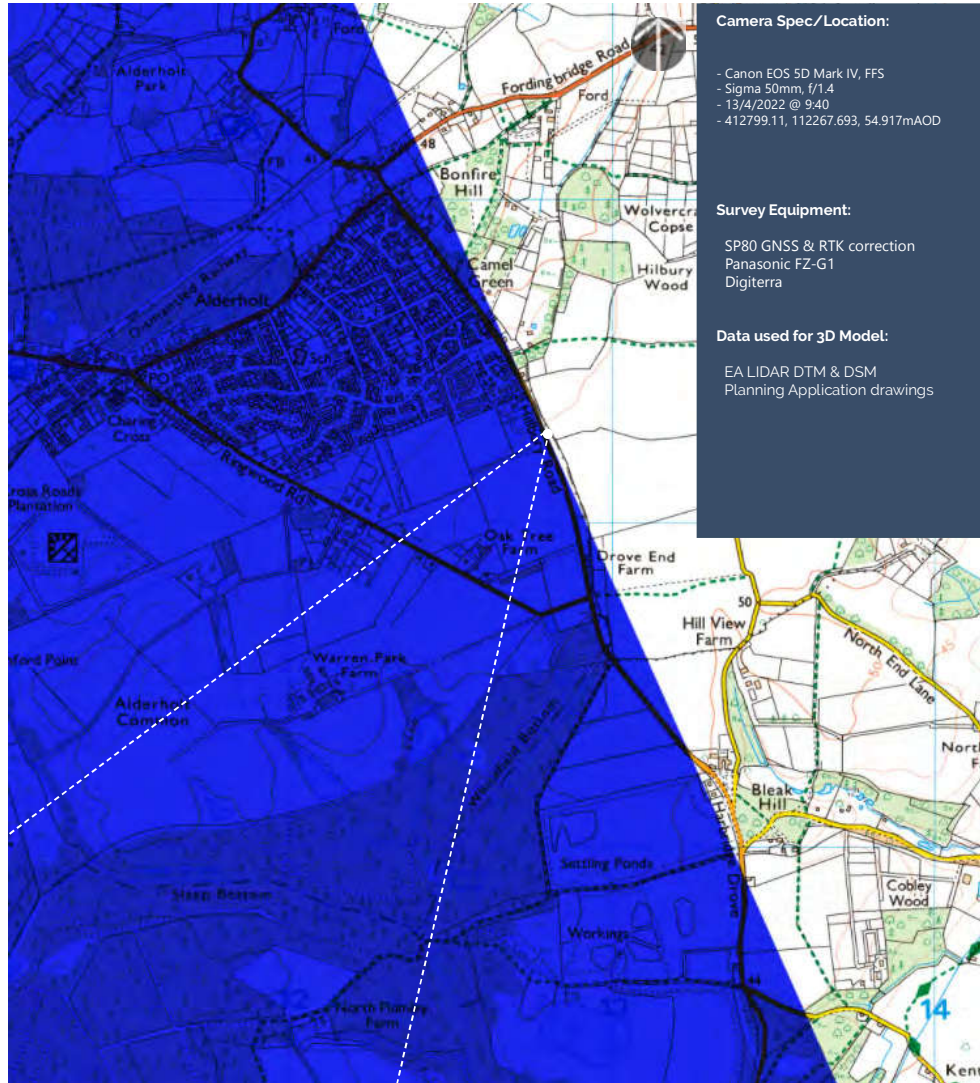
Point of Perspective



# Viewpoint 3 Winter Photography



## Camera Location:



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## Tripod:



50mm Lens Planar Projection (actual 49.6mm; 39.9 deg HFOV)

Point of Perspective



Point of Perspective

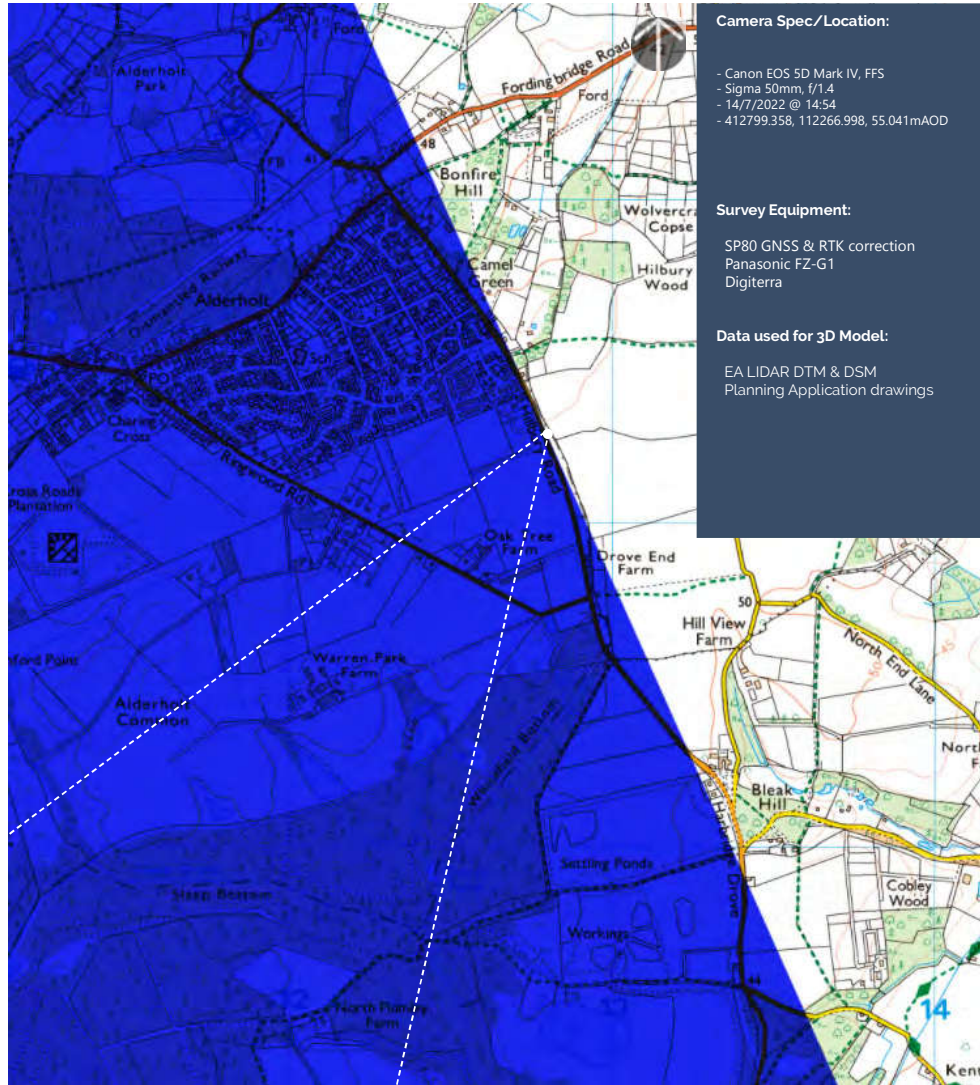
Point of Perspective

Point of Perspective

Viewpoint 3 Winter Single Frame 50mm image



## Camera Location:



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## Tripod:



50mm Lens Planar Projection (actual 49.6mm; 39.9 deg HFOV)

Point of Perspective



Point of Perspective

Point of Perspective

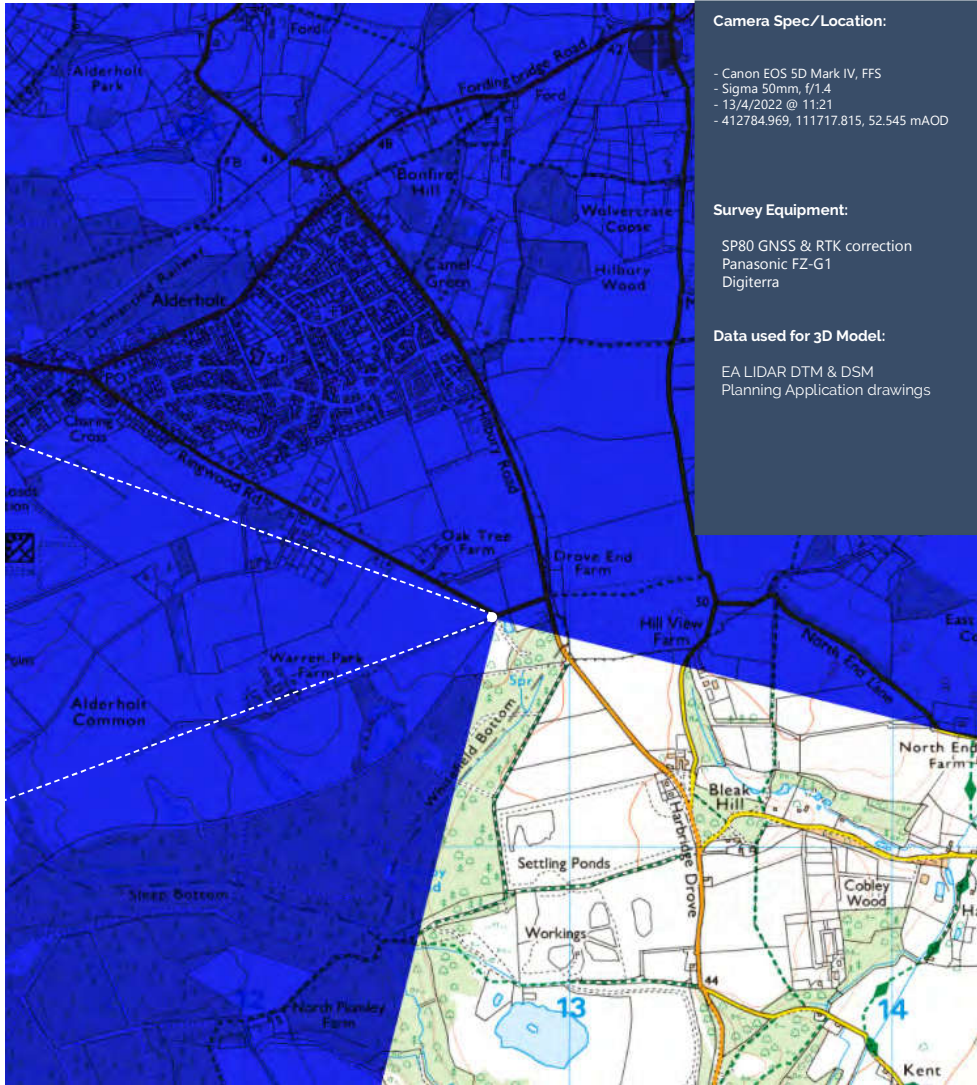
Point of Perspective

Viewpoint 3 Summer Single Frame 50mm image

# Viewpoint 4 Winter Photography



## Camera Location:



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## Tripod:



50mm Lens Planar Projection (actual 49.6mm; 39.9 deg HFOV)

Point of Perspective



Point of Perspective

Point of Perspective

Point of Perspective

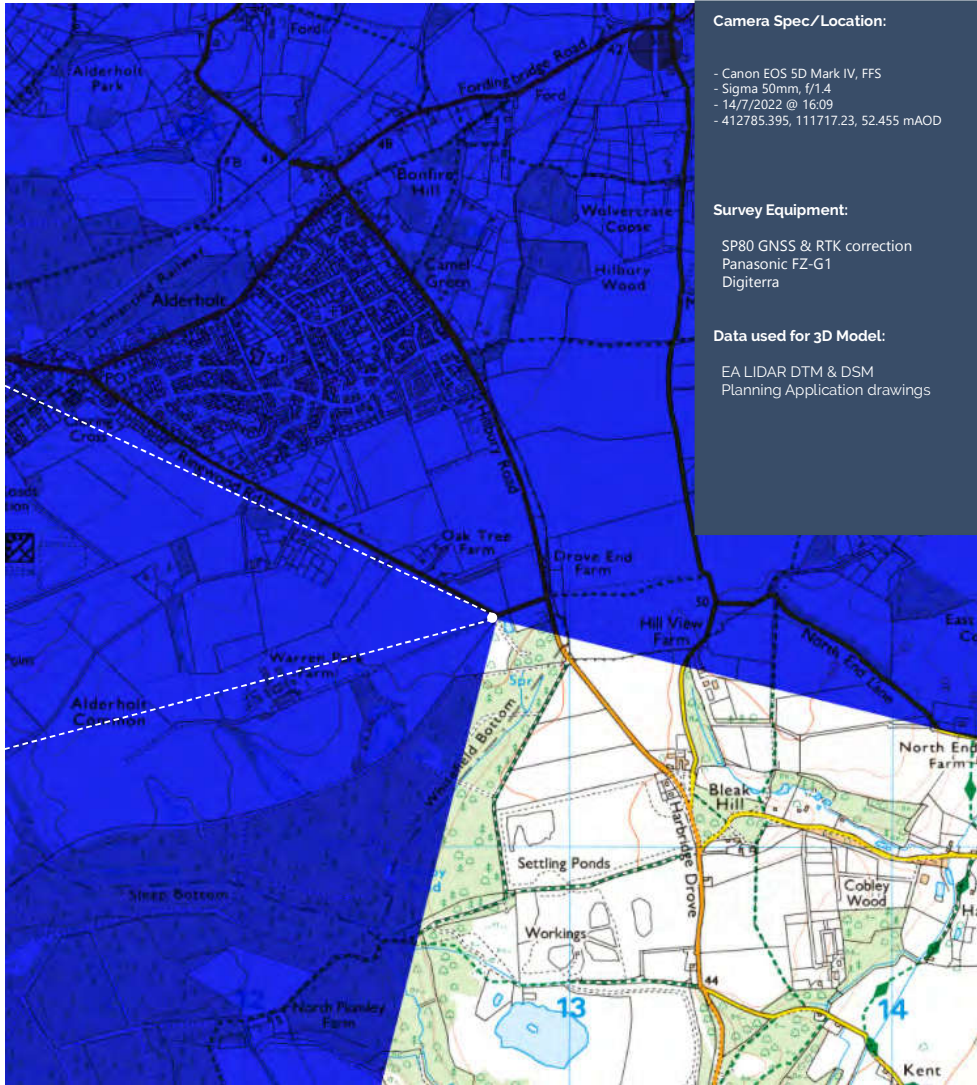
Viewpoint 4 Winter Single Frame 50mm image



# Viewpoint 4 Summer Photography



## Camera Location:



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## Tripod:



50mm Lens Planar Projection (actual 49.6mm; 39.9 deg HFOV)

Point of Perspective



Point of Perspective

Point of Perspective

Point of Perspective

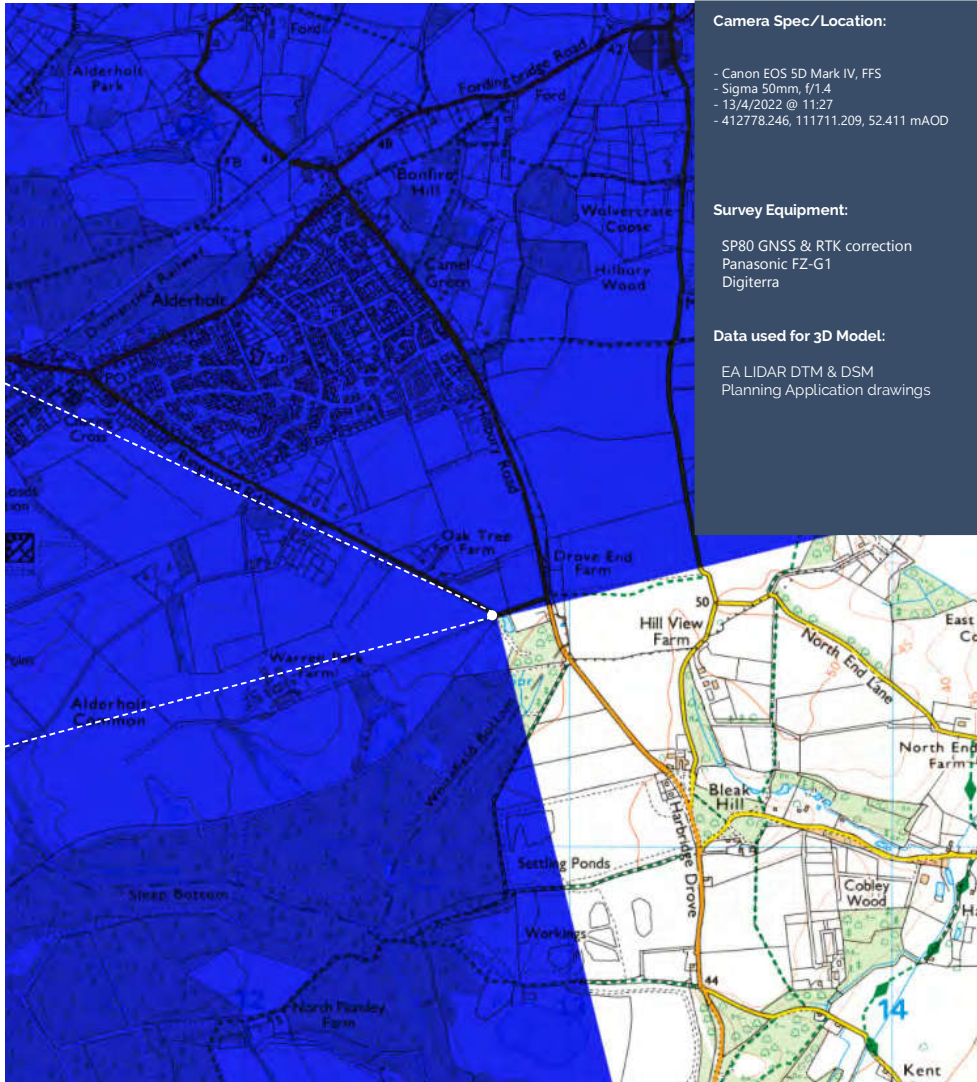
Viewpoint 4 Summer Single Frame 50mm image



# Viewpoint 5 Winter Photography



## Camera Location:



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## Tripod:



50mm Lens Planar Projection (actual 49.6mm; 39.9 deg HFOV)

Point of Perspective



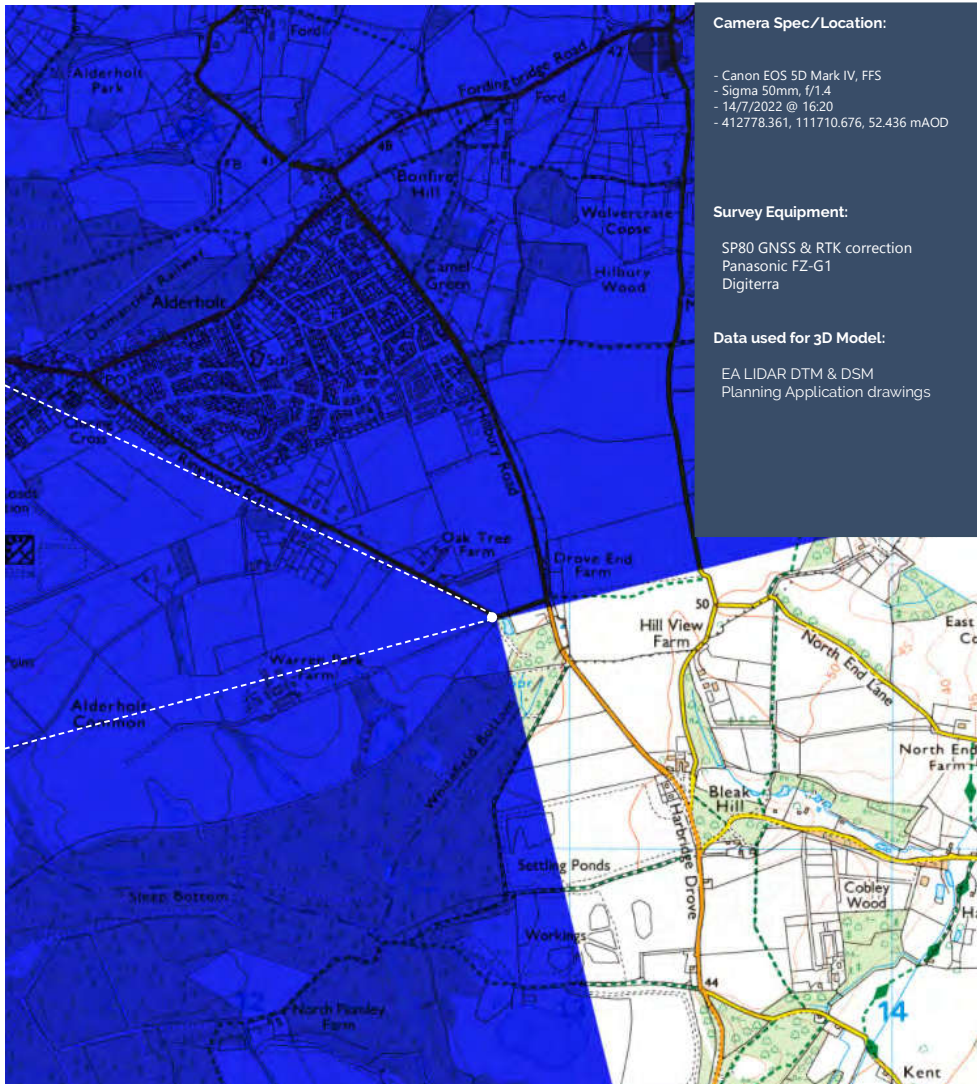
Point of Perspective

Point of Perspective

Point of Perspective

Viewpoint 5 Winter Single Frame 50mm image

## Camera Location:



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## Tripod:



50mm Lens Planar Projection (actual 49.6mm; 39.9 deg HFOV)

Point of Perspective



Point of Perspective

Point of Perspective

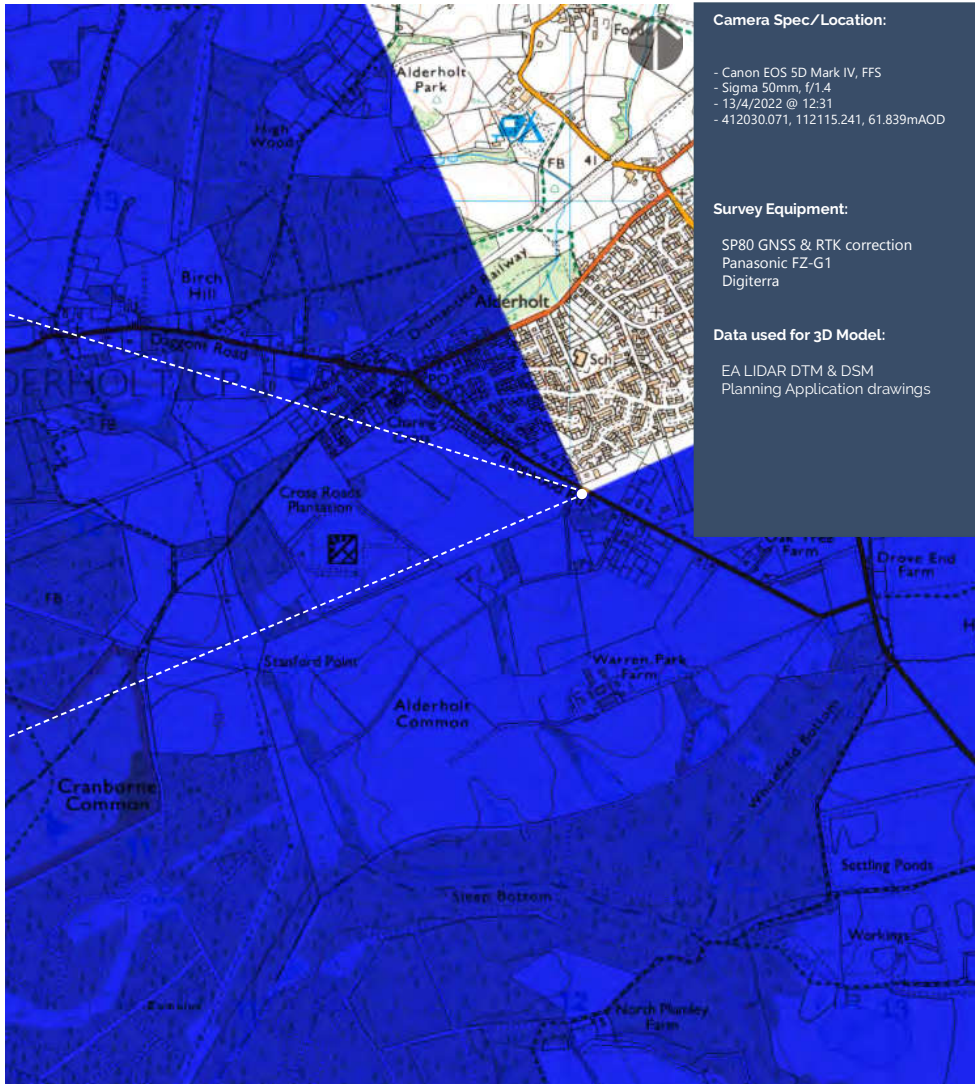
Viewpoint 5 Summer Single Frame 50mm image



# Viewpoint 6 Winter Photography



## Camera Location:



### Camera Spec/Location:

- Canon EOS 5D Mark IV, FFS
- Sigma 50mm, f/1.4
- 13/4/2022 @ 12:31
- 412030.071, 112115.241, 61.839mAOD

### Survey Equipment:

- SP80 GNSS & RTK correction
- Panasonic FZ-G1
- Digiterra

### Data used for 3D Model:

- EA LIDAR DTM & DSM
- Planning Application drawings

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## Tripod:



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

Point of Perspective



Point of Perspective

Point of Perspective

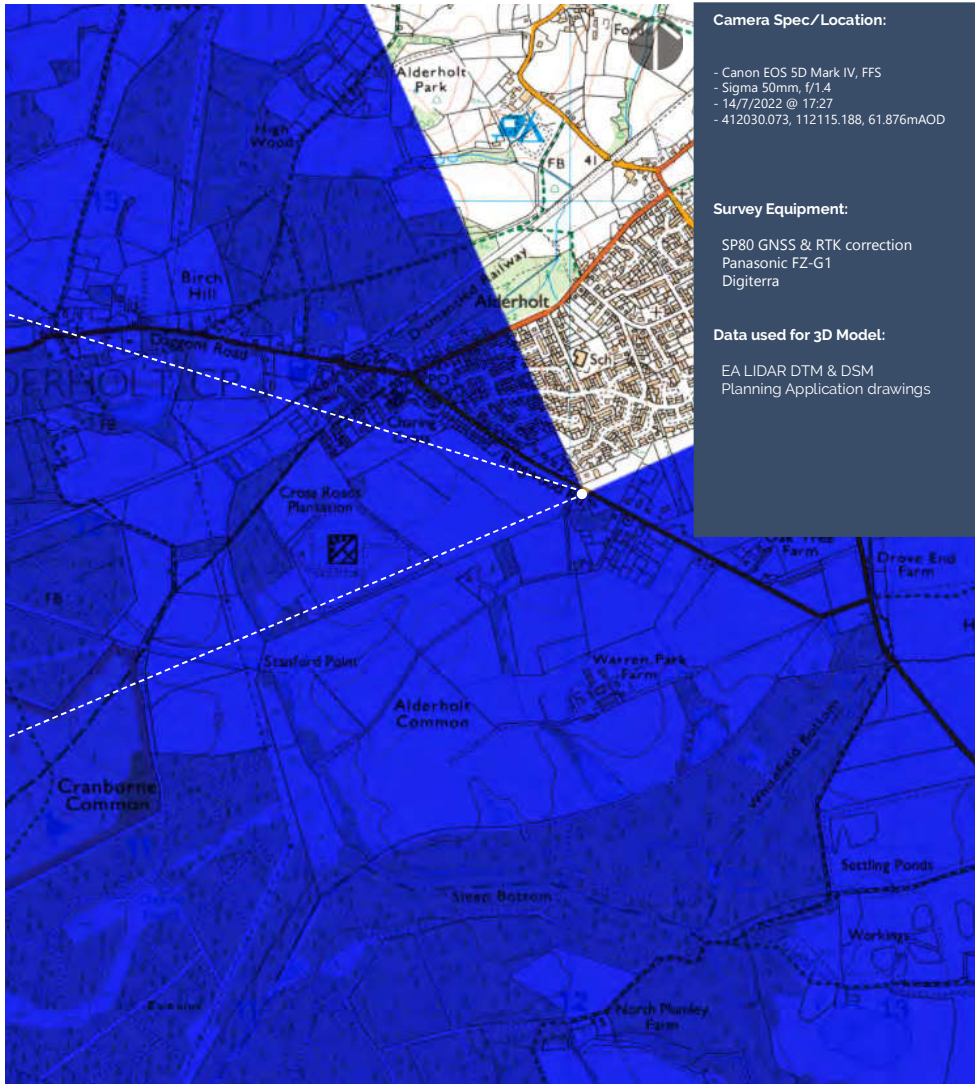
Point of Perspective

Viewpoint 6 Winter Single Frame 50mm image

# Viewpoint 6 Summer Photography



## Camera Location:



### Camera Spec/Location:

- Canon EOS 5D Mark IV, FFS
- Sigma 50mm, f/1.4
- 14/7/2022 @ 17:27
- 412030.073, 112115.188, 61.876m AOD

### Survey Equipment:

- SP80 GNSS & RTK correction
- Panasonic FZ-G1
- Digiterra

### Data used for 3D Model:

- EA LIDAR DTM & DSM
- Planning Application drawings

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## Tripod:



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

Point of Perspective



Point of Perspective

Point of Perspective

Point of Perspective

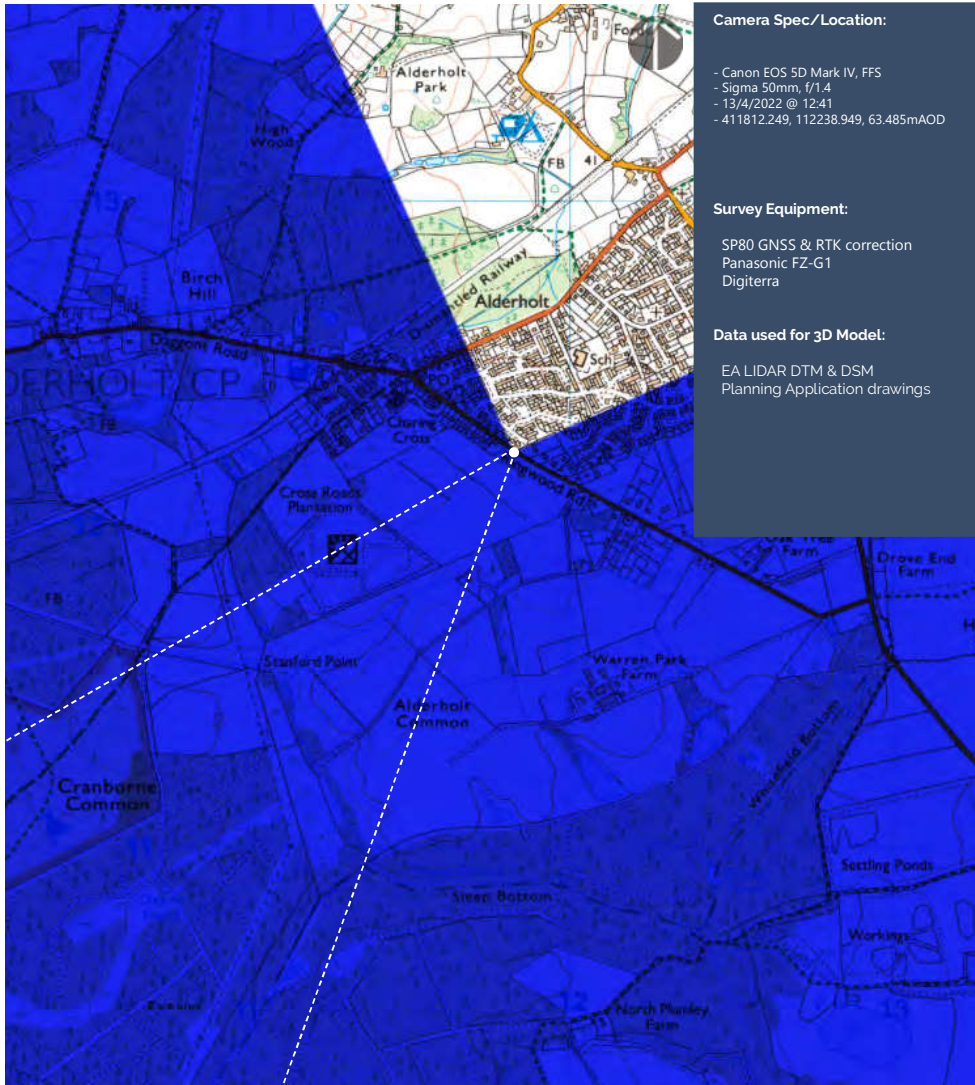
Viewpoint 6 Summer Single Frame 50mm image



# Viewpoint 7 Winter Photography



## Camera Location:



**Camera Spec/Location:**

- Canon EOS 5D Mark IV, FFS
- Sigma 50mm, f/1.4
- 13/4/2022 @ 12:41
- 411812.249, 112238.949, 63.485m AOD

**Survey Equipment:**

- SP80 GNSS & RTK correction
- Panasonic FZ-G1
- Digiterra

**Data used for 3D Model:**

- EA LIDAR DTM & DSM
- Planning Application drawings

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## Tripod:



50mm Lens Planar Projection (actual 49.6mm; 39.9 deg HFOV)

Point of Perspective



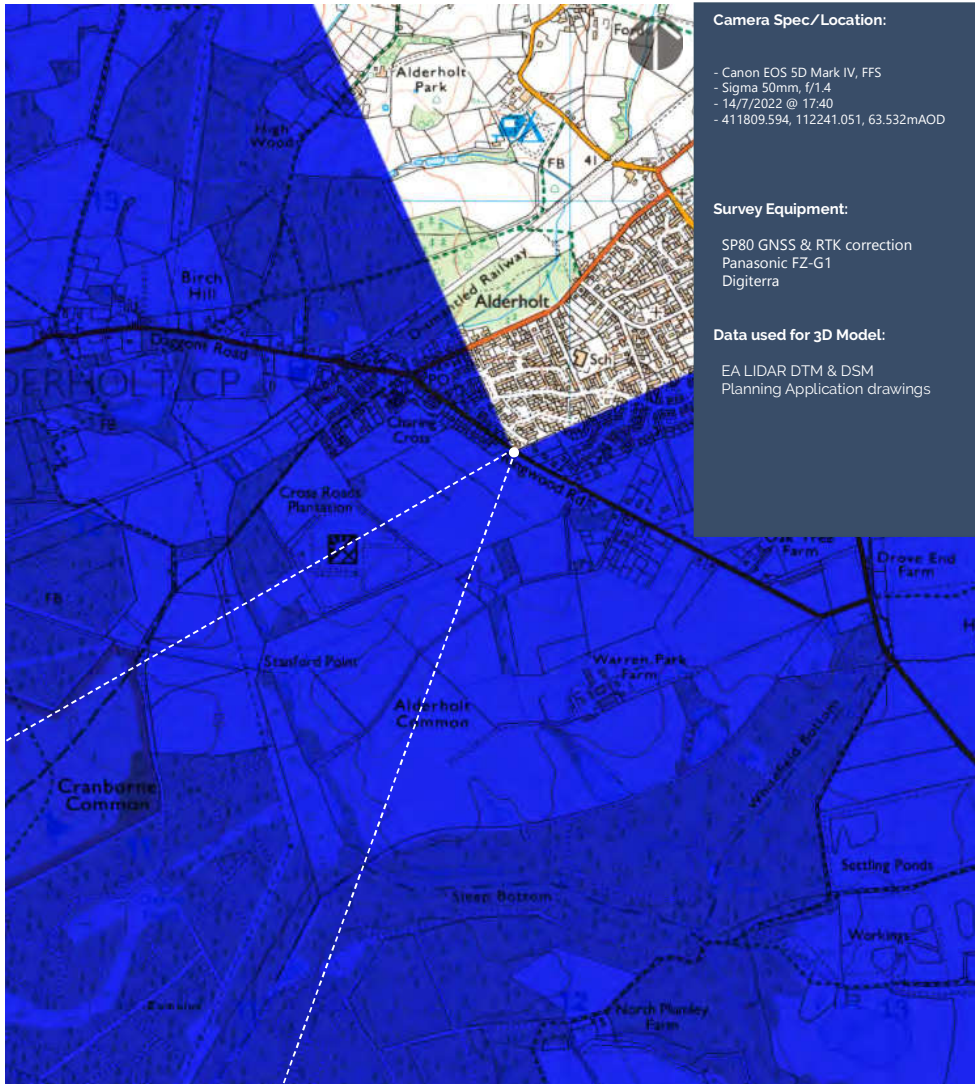
Point of Perspective

Point of Perspective

Point of Perspective

Viewpoint 7 Winter Single Frame 50mm image

## Camera Location:



### Camera Spec/Location:

- Canon EOS 5D Mark IV, FFS
- Sigma 50mm, f/1.4
- 14/7/2022 @ 17:40
- 411809.594, 112241.051, 63.532mAOD

### Survey Equipment:

- SP80 GNSS & RTK correction
- Panasonic FZ-G1
- Digiterra

### Data used for 3D Model:

- EA LIDAR DTM & DSM
- Planning Application drawings

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## Tripod:



50mm Lens Planar Projection (actual 49.6mm; 39.9 deg HFOV)

Point of Perspective



Point of Perspective

Point of Perspective

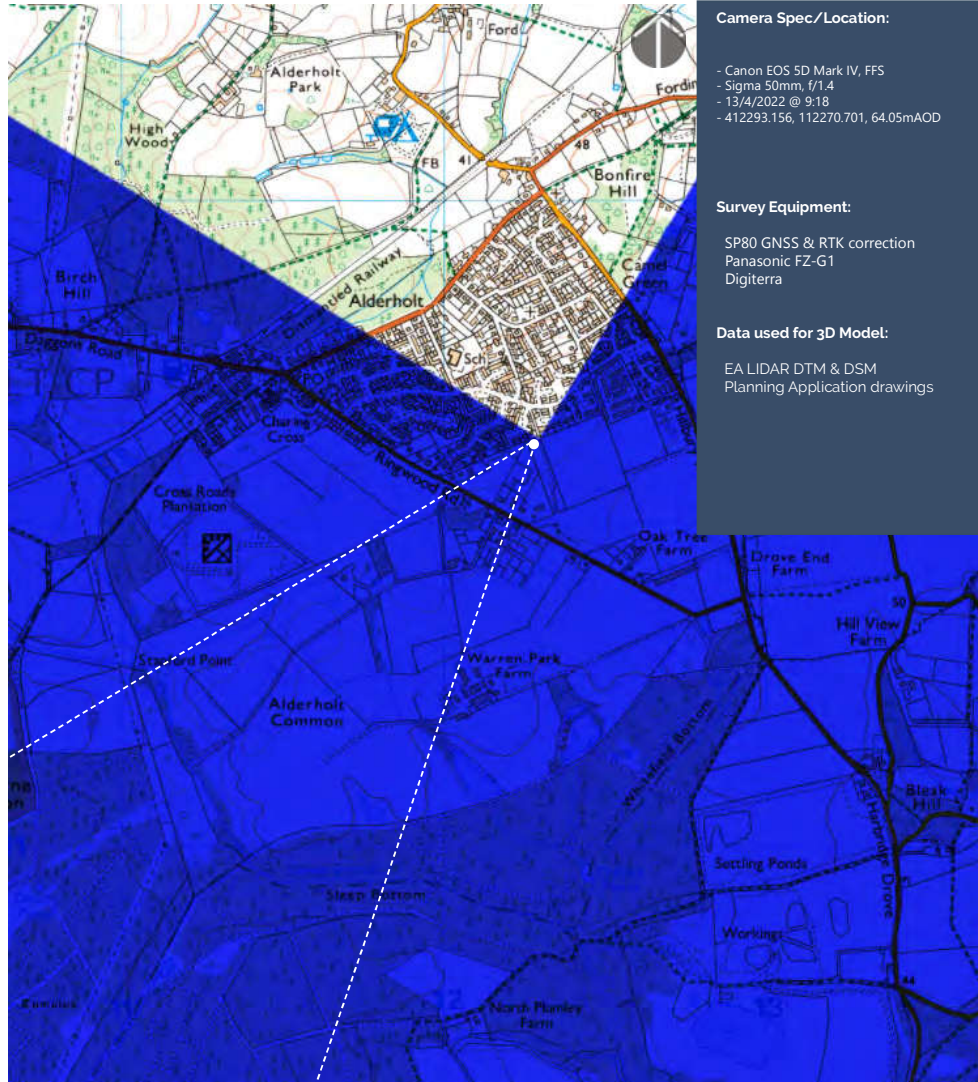
Viewpoint 7 Summer Single Frame 50mm image

Point of Perspective

# Viewpoint 8 Winter Photography



## Camera Location:



### Camera Spec/Location:

- Canon EOS 5D Mark IV, FFS
- Sigma 50mm, f/1.4
- 13/4/2022 @ 9:18
- 412293.156, 112270.701, 64.05mAOD

### Survey Equipment:

- SP80 GNSS & RTK correction
- Panasonic FZ-G1
- Digiterra

### Data used for 3D Model:

- EA LIDAR DTM & DSM
- Planning Application drawings

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## Tripod:



50mm Lens Planar Projection (actual 49.6mm; 39.9 deg HFOV)

Point of Perspective



Point of Perspective

Point of Perspective

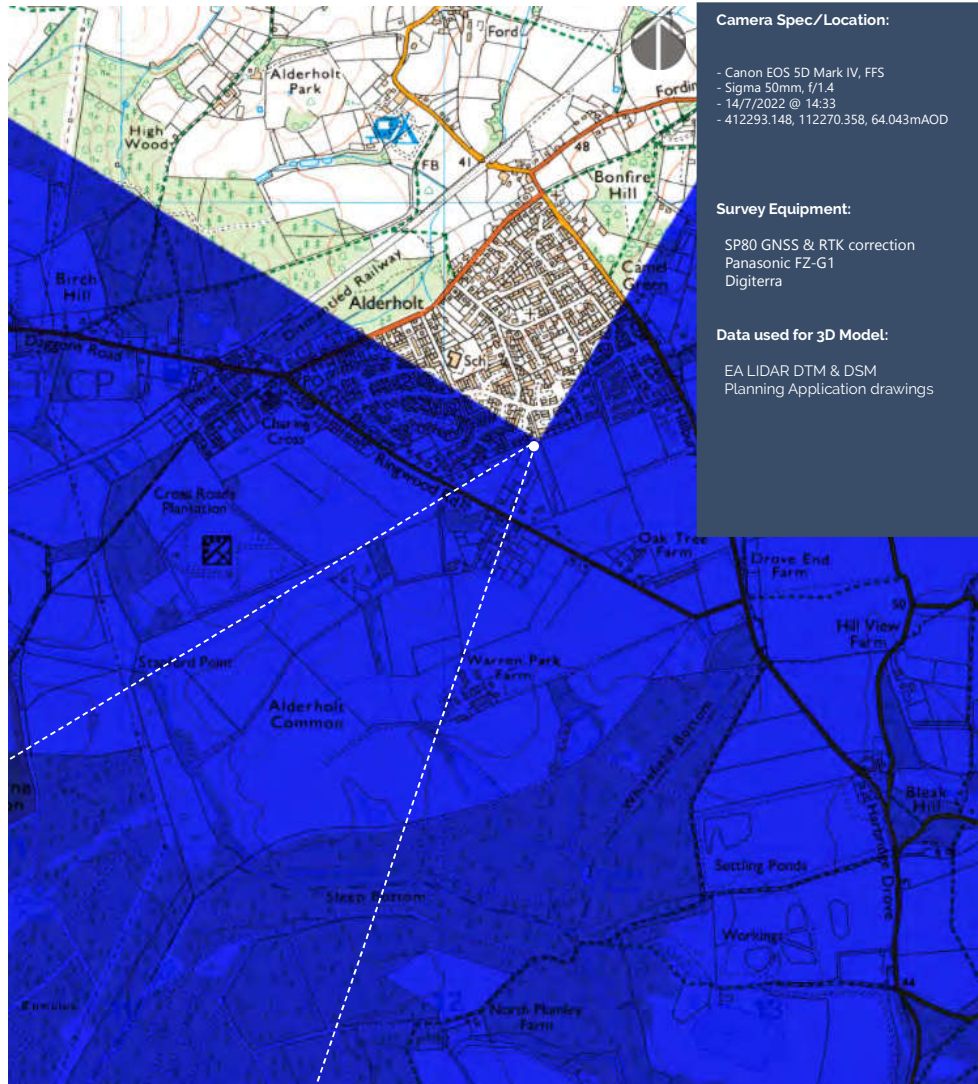
Point of Perspective

Viewpoint 8 Winter Single Frame 50mm image

# Viewpoint 8 Summer Photography



## Camera Location:



### Camera Spec/Location:

- Canon EOS 5D Mark IV, FFS
- Sigma 50mm, f/1.4
- 14/7/2022 @ 14:33
- 412293.148, 112270.358, 64.043mAOD

### Survey Equipment:

- SP80 GNSS & RTK correction
- Panasonic FZ-G1
- Digiterra

### Data used for 3D Model:

- EA LIDAR DTM & DSM
- Planning Application drawings

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## Tripod:



50mm Lens Planar Projection (actual 49.6mm; 39.9 deg HFOV)

Point of Perspective



Point of Perspective

Point of Perspective

Viewpoint 8 Summer Single Frame 50mm image

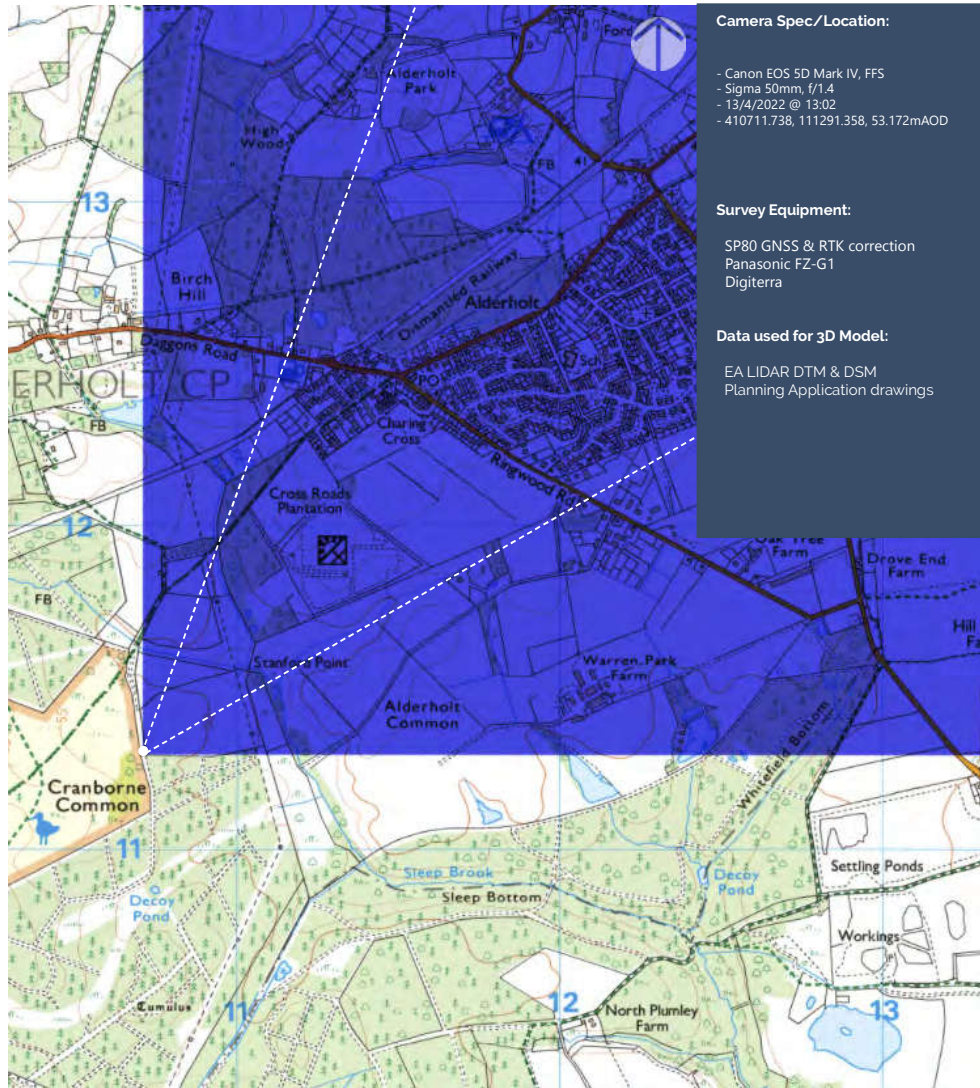
Point of Perspective



# Viewpoint 9 Winter Photography



## Camera Location:



### Camera Spec/Location:

- Canon EOS 5D Mark IV, FFS
- Sigma 50mm, f/1.4
- 13/4/2022 @ 13:02
- 410711.738, 111291.358, 53.172m AOD

### Survey Equipment:

- SP80 GNSS & RTK correction
- Panasonic FZ-G1
- Digiterra

### Data used for 3D Model:

- EA LIDAR DTM & DSM
- Planning Application drawings

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## Tripod:



50mm Lens Planar Projection (actual 49.6mm; 39.9 deg HFOV)

Point of Perspective



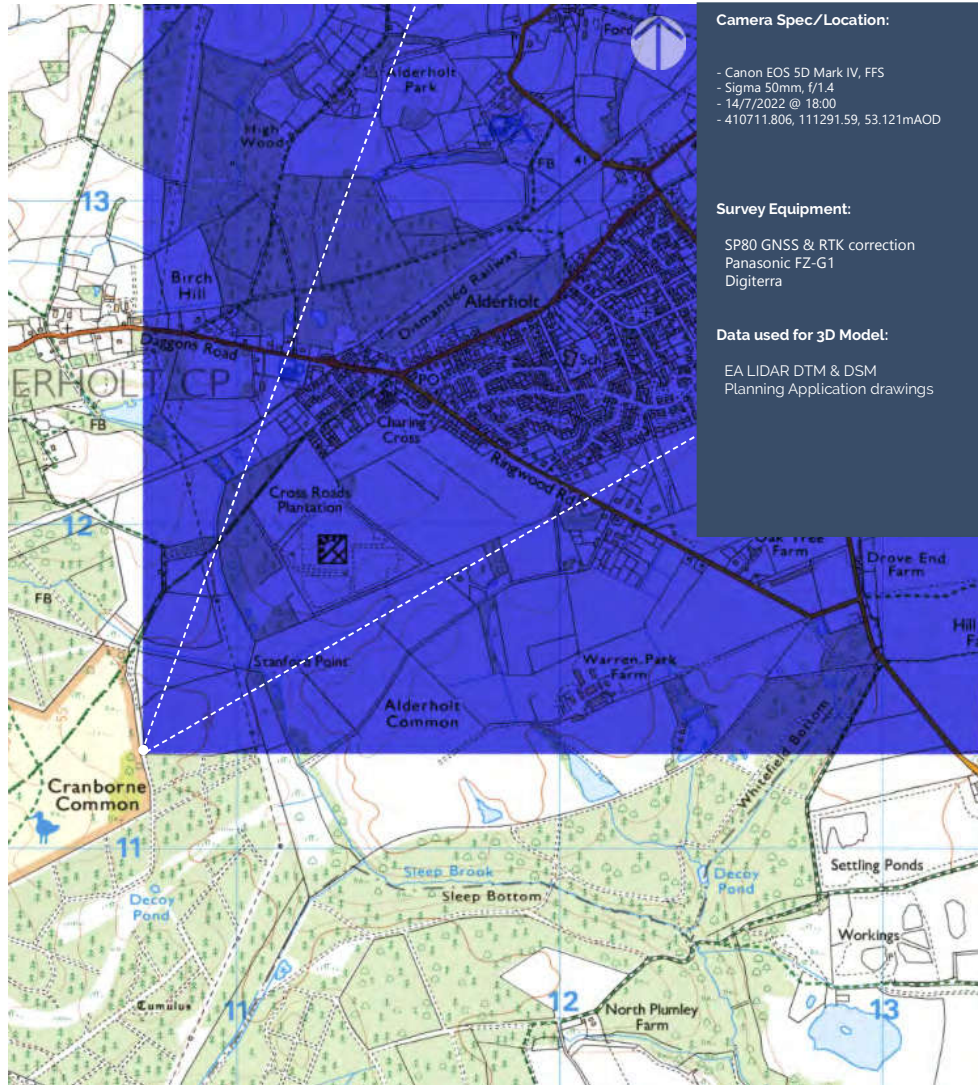
Point of Perspective

Point of Perspective

Point of Perspective

Viewpoint 9 Winter Single Frame 50mm image

## Camera Location:



### Camera Spec/Location:

- Canon EOS 5D Mark IV, FFS
- Sigma 50mm, f/1.4
- 14/7/2022 @ 18:00
- 410711.806, 111291.59, 53.121mAO

### Survey Equipment:

- SP80 GNSS & RTK correction
- Panasonic FZ-G1
- Digiterra

### Data used for 3D Model:

- EA LIDAR DTM & DSM
- Planning Application drawings

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## Tripod:



50mm Lens Planar Projection (actual 49.6mm; 39.9 deg HFOV)

Point of Perspective



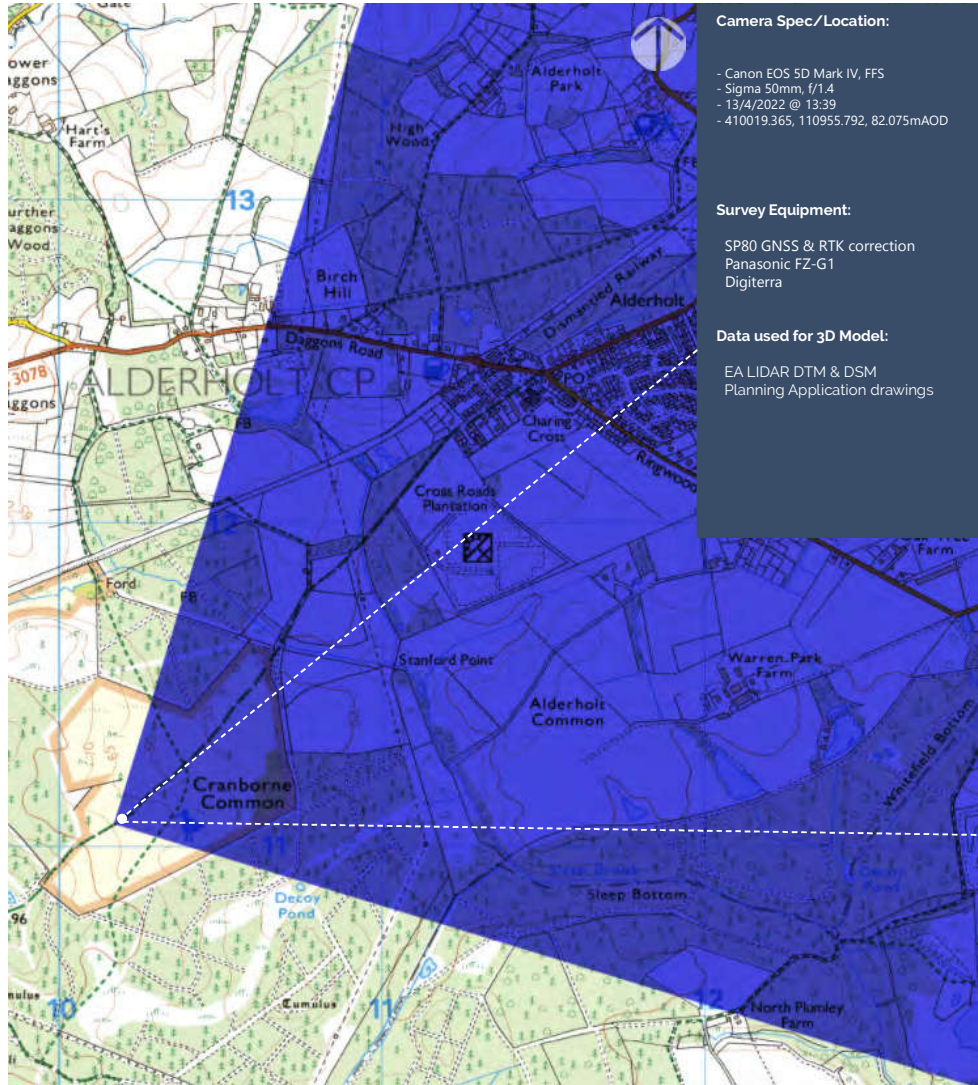
Point of Perspective

Point of Perspective

Point of Perspective

Viewpoint 9 Summer Single Frame 50mm image

## Camera Location:



### Camera Spec/Location:

- Canon EOS 5D Mark IV, FFS
- Sigma 50mm, f/1.4
- 13/4/2022 @ 13:39
- 410019.365, 110955.792, 82.075m AOD

### Survey Equipment:

- SP80 GNSS & RTK correction
- Panasonic FZ-G1
- Digiterra

### Data used for 3D Model:

- EA LIDAR DTM & DSM
- Planning Application drawings

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## Tripod:



50mm Lens Planar Projection (actual 49.6mm; 39.9 deg HFOV)

Point of Perspective



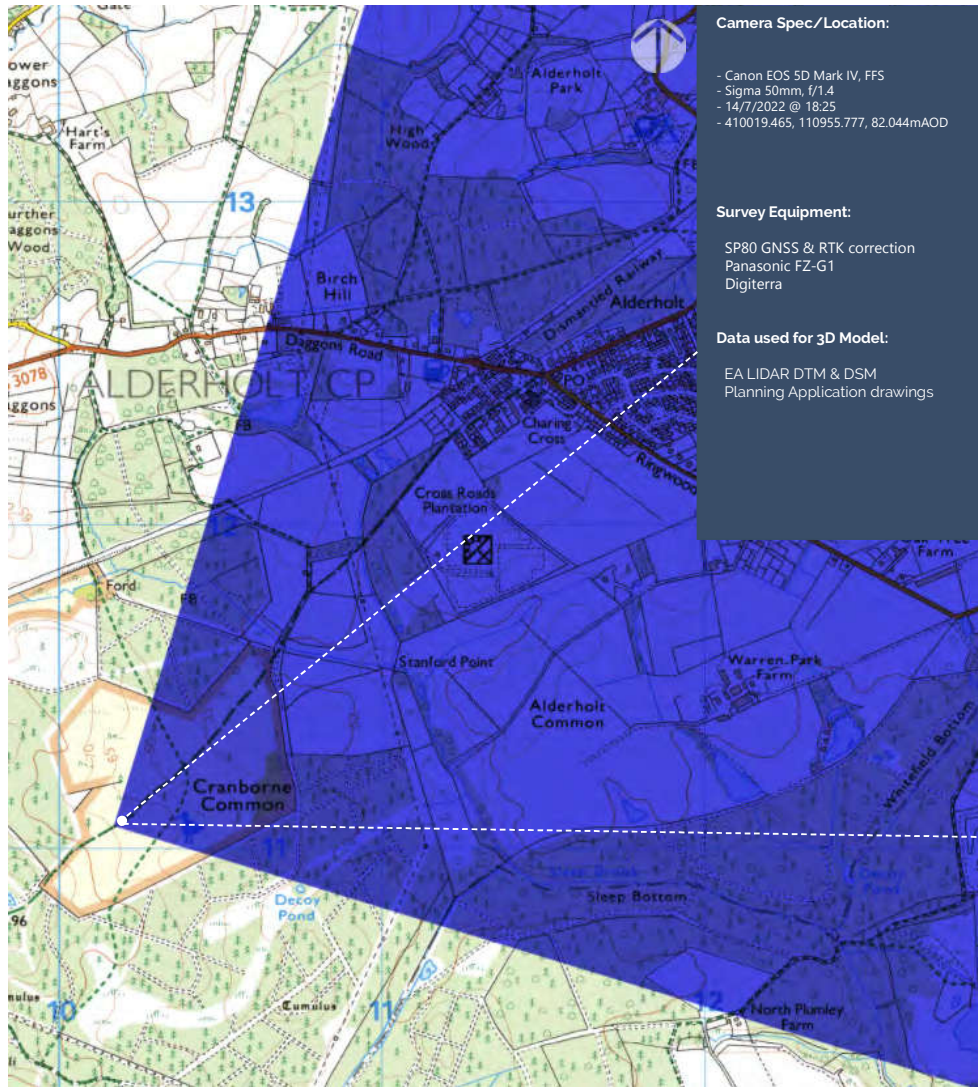
Point of Perspective

Point of Perspective

Point of Perspective

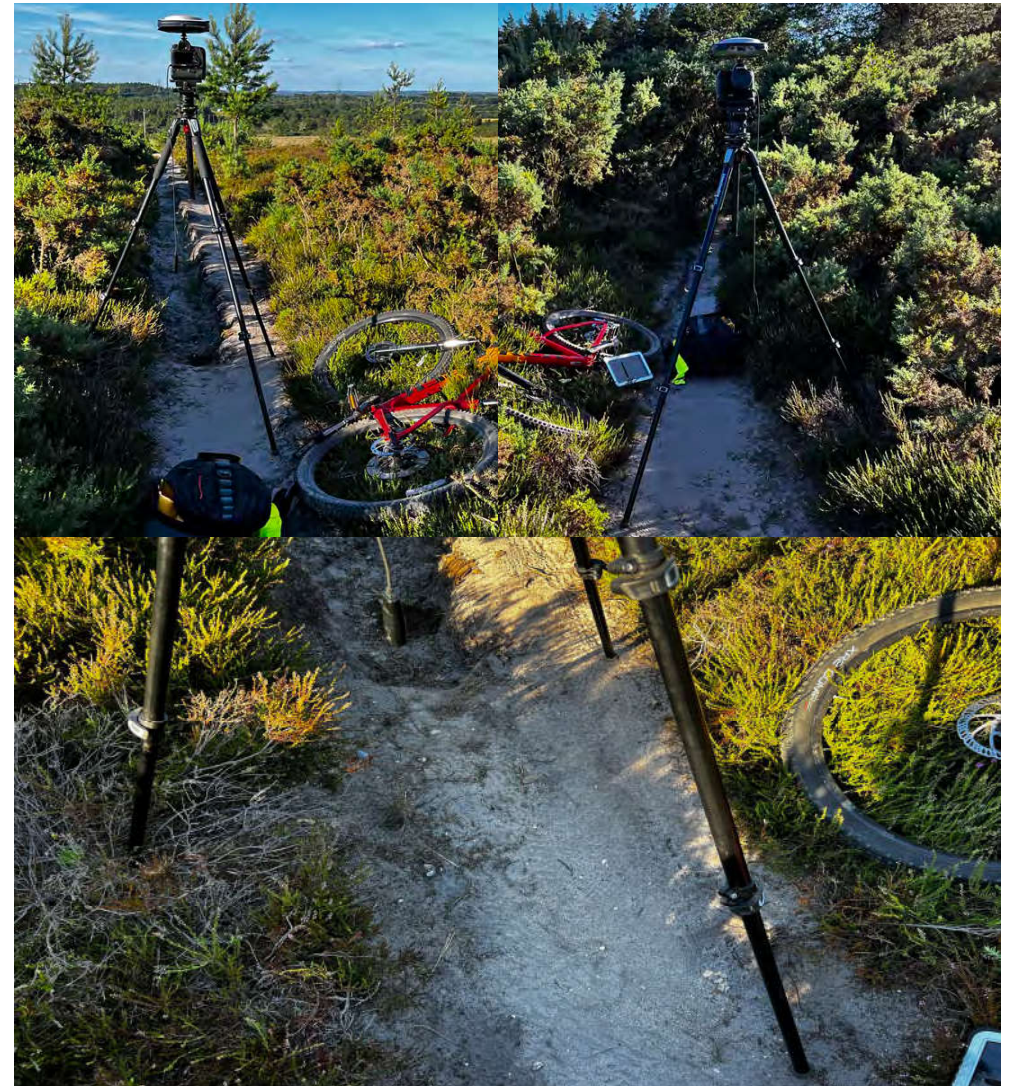
Viewpoint 10 Winter Single Frame 50mm image

## Camera Location:



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## Tripod:



50mm Lens Planar Projection (actual 49.6mm; 39.9 deg HFOV)

Point of Perspective



Point of Perspective

Point of Perspective

Point of Perspective

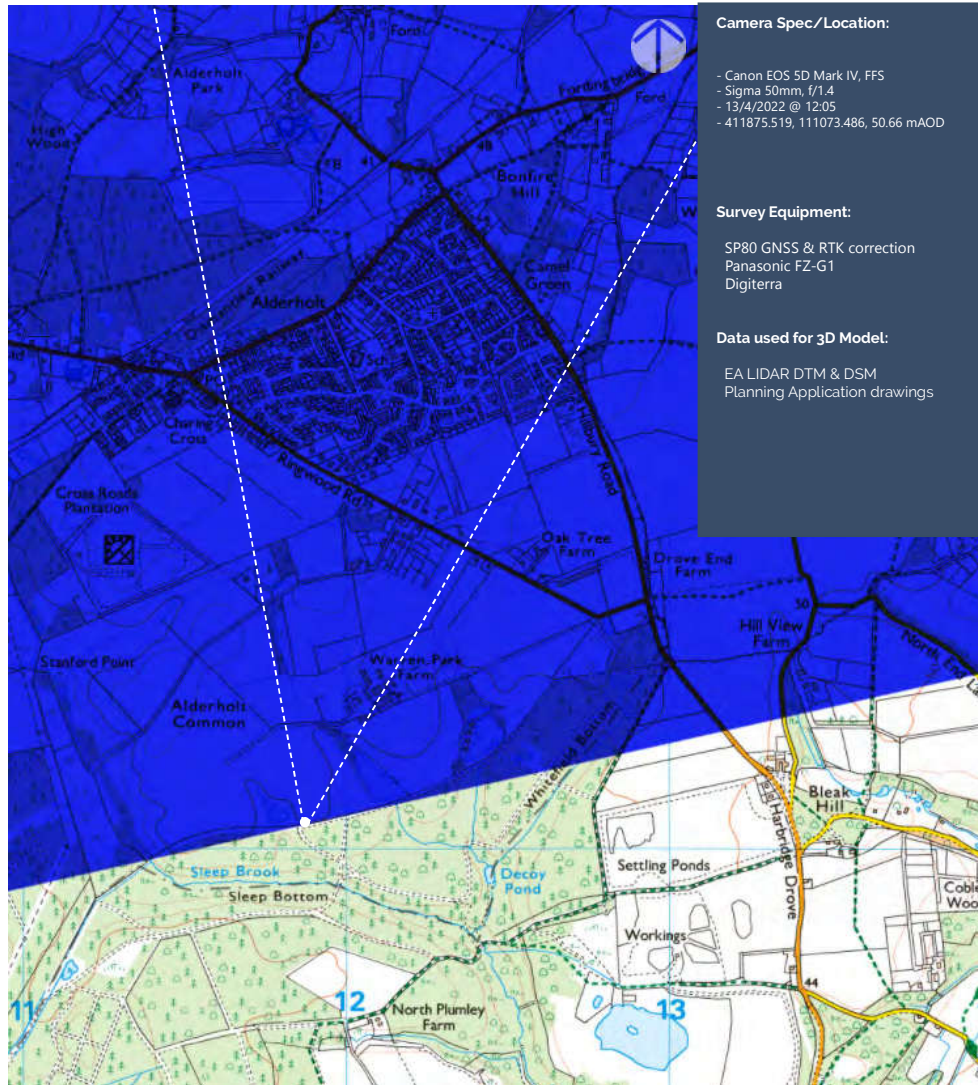
Viewpoint 10 Summer Single Frame 50mm image



# Viewpoint 11 Winter Photography



## Camera Location:



### Camera Spec/Location:

- Canon EOS 5D Mark IV, FFS
- Sigma 50mm, f/1.4
- 13/4/2022 @ 12:05
- 411875.519, 111073.486, 50.66 mAOD

### Survey Equipment:

- SP80 GNSS & RTK correction
- Panasonic FZ-G1
- Digiterra

### Data used for 3D Model:

- EA LIDAR DTM & DSM
- Planning Application drawings

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## Tripod:



50mm Lens Planar Projection (actual 49.6mm; 39.9 deg HFOV)

Point of Perspective



Point of Perspective

Point of Perspective

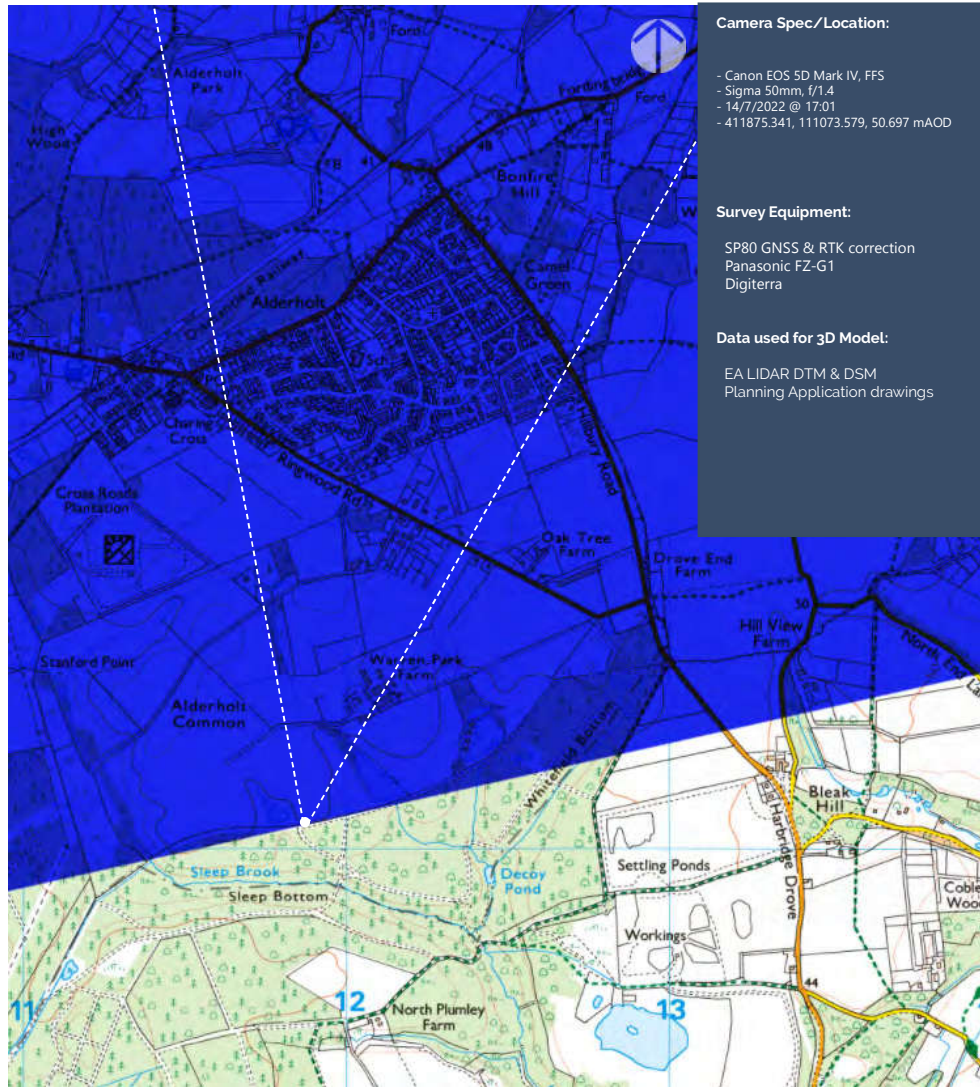
Point of Perspective

Viewpoint 11 Winter Single Frame 50mm image

# Viewpoint 11 Summer Photography



## Camera Location:



### Camera Spec/Location:

- Canon EOS 5D Mark IV, FFS
- Sigma 50mm, f/1.4
- 14/7/2022 @ 17:01
- 411875.341, 111073.579, 50.697 mAOD

### Survey Equipment:

- SP80 GNSS & RTK correction
- Panasonic FZ-G1
- Digiterra

### Data used for 3D Model:

- EA LIDAR DTM & DSM
- Planning Application drawings

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## Tripod:



50mm Lens Planar Projection (actual 49.6mm; 39.9 deg HFOV)

Point of Perspective



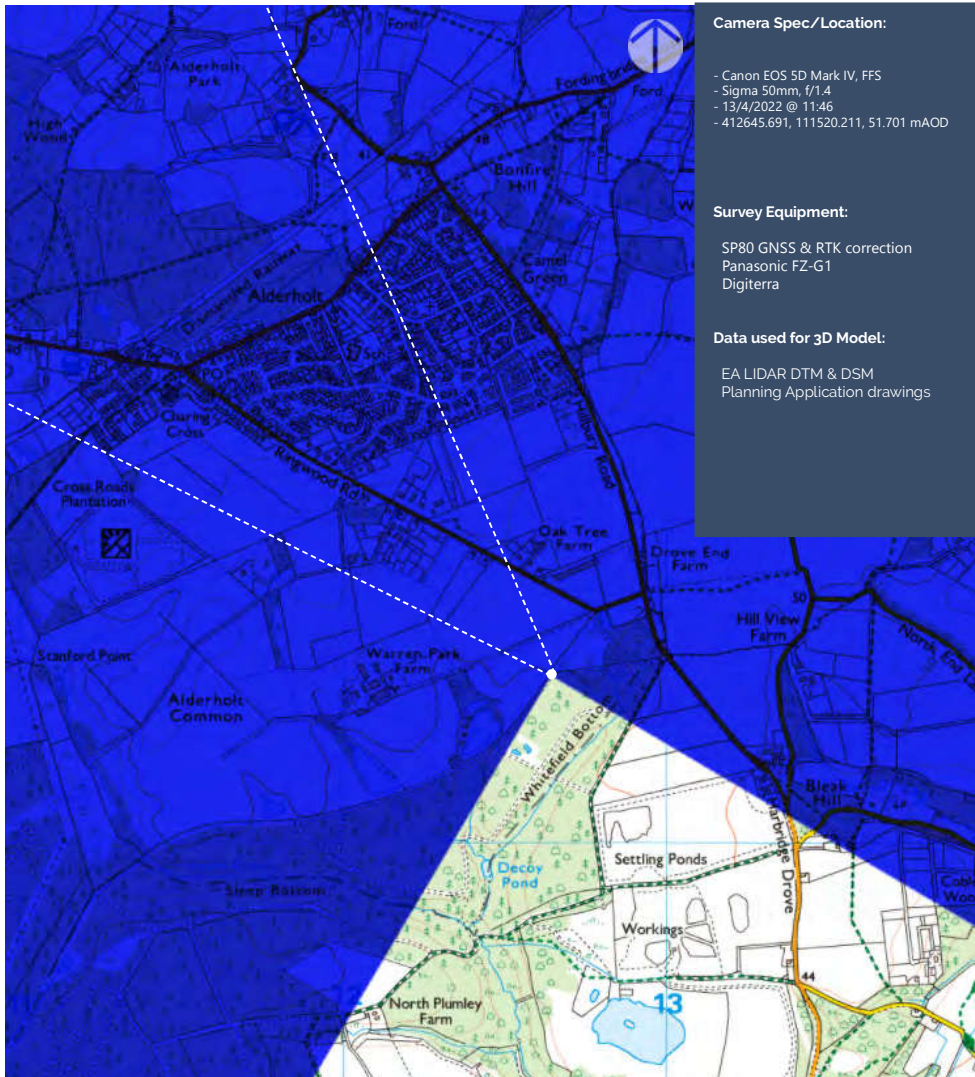
Point of Perspective

Point of Perspective

Point of Perspective

Viewpoint 11 Summer Single Frame 50mm image

### Camera Location:



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### Tripod:



50mm Lens Planar Projection (actual 49.6mm; 39.9 deg HFOV)

Point of Perspective

Point of Perspective

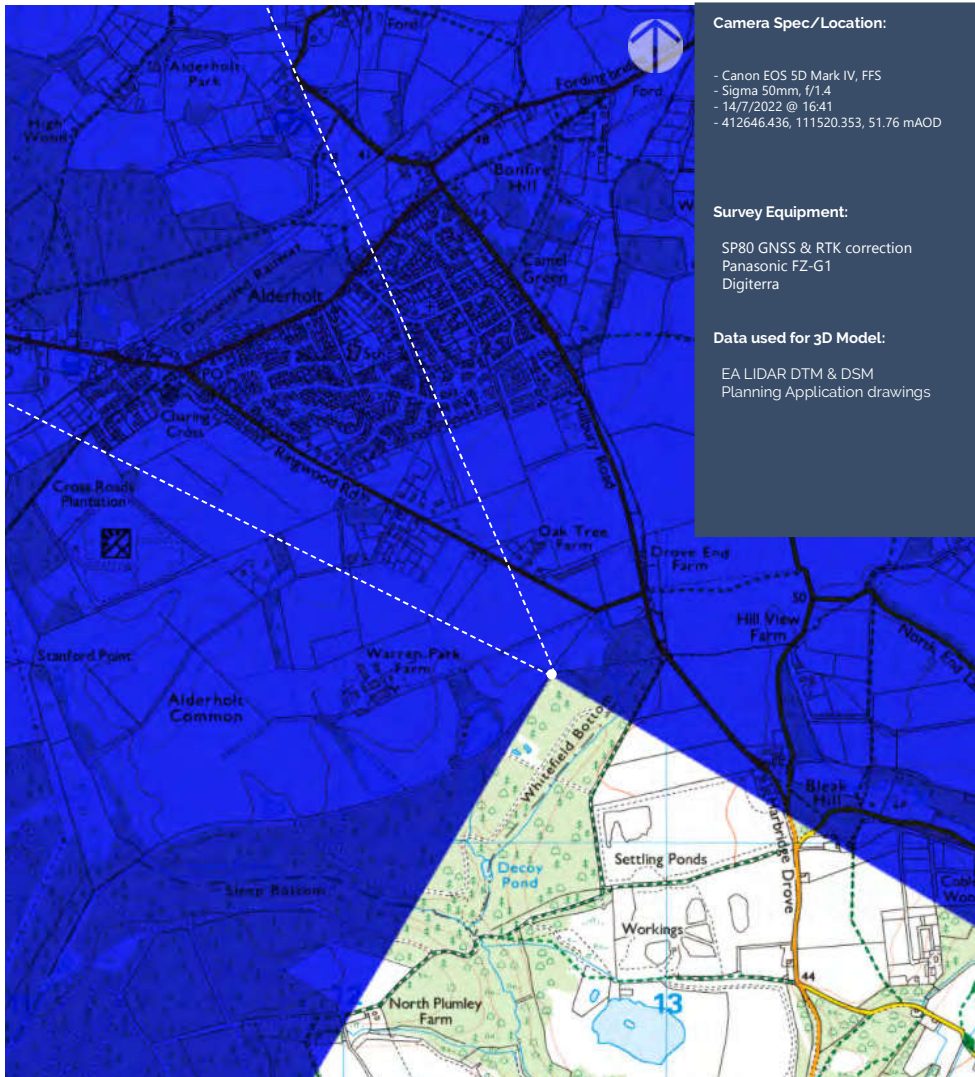


Point of Perspective

Point of Perspective

Viewpoint 12 Winter Single Frame 50mm image

### Camera Location:



#### Camera Spec/Location:

- Canon EOS 5D Mark IV, FFS
- Sigma 50mm, f/1.4
- 14/7/2022 @ 16:41
- 412646.436, 111520.353, 51.76 mAOD

#### 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 49.6mm; 39.9 deg HFOV)

Point of Perspective



Point of Perspective

Point of Perspective

Viewpoint 12 Summer Single Frame 50mm image

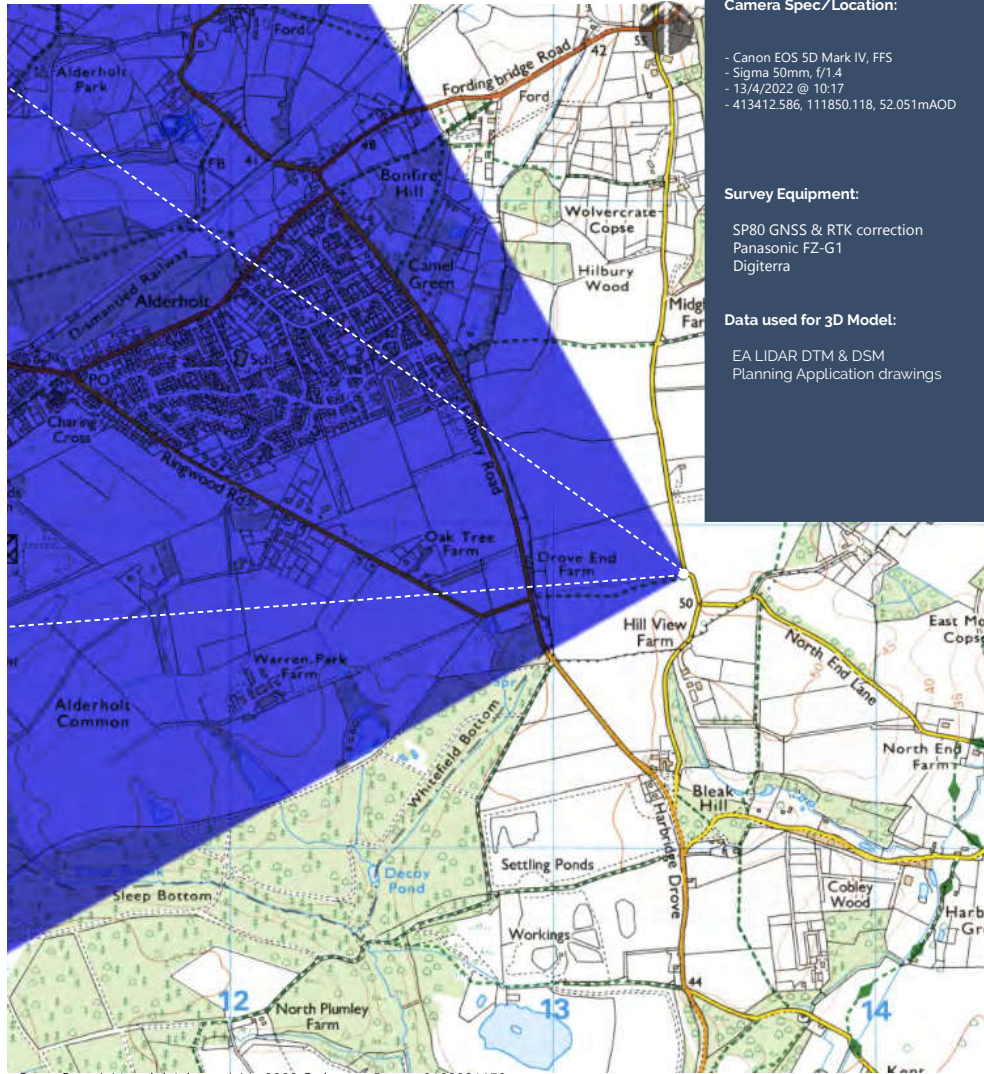
Point of Perspective



# Viewpoint 13 Winter Photography



## Camera Location:



**Camera Spec/Location:**

- Canon EOS 5D Mark IV, FFS
- Sigma 50mm, f/1.4
- 13/4/2022 @ 10:17
- 413412.586, 111850.118, 52.051m AOD

**Survey Equipment:**

- SP80 GNSS & RTK correction
- Panasonic FZ-G1
- Digiterra

**Data used for 3D Model:**

- EA LIDAR DTM & DSM
- Planning Application drawings

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## Tripod:



50mm Lens Planar Projection (actual 49.6mm; 39.9 deg HFOV)

Point of Perspective



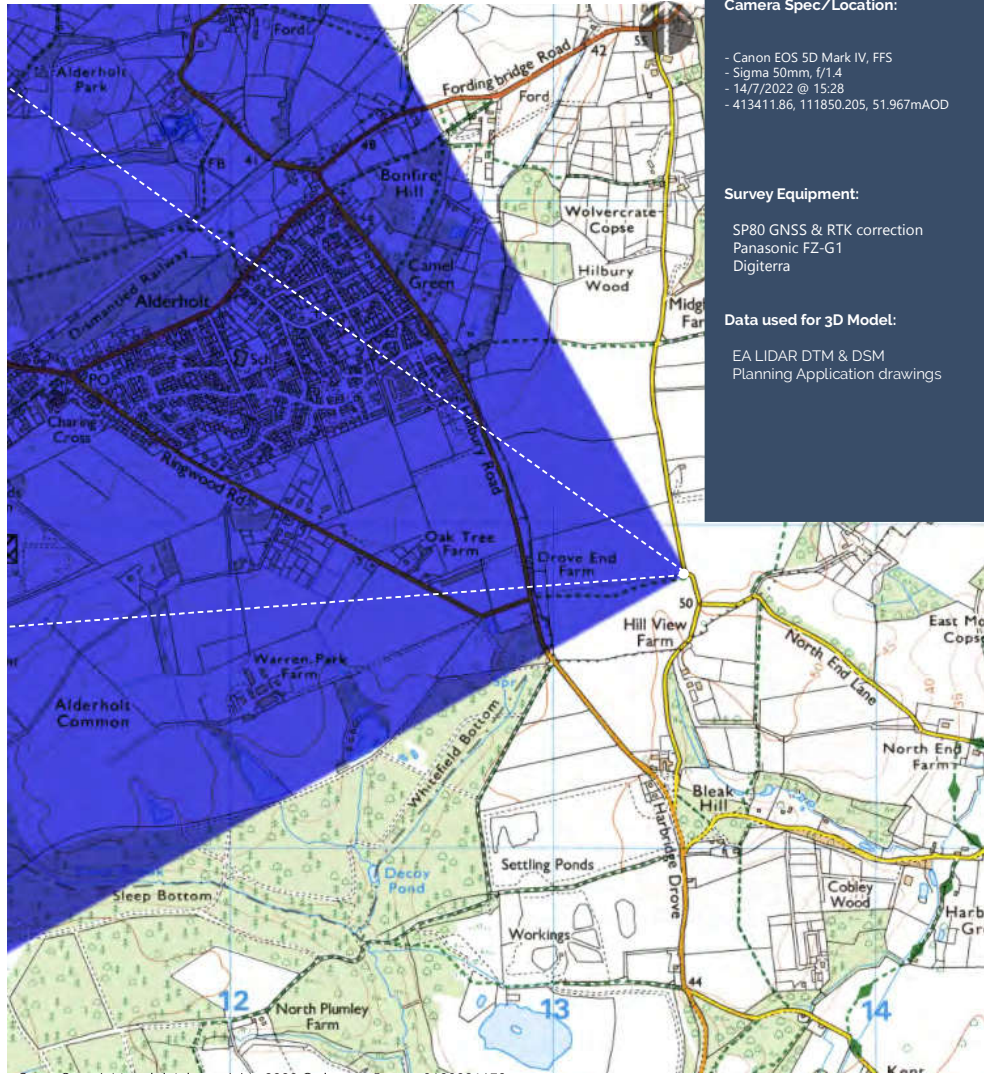
Point of Perspective

Point of Perspective

Point of Perspective

Viewpoint 13 Winter Single Frame 50mm image

## Camera Location:



## Tripod:



50mm Lens Planar Projection (actual 49.6mm; 39.9 deg HFOV)

Point of Perspective



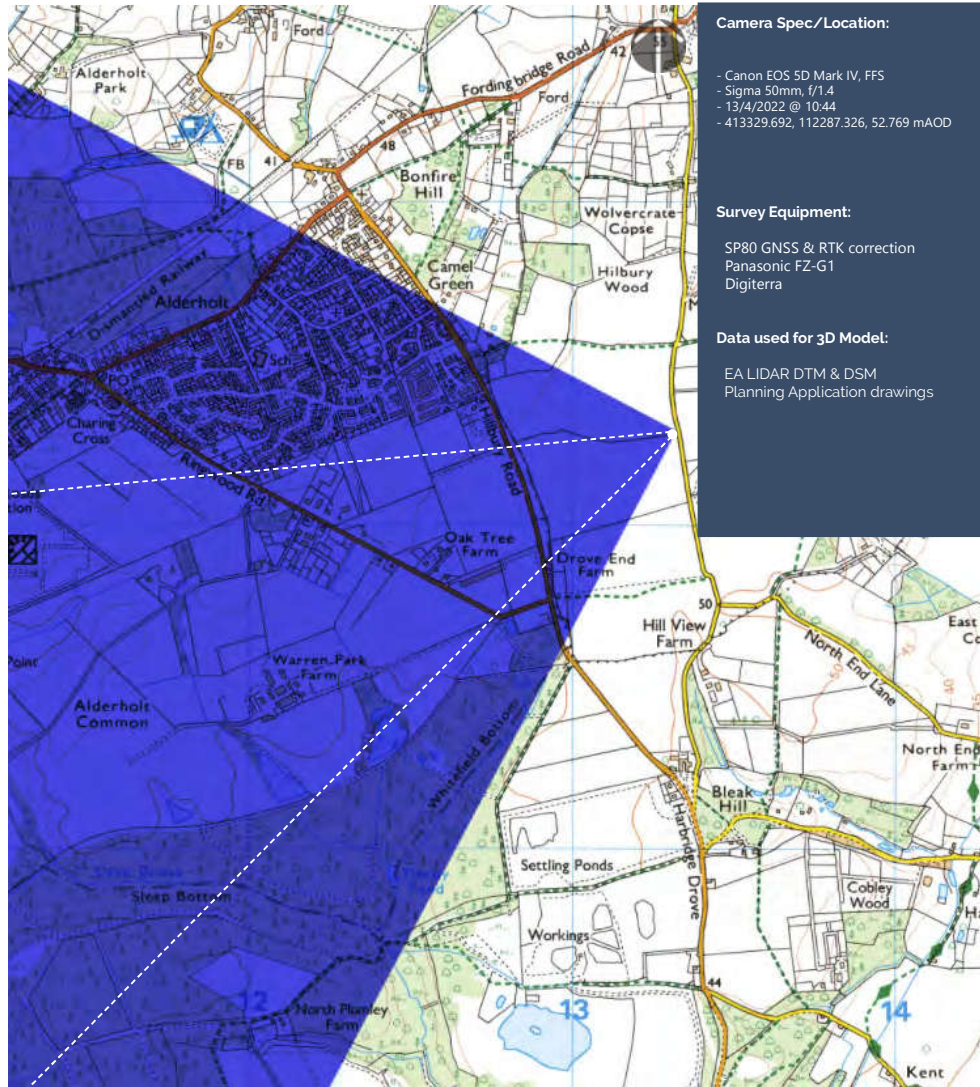
Point of Perspective

Point of Perspective

Point of Perspective

Viewpoint 13 Summer Single Frame 50mm image

## Camera Location:



### Camera Spec/Location:

- Canon EOS 5D Mark IV, FFS
- Sigma 50mm, f/1.4
- 13/4/2022 @ 10:44
- 413329.692, 112287.326, 52.769 mAOD

### Survey Equipment:

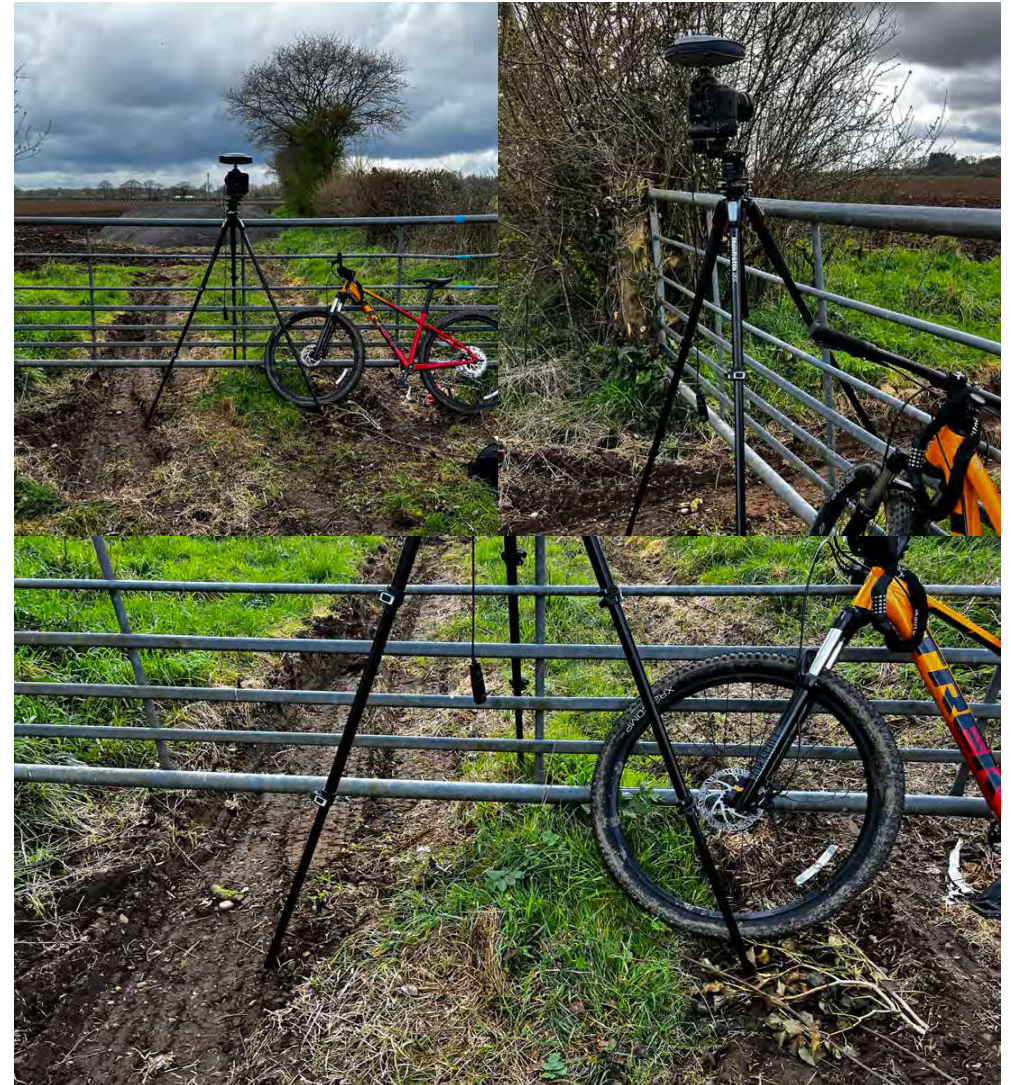
- SP80 GNSS & RTK correction
- Panasonic FZ-G1
- Digiterra

### Data used for 3D Model:

- EA LIDAR DTM & DSM
- Planning Application drawings

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## Tripod:



50mm Lens Planar Projection (actual 49.6mm; 39.9 deg HFOV)

Point of Perspective



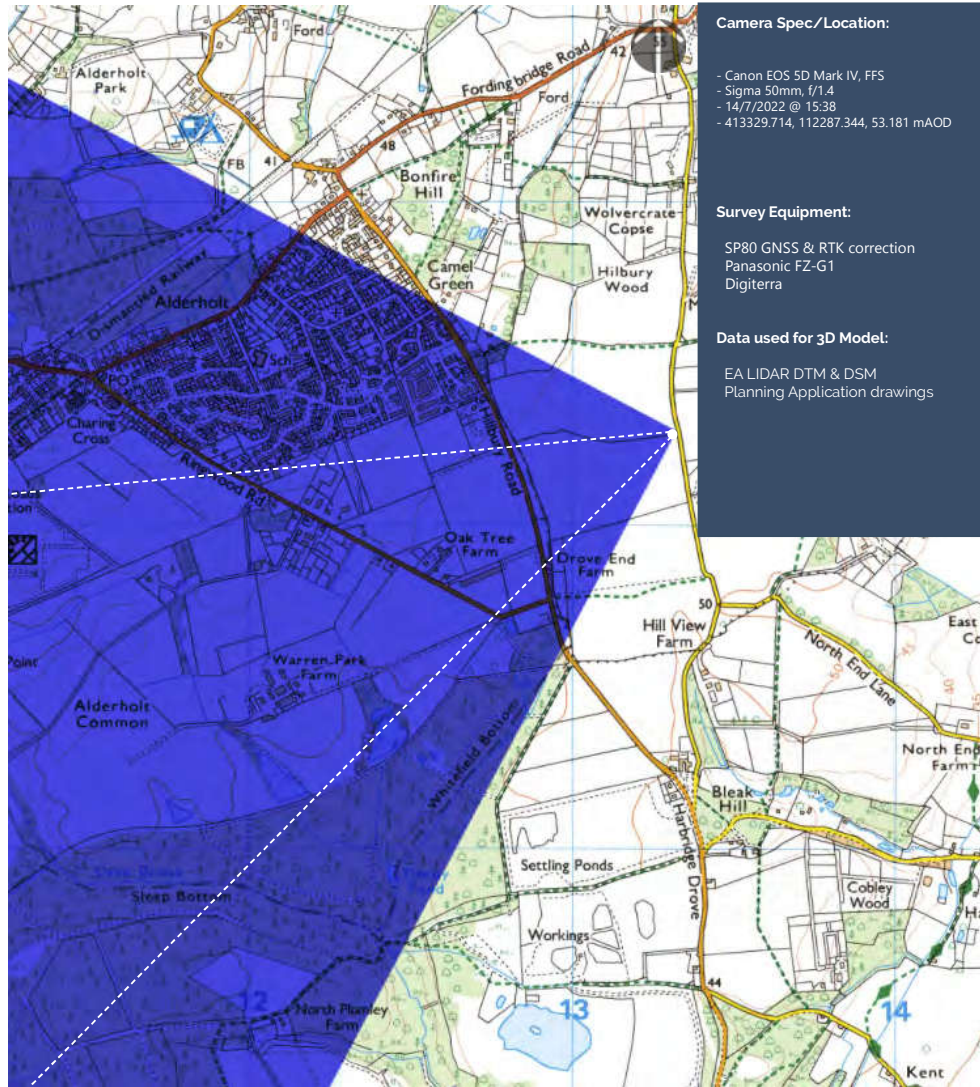
Point of Perspective

Point of Perspective

Viewpoint 14 Winter Single Frame 50mm image

Point of Perspective

## Camera Location:



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## Tripod:



50mm Lens Planar Projection (actual 49.6mm; 39.9 deg HFOV)

Point of Perspective



Point of Perspective

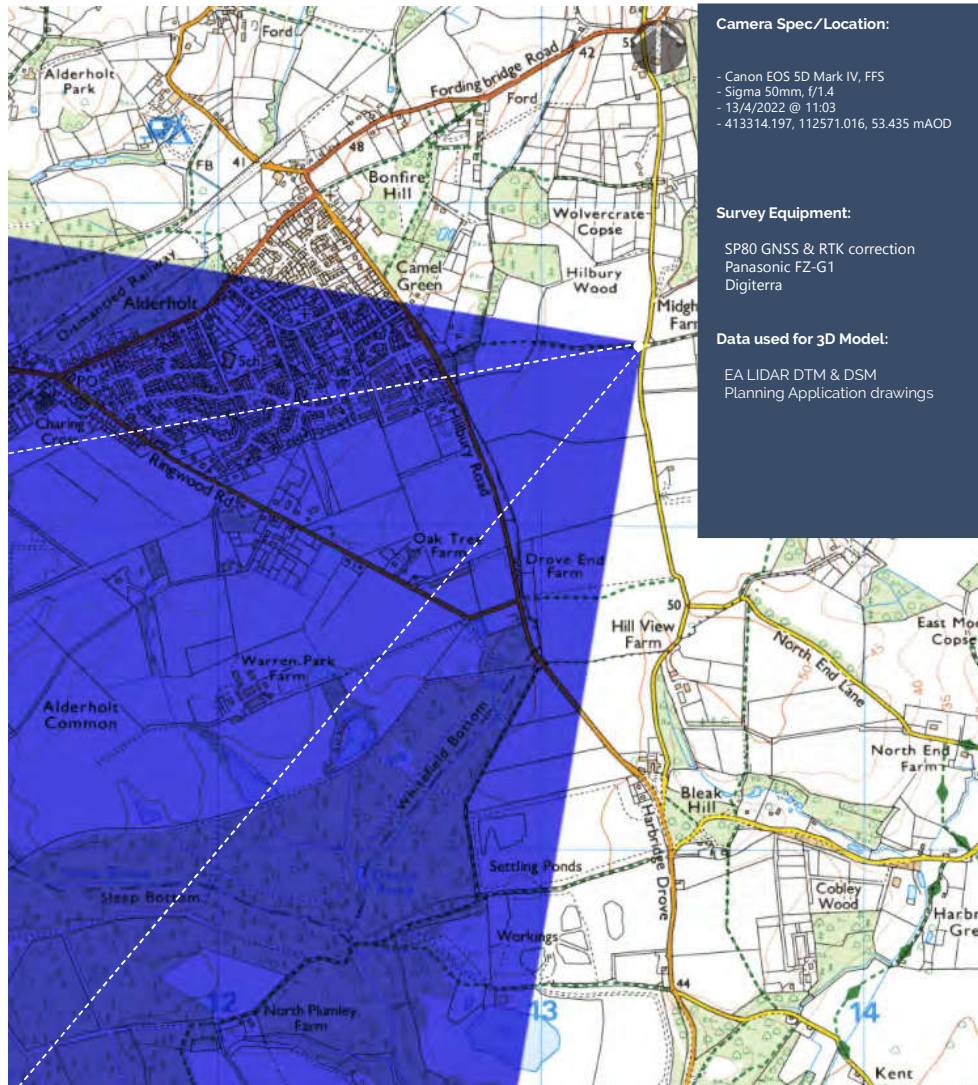
Point of Perspective

Viewpoint 14 Summer Single Frame 50mm image

Point of Perspective



## Camera Location:



### Camera Spec/Location:

- Canon EOS 5D Mark IV, FFS
- Sigma 50mm, f/1.4
- 13/4/2022 @ 11:03
- 413314.197, 112571.016, 53.435 mAOD

### Survey Equipment:

- SP80 GNSS & RTK correction
- Panasonic FZ-G1
- Digiterra

### Data used for 3D Model:

- EA LIDAR DTM & DSM
- Planning Application drawings

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## Tripod:



50mm Lens Planar Projection (actual 49.6mm; 39.9 deg HFOV)

Point of Perspective



Point of Perspective

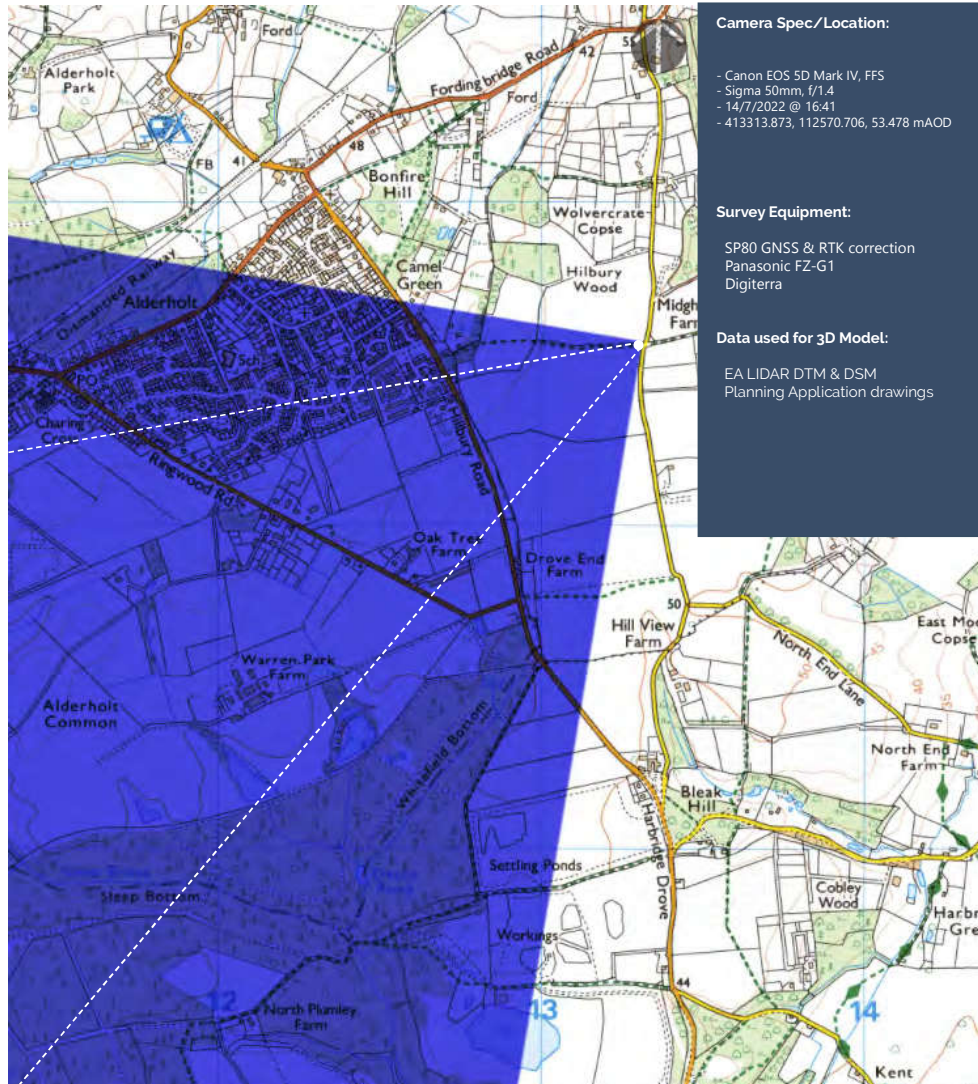
Point of Perspective

Viewpoint 15 Winter Single Frame 50mm image

Point of Perspective



## Camera Location:



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## Tripod:



50mm Lens Planar Projection (actual 49.6mm; 39.9 deg HFOV)

Point of Perspective



Point of Perspective

Point of Perspective

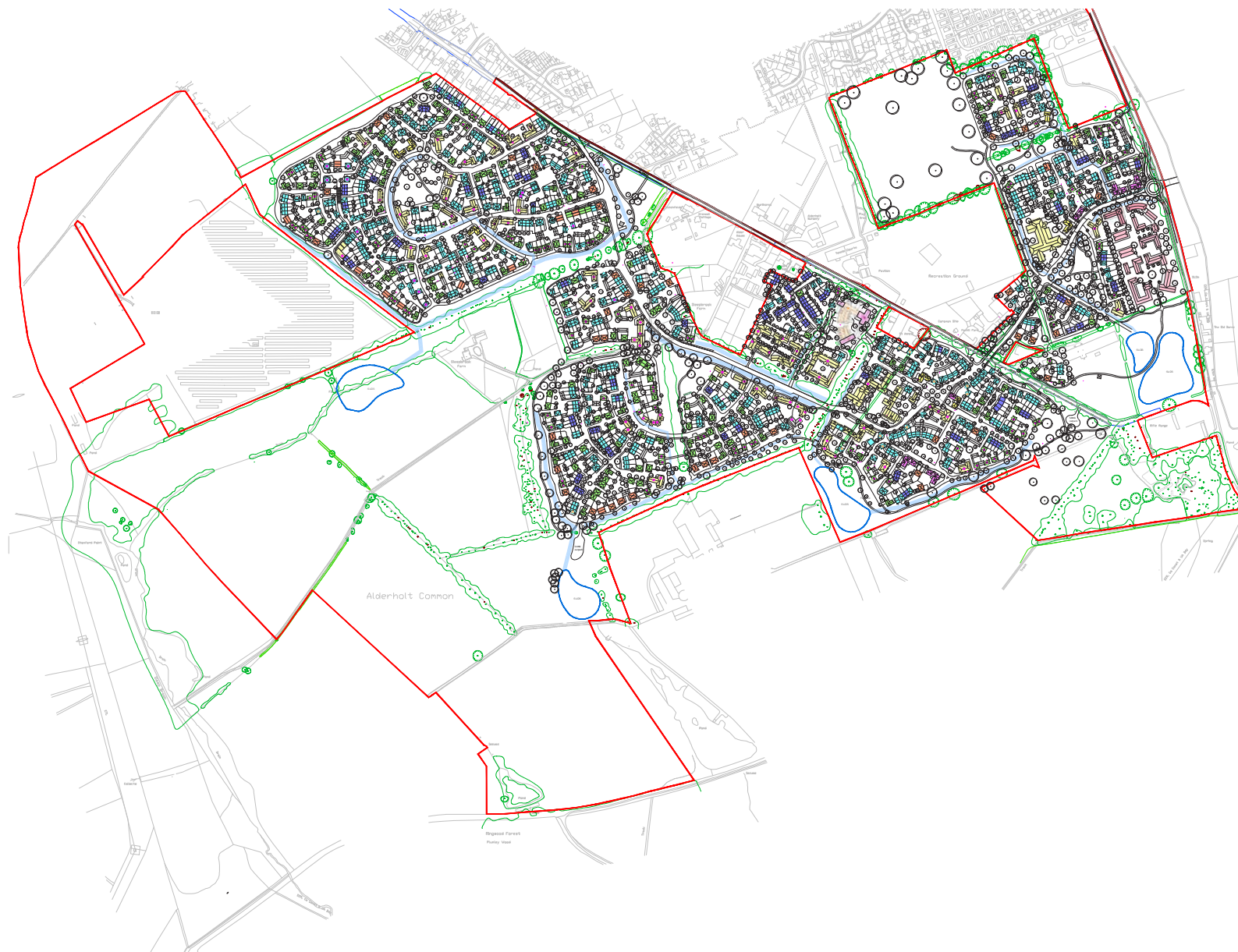
Viewpoint 15 Summer Single Frame 50mm image

Point of Perspective

# APPENDIX 1.2: LAYOUT INFORMATION USED FOR 3D MODEL CONSTRUCTION



A0



**NOTES**

The drawings are intended to show the general arrangement and not to be used for construction purposes. The drawings are not to be used for any other purpose without the written consent of the author.

1. All dimensions are in millimetres unless otherwise stated.

2. All dimensions are to the centre of the line unless otherwise stated.

3. All dimensions are to the face of the wall unless otherwise stated.

4. All dimensions are to the face of the slab unless otherwise stated.

5. All dimensions are to the face of the concrete unless otherwise stated.

6. All dimensions are to the face of the brickwork unless otherwise stated.

7. All dimensions are to the face of the masonry unless otherwise stated.

8. All dimensions are to the face of the stone unless otherwise stated.

9. All dimensions are to the face of the timber unless otherwise stated.

10. All dimensions are to the face of the metal unless otherwise stated.

11. All dimensions are to the face of the glass unless otherwise stated.

12. All dimensions are to the face of the plastic unless otherwise stated.

13. All dimensions are to the face of the paper unless otherwise stated.

14. All dimensions are to the face of the ink unless otherwise stated.

15. All dimensions are to the face of the drawing unless otherwise stated.

NO.	DESCRIPTION	DATE	REVISION
01	ISSUED FOR TENDERS	15/04/2022	1
02	REVISIONS	15/04/2022	2
03	REVISIONS	15/04/2022	3
04	REVISIONS	15/04/2022	4
05	REVISIONS	15/04/2022	5
06	REVISIONS	15/04/2022	6
07	REVISIONS	15/04/2022	7
08	REVISIONS	15/04/2022	8
09	REVISIONS	15/04/2022	9
10	REVISIONS	15/04/2022	10

- 25mm
- 50mm
- 100mm
- 200mm
- 400mm
- 800mm
- 1600mm
- 3200mm
- 6400mm
- 12800mm
- 25600mm
- 51200mm
- 102400mm
- 204800mm
- 409600mm
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- 6553600mm
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**NOTES**

The plan is a summary of the layout information used for the 3D model construction. It is not a detailed site plan and should not be used for construction purposes. The plan is based on the layout information provided in the SANG plan and the 3D model construction. The plan is subject to change without notice.

**REV**

1.00 Initial design and layout information

1.01 Final design and layout information

1.02 Final design and layout information

1.03 Final design and layout information

1.04 Final design and layout information

REV	DESCRIPTION	DATE	BY	CHECKED
1.00	Initial design and layout information	2023/08/01	...	...
1.01	Final design and layout information	2023/08/01	...	...
1.02	Final design and layout information	2023/08/01	...	...
1.03	Final design and layout information	2023/08/01	...	...
1.04	Final design and layout information	2023/08/01	...	...

**KEY**

- Site boundary
- SANG boundary
- Existing trees / woodland
- Existing hedgerow
- Proposed tree / woodland
- Proposed hedgerow
- Open grass area
- Wildflower meadow
- Pond
- Swale
- Wetland / reedbed
- Path network
- Boardwalk
- Children's play area (formal)
- Playful landscape
- SANG car park
- SANG info point / seating
- Allotments

- LEGEND**
- Site boundary
  - SANG Boundary
  - Existing trees / woodland
  - Existing hedgerow
  - Proposed tree / woodland
  - Proposed hedgerow
  - Open grass area
  - Wildflower meadow
  - Pond
  - Swale
  - Wetland / reedbed
  - Path network
  - Boardwalk
  - Children's play area (formal)
  - Playful landscape
  - SANG car park
  - SANG info point / seating
  - Allotments

## SPECTRA<sup>®</sup> GEOSPATIAL

## SP80

### GNSS CHARACTERISTICS

- 240 GNSS channels
  - GPS L1CA, L1P(Y1), L2C, L2P(Y1), L5
  - GLONASS L1CA, L1P, L2CA, L2P, L5
  - BeiDou (Phase 1) B1C, B2
  - Galileo E1, E5a, E5b
  - QZSS L1CA, L1S (SMF), L1C, L2C, L5
  - SBAS L1CA, L5 (WAAS, EGNOS, MSAS, GAGAN, GDCPR)
  - IRNSS L5
- Support for Trimble RTX<sup>™</sup> real-time correction services
- Patented Z-Delta technology for optimal GNSS performance
- Full utilization of signals from all 6 GNSS systems (GPS, GLONASS, BeiDou, Galileo, QZSS and SBAS)
- Patented GNSS correction algorithm: fully independent GNSS signal tracking and optimal data processing, including GPS-only, GLONASS-only or kinematic-only solution (Autonomous to SBAS RTK)
- Fast Search engine for quick acquisition and re-acquisition of GNSS signals
- Patented SBAS module for using SBAS code & carrier observations and orbits in RTK processing
- Patented Strata<sup>™</sup> Controller for reduced GNSS multi-path
- Up to 20MHz real-time raw data (code & carrier and position output)
- Supported data formats: ATOM, CHR, DMW, RTCM 2.1, 2.2, 2.3, 3.1, 3.2, 3.3, and 3.2 (including MCR), DMW and scRNA (user only)
- NMEA 0183 messages output

### REAL-TIME ACCURACY (RHS)<sup>(1)</sup> (M)

#### SBAS (WAAS/EGNOS/MSAS/GAGAN)

- Horizontal: < 50 cm
- Vertical: < 85 cm

#### Real-Time GPS position

- Horizontal: 25 cm + 1 ppm
- Vertical: 50 cm + 1 ppm

#### Real-Time Kinematic Position (RTK)

- Horizontal: 8 mm + 1 ppm
- Vertical: 35 mm + 1 ppm

#### Network RTK (N)

- Horizontal: 8 mm + 0.5 ppm
- Vertical: 35 mm + 0.5 ppm

#### REAL-TIME PERFORMANCE

- Instant RTK initialization
- Typically 2 sec. for baselines < 20 km
- Up to 99.9% reliability
- RTK initialization success over 40 km

### POST-PROCESSING ACCURACY (RHS)<sup>(1)(M)</sup>

#### Static & Fast Static

- Horizontal: 3 mm + 0.5 ppm
- Vertical: 5 mm + 0.5 ppm

#### High-Precision Static<sup>(M)</sup>

- Horizontal: 3 mm + 0.1 ppm
- Vertical: 3.5 mm + 0.4 ppm

### DATA LOGGING CHARACTERISTICS

#### Recording Interval

- 1, 0.5 - 999 seconds

#### PHYSICAL CHARACTERISTICS

##### Size

- 20.2 x 8.6 x 7.5 cm (8.7 x 7.6 x 3.0 in)

##### Weight

- 1.7 kg (2.57 lb)

#### User Interface

- Graphical PHOLED display
- WEB UI (accessible via WiFi) for easy configuration, operation, status, and data transfer

#### I/O Interface

- RS232 serial link
- USB 2.0 (A/B)
- Bluetooth 2.1 + EDR
- WB (802.11 b/g/n)
- 3.50 user-level GSM (850/900/1800/1900 MHz) / geospatial UHF1S module (850/950/1600/1800 MHz)

#### Memory

- 2 GB internal memory NAND Flash (512MB user data)
- Over a year of 15 sec. raw GNSS data from 14 satellites
- 32GB eMMC internal memory card (up to 32GB)

#### Operation

- RTK rover & base
- RTK network user: VRS, FKP, NAC
- NTRIP (Direct IP)
- C2D mode
- Post processing
- RTK bridge
- UHF receiver
- UHF networking
- Trimble RTX (collateral IP)

#### Environmental Characteristics

- Operating temperature: -40° to +85°C [-40° to +185°F]
- Storage temperature: -40° to +85°C [-40° to +185°F]
- Humidity: 5% to 95% condensing
- IP67 waterproof, sealed against sand and dust
- Drop: 2m pole drop on concrete
- Shock: 6133G/0.5
- Vibration: MIL-STD-883C

#### Power Characteristics

- 2 Li-Ion hot-swappable batteries, 35.5 Wh (7.2 x 7.5 x 200 mm)
- Battery life time (w/ batteries): 10 hrs (GNSS On, and GSM or UHF Rx On)
- External DC power: 9-30 V

### Standard System Components

#### Recording Interval

- 2 Li-Ion batteries
- Dual battery charger, power supply and international power cord kit
- Tape measure (5.6 m / 12 ft)
- 7 cm pole extension
- USB to mini-USB cable
- Hard case
- 2 year warranty

#### Optional System Components

- SP80 UHF RTK (400 x 2) RTK SW (1kg)
- SP80 Fast Power Kit
- SP80 Office Power Kit

#### Data interface

- Ranger 3
- T6
- MobileMapper 50
- Normat 1500

#### Field software

- Survey Pro
- FAST Survey
- Survey Mobile (Android)
- Office control app for 3rd party devices (Android)

### 1. Accuracy and 117.7. Identifications may be affected by atmospheric conditions

- 1. Accuracy and 117.7. Identifications may be affected by atmospheric conditions
- 2. Performance values shown minimum of five satellites, following the procedure recommended in the product manual. High multi-path areas, high AOP values and periods of poor atmospheric conditions may degrade performance.
- 3. Long baselines, long occupations, precise atmospheric correction
- 4. Any very low temperatures (LMT) modes should not be used (with transmission errors)
- 5. Without LMT mode, batteries can be stored up to -70°C.
- 6. Network RTK (NTRIP) values are not based on GNSS constellation health, user IP address and proximity to observations such as satellites and obstacles.

### TRIMBLE RTX INITIALIZATION<sup>(1)(M)</sup>

	Horizontal (RHS)	Initialization	GNSS
CENTERPOINT <sup>®</sup> RTX	<4 cm	<20 mins, <5 mins	L1 + L2

### CONTACT INFORMATION:

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6358 Westmore Drive  
Westminster, CO 80022 • USA  
+1 720-587-4700 Phone  
888-477-7956 (Toll Free in USA)

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Please visit [spectrageospatial.com](http://spectrageospatial.com) for the latest product information and to boost your network capabilities. Specifications and descriptions are subject to change without notice.

[spectrageospatial.com](http://spectrageospatial.com)

THE MOST CONNECTED  
GNSS RECEIVER

## SP80 GNSS RECEIVER

The Spectra Geospatial 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 combined with the patented Z-Blade technology, the SP80 system is optimized for tracking and processing signals from all GNSS constellations in challenging environments.

As the most connected GNSS receiver in the industry, the SP80 offers a unique combination of integrated 3.5G cellular, Wi-Fi and UHF communications with SMS, email and anti-theft technology.

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



### KEY FEATURES

- Patented Z-Blade technology
- 240-channel 6G ASIC
- Hot-swappable batteries
- Internal TRx UHF radio
- 3.5G cellular modem
- Built-in WiFi communication
- SMS and e-mail alerts
- Anti-theft technology
- Backup RTK
- RTK Bridge
- eLevel technology
- Trimble RTX correction services

### UNIQUE 6G GNSS-CENTRIC TECHNOLOGY

Patented Z-Blade processing technology running on a next generation Spectra Geospatial 240-channel 6G ASIC fully utilizes all 6 GNSS systems: GPS, GLONASS, BeiDou, Galileo, QZSS and SBAS. Unlike GPS-centric technology which requires a minimum number of GPS satellites for GNSS processing, Z-Blades 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. SMS (text messages) can be used to monitor and configure the receiver. 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

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, a 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.

### TRIMBLE RTX CAPABLE

Trimble RTX correction services offer a wide range of accuracy requirements ranging from better than 4 cm accuracies, up to sub-meter accuracies, without the need of an RTK base station. Trimble RTX is available for the SP80 GNSS receiver via cellular/IP delivery. The premium service, CenterPoint® RTX is the most accurate satellite-delivered correction service available today. With the SP80 GNSS receiver and a Trimble RTX correction, achieve high-accuracy positioning nearly anywhere in the world.

### THE MOST POWERFUL TOOL FOR RELIABLE FIELD USE

The SP80's rugged housing, created by Spectra Geospatial'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. With eLevel technology, the user is able to focus in one place when leveling and measuring as well as automatically store measurements when the receiver is level. These powerful design features combine to make SP80 the most capable, most reliable GNSS receiver, backed by a comprehensive standard 2 year warranty.



Patented inside-the-rod mounted UHF antenna design



### THE SPECTRA GEOSPATIAL EXPERIENCE

With the most advanced and rugged field data collectors from Spectra Geospatial, surveyors get maximum productivity and reliability every day. Spectra Geospatial 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 Geospatial 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 Geospatial field and office software, SP80 is a very powerful and complete solution.



# APPENDIX 1.3: SURVEY EQUIPMENT



## TOUGHPAD FZ-G1

Panasonic recommends Windows.

<b>SOFTWARE</b>	<ul style="list-style-type: none"> <li>Windows 10 Pro 64-bit</li> <li>Panasonic Utilities (Including Dashboard, Recovery Partition)</li> </ul>												
<b>DURABILITY</b>	<ul style="list-style-type: none"> <li>MIL-STD-810G certified (4' drop, shock, vibration, rain, dust, sand, altitude, freeze/thaw, high/low temperature, temperature shock, humidity, explosive atmosphere)</li> <li>IP55 certified sealed all-weather design</li> <li>Optional class 1/division 2, groups ABCD certified model</li> <li>Solid state drive heater</li> <li>Magnesium alloy chassis encased with ABS and elastomer corner guards</li> <li>Optional hand strap or rotating hand strap</li> <li>Port covers</li> <li>Raised bezel for LCD impact protection</li> <li>Pre-installed replaceable screen film for LCD protection</li> </ul>												
<b>CPU</b>	<ul style="list-style-type: none"> <li>Intel® Core™ i5-4300U vPro™ Processor</li> <li>~2.4 GHz up to 3.0 GHz with Intel® Turbo Boost Technology</li> <li>Intel Smart Cache 3MB</li> </ul>												
<b>STORAGE &amp; MEMORY</b>	<ul style="list-style-type: none"> <li>8GB DDR3L SDRAM<sup>1</sup></li> <li>256GB solid state drive (SSD) with heater<sup>1</sup></li> <li>Optional 512GB<sup>1</sup></li> <li>up to 4GB additional storage with optional microSDXC card slot</li> </ul>												
<b>DISPLAY</b>	<ul style="list-style-type: none"> <li>10.1" WUXGA 1920 x 1200 with LED backlighting</li> <li>10-point capacitive multi touch + Waterproof Digitizer pen daylight-readable screen</li> <li>~2.800 mm</li> <li>IPS display with direct bonding</li> <li>Anti-reflective and anti-glare screen treatments</li> <li>Ambient light sensor, digital compass, gyro and acceleration sensors</li> <li>Automatic screen rotation</li> <li>Intel® HD Graphics 500 (Built-in CPU) video controller</li> <li> concealed mode (configurable)</li> </ul>												
<b>AUDIO</b>	<ul style="list-style-type: none"> <li>Integrated microphone</li> <li>Realtek high-definition audio</li> <li>Integrated speaker</li> <li>On-screen and button volume and mute controls</li> </ul>												
<b>KEYBOARD &amp; INPUT</b>	<ul style="list-style-type: none"> <li>10-point glove<sup>2</sup> multi touch + digitizer screen</li> <li>Supports bare-hand touch and gestures and electronic waterproof stylus pen</li> <li>Supports glove mode and wet touch mode</li> <li>7 tablet buttons (2 user-definable)</li> <li>Integrated stylus holder</li> <li>On-screen QWERTY keyboard</li> </ul>												
<b>CAMERAS</b>	<ul style="list-style-type: none"> <li>720p webcam with mic</li> <li>BMP rear camera with autofocus and LED light</li> </ul>												
<b>EXPANSION</b>	<ul style="list-style-type: none"> <li>Optional microSDXC</li> </ul>												
<b>INTERFACE</b>	<table border="0"> <tr> <td>Docking connector</td> <td>24-pin Type A</td> </tr> <tr> <td>Headphones/speaker</td> <td>Mini-jack stereo</td> </tr> <tr> <td>Optional Serial Dongle<sup>3</sup></td> <td>D-sub 9-pin</td> </tr> <tr> <td>USB 3.0 1/2"</td> <td>4-pin</td> </tr> <tr> <td>Optional second USB 2.0<sup>4</sup></td> <td>4-pin</td> </tr> <tr> <td>Optional 10/100/1000 Ethernet<sup>5</sup></td> <td>RJ-45</td> </tr> </table>	Docking connector	24-pin Type A	Headphones/speaker	Mini-jack stereo	Optional Serial Dongle <sup>3</sup>	D-sub 9-pin	USB 3.0 1/2"	4-pin	Optional second USB 2.0 <sup>4</sup>	4-pin	Optional 10/100/1000 Ethernet <sup>5</sup>	RJ-45
Docking connector	24-pin Type A												
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Optional second USB 2.0 <sup>4</sup>	4-pin												
Optional 10/100/1000 Ethernet <sup>5</sup>	RJ-45												
<b>WIRELESS</b>	<ul style="list-style-type: none"> <li>Optional integrated 4G LTE multi carrier mobile broadband with satellite GPS</li> <li>Optional GPS (w/ black ANSO MBN)</li> <li>Intel® Dual Band Wireless-AC 8260 (IEEE802.11a/b/g/n/ac)</li> <li>Bluetooth v4.1, Classic mode/ Low Energy mode, Class 1 (Windows 10 pro 64-bit)</li> <li>Security             <ul style="list-style-type: none"> <li>Authentication: LEAP, WPA, 802.1X, EAP-TLS, EAP-FAST, PEAP</li> <li>Encryption: TKIP, 128-bit and 64-bit WEP, Hardware AES</li> </ul> </li> <li>Dual high-gain antenna pass-through</li> </ul>												
<b>POWER SUPPLY</b>	<ul style="list-style-type: none"> <li>Li-ion battery pack             <ul style="list-style-type: none"> <li>Standard battery: Li-ion 11.1 V, 4200 mAh (typ.), 4080 mAh (min.)</li> <li>Optional long life battery<sup>6</sup>: Li-ion 10.8V, 9300mAh (typ.), 8700mAh (min.)</li> </ul> </li> <li>Battery operation             <ul style="list-style-type: none"> <li>Standard battery: 14 hours</li> <li>Optional long life battery<sup>6</sup>: 28 hours</li> </ul> </li> <li>Battery charging time             <ul style="list-style-type: none"> <li>Standard battery: 2.5 hours off, 3 hours on</li> <li>Optional long life battery<sup>6</sup>: 3 hours off, 4 hours on</li> </ul> </li> <li>Optional bridge battery<sup>7</sup> (1 minute swap time)</li> </ul>												
<b>POWER MANAGEMENT</b>	<ul style="list-style-type: none"> <li>Suspend/Resume Function, Hibernation, Standby</li> </ul>												
<b>SECURITY FEATURES</b>	<ul style="list-style-type: none"> <li>Password Security: Supervisor, User, Hard Disk Lock</li> <li>Kensington cable lock slot</li> <li>Trusted platform module (TPM) security chip v2.0<sup>8</sup></li> <li>CompuSecure<sup>9</sup> theft protection agent w/ BIOS</li> <li>Optional Inseparable SmartCard reader<sup>10</sup></li> <li>Optional Contactless SmartCard/HF RFID reader<sup>11</sup></li> <li>ISO 15693 and 14443 A/B compliant</li> </ul>												

<b>WARRANTY</b>	<ul style="list-style-type: none"> <li>3-year limited warranty, parts and labor</li> </ul>
<b>DIMENSIONS &amp; WEIGHT<sup>12</sup></b>	<ul style="list-style-type: none"> <li>10.1" x 7.7" x 1.1" (L x W x D) (mm)</li> <li>2.4 lbs. (standard battery)</li> <li>3.0 lbs. (optional long life battery)</li> </ul>
<b>INTEGRATED OPTIONS<sup>13</sup></b>	<ul style="list-style-type: none"> <li>4G LTE multi carrier mobile broadband with satellite GPS</li> <li>Choice of 1D/2D barcode reader (EA11 or EA21), GPS, Serial Dongle, Ethernet, MicroSDXC or second USB 2.0 port</li> <li>Choice of bridge battery, magstripe reader, inseparable SmartCard reader, inseparable SmartCard reader with bridge battery, contactless SmartCard/HF RFID reader or UHF 150MHz RFID reader (EPC Gen 2)</li> </ul>

<b>ACCESSORIES<sup>14</sup></b>	<ul style="list-style-type: none"> <li>AC Adapter (3-prong)</li> <li>Standard Battery Pack</li> <li>Long Life Battery Pack<sup>6</sup></li> <li>Long Life Battery Bundle</li> <li>Includes rotating hand strap and corner-guard set</li> <li>Single Battery Charger Bundle</li> <li>LIND 3-Bay Battery Charger</li> <li>LIND Car Adapter 120W</li> <li>LIND Car/AC Adapter 100W (with USB port)</li> <li>LIND Car Adapter 100W MIL-STD</li> <li>Tall Corner Guard Set</li> <li>Rotating Hand Strap and Tall Corner Guard Set Bundle</li> <li>ToughMate G1 Always-On-Case (with hand strap)</li> <li>ToughMate G1 Professional Portfolio</li> <li>ToughMate G1 "X" Hand Strap</li> <li>Desktop Cradle</li> <li>Vehicle Docks (no pass-through)             <ul style="list-style-type: none"> <li>Gambler-Johnson</li> <li>Has with LIND power supply</li> </ul> </li> <li>Vehicle Docks (pass-through)             <ul style="list-style-type: none"> <li>Gambler-Johnson</li> <li>Has with LIND power supply</li> </ul> </li> <li>Credentia Router             <ul style="list-style-type: none"> <li>Verizon</li> </ul> </li> <li>Replacement Digitizer Pen Waterproof</li> <li>Teblet</li> <li>10.1" LCD Protective Film</li> </ul>
	<ul style="list-style-type: none"> <li>CF-AA413CM</li> <li>FZ-V25U842JU</li> <li>FZ-V25U898U</li> <li>FZ-BNDLGL11511CG4</li> <li>FZ-BNDLGL16ATCHRGR</li> <li>FZ-LIND3BAYG1</li> <li>CF-LINDDC120</li> <li>CF-LINDACD300</li> <li>CF-LINDMLD390</li> <li>FZ-WCGG111</li> <li>FZ-BNDLGL1511CG4</li> <li>TBCD1A20NLP</li> <li>TBCD1PFLD-BLK-P</li> <li>TBCD1X5TP-P</li> <li>FZ-VEBG11AU</li> <li>7140-0486-00-P</li> <li>CF-H-PAN-702-2-P</li> <li>7140-0486-02-P</li> <li>CF-H-PAN-702-2-P</li> <li>CP-IBR1100LPE-VZ</li> <li>CP-IBR1100LPE-AT</li> <li>FZ-WPFS11U-S</li> <li>FZ-WPFS11U</li> <li>FZ-VPPFS11U</li> </ul>

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. Aggressive line 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 Panasonic 2015.

<sup>1</sup>Bridge battery, magstripe reader, inseparable SmartCard reader, inseparable SmartCard reader with bridge battery, contactless SmartCard reader and UHF 150MHz RFID reader are mutually exclusive. Power over USB port cannot be accessed when the unit is equipped with the magstripe reader, the optional USB 3.0 port can be accessed.

<sup>2</sup>GPS, Serial Dongle, Ethernet, MicroSDXC and second USB port are mutually exclusive options.

<sup>3</sup>USB 3.0/1000Mbps types.

<sup>4</sup>Total available memory will be less depending upon actual system configuration.

<sup>5</sup>The case of the WLAN card is not to be used for operating system as well as the size of the RAM (Windows 7 max. 16GB or 32GB).

<sup>6</sup>Magstripe reader, inseparable SmartCard reader, inseparable SmartCard reader with bridge battery and UHF 150MHz RFID reader include tall corner guards and rotating hand strap. Bridge battery (without SmartCard reader) includes medium corner guards and rotating hand strap.

<sup>7</sup>Requires software and activation to enable theft protection.

<sup>8</sup>Length measurements do not include protrusions. Weight varies with options and digitizer pen.

<sup>9</sup>Accessories and Integrated System may vary depending on your configuration. Visit the Panasonic website for more accessories and details.

<sup>10</sup>Requires location certifications may not apply to all configurations. Consult your Panasonic representative for availability.

<sup>11</sup>RFM 1.2 available upon request - please contact your reseller or Panasonic representative.



**TOUGHPAD**

1.800.662.3537  
panasonic.com/toughpad/G1

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**Canon**  
**EOS 5D Mark IV**



+ Design detail



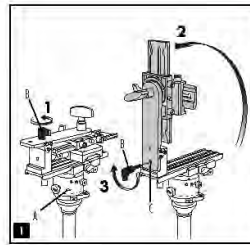
Incredible resolution ideal for the high-megapixel era. Introducing the new benchmark large-aperture standard lens

In 2008, Sigma released a large diameter standard lens designed for digital SLRs, "SIGMA 50mm F1.4 EX DG HSM". At that time, products for film cameras were prevalent, yet we spent enormous effort to set a new benchmark for the 50mm lens that optimizes the characteristics of digital cameras, such as compensating peripheral brightness, controlling the point images in the corners, and improving the image drawing, not only around the focusing point, but also other areas in the image.

# APPENDIX 1.4: CAMERA EQUIPMENT (MANFROTTO 303 SPH)



**303SPH**  
Universal "SPH" Head



The universal "SPH" head is designed to allow vertical angles to be created by Creppaco from a narrow panoramic sequence of digital or digital photographs when all three vertical angles.

- There are 4 requirements to achieve good panoramic sequence photos:
1. Accurate leveling of the panoramic case.
  2. A horizontal head that enables you to choose the angle of rotation between one shot and the next.
  3. The ability to position the camera in the "Middle Point" of the lens (the line) to ensure that the panoramic sequence of rotation, to eliminate any perspective problems between the two and adjacent the scene.
  4. An additional rotary axis that enables you to also correct panoramic sequence's differences in angle in order to achieve a complete spherical scene.

The universal "SPH" head consists of three main modules that perform the four requirements shown in points 1, 2 and 4.

Adjust over horizontal level in leveling device lock as the level in the level's 5mm ball (Fig. 1), you will need to use one of the leveling screws outside. First, the ball is raised to a certain angle of level of the head (see point 1).

**STEP 1**  
For the leveling device (not supplied) to be rigid, first the "SPH" head on the leveling device its level and then "T" (universal camera lock "T" inside the back) into the vertical section as shown in Fig. 1 and lock it in place by screwing the lock "E" on hub "U".



Fig. 1: When the horizontal level is leveled, the level "T" will adjust the plate "U" and the level "U" will adjust the level "U".

Fig. 2: When the horizontal level is leveled, the level "T" will adjust the plate "U" and the level "U" will adjust the level "U".

Fig. 3: When the horizontal level is leveled, the level "T" will adjust the plate "U" and the level "U" will adjust the level "U".

Fig. 4: When the horizontal level is leveled, the level "T" will adjust the plate "U" and the level "U" will adjust the level "U".

Fig. 5: When the horizontal level is leveled, the level "T" will adjust the plate "U" and the level "U" will adjust the level "U".

Fig. 6: When the horizontal level is leveled, the level "T" will adjust the plate "U" and the level "U" will adjust the level "U".

Fig. 7: When the horizontal level is leveled, the level "T" will adjust the plate "U" and the level "U" will adjust the level "U".

Fig. 8: When the horizontal level is leveled, the level "T" will adjust the plate "U" and the level "U" will adjust the level "U".

Fig. 9: When the horizontal level is leveled, the level "T" will adjust the plate "U" and the level "U" will adjust the level "U".

Fig. 10: When the horizontal level is leveled, the level "T" will adjust the plate "U" and the level "U" will adjust the level "U".

Fig. 11: When the horizontal level is leveled, the level "T" will adjust the plate "U" and the level "U" will adjust the level "U".

Fig. 12: When the horizontal level is leveled, the level "T" will adjust the plate "U" and the level "U" will adjust the level "U".

Fig. 13: When the horizontal level is leveled, the level "T" will adjust the plate "U" and the level "U" will adjust the level "U".

Fig. 14: When the horizontal level is leveled, the level "T" will adjust the plate "U" and the level "U" will adjust the level "U".

Fig. 15: When the horizontal level is leveled, the level "T" will adjust the plate "U" and the level "U" will adjust the level "U".

Fig. 16: When the horizontal level is leveled, the level "T" will adjust the plate "U" and the level "U" will adjust the level "U".

Fig. 17: When the horizontal level is leveled, the level "T" will adjust the plate "U" and the level "U" will adjust the level "U".

Fig. 18: When the horizontal level is leveled, the level "T" will adjust the plate "U" and the level "U" will adjust the level "U".

Fig. 19: When the horizontal level is leveled, the level "T" will adjust the plate "U" and the level "U" will adjust the level "U".

Fig. 20: When the horizontal level is leveled, the level "T" will adjust the plate "U" and the level "U" will adjust the level "U".

Fig. 21: When the horizontal level is leveled, the level "T" will adjust the plate "U" and the level "U" will adjust the level "U".

Fig. 22: When the horizontal level is leveled, the level "T" will adjust the plate "U" and the level "U" will adjust the level "U".

Fig. 23: When the horizontal level is leveled, the level "T" will adjust the plate "U" and the level "U" will adjust the level "U".

Fig. 24: When the horizontal level is leveled, the level "T" will adjust the plate "U" and the level "U" will adjust the level "U".

Fig. 25: When the horizontal level is leveled, the level "T" will adjust the plate "U" and the level "U" will adjust the level "U".

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Fig. 42: When the horizontal level is leveled, the level "T" will adjust the plate "U" and the level "U" will adjust the level "U".

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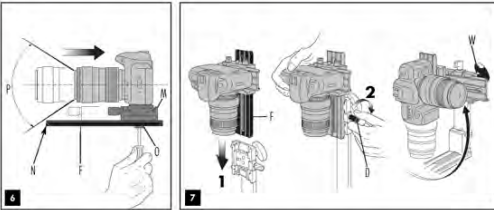
Fig. 56: When the horizontal level is leveled, the level "T" will adjust the plate "U" and the level "U" will adjust the level "U".

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**NOTE 2**  
The position of the housing "W" relative to the long plate "Y" 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 "M" of the long plate "Y" becomes visible in the camera's field of view "P".

**MONITOR THE CAMERA ON THE HEAD 2**  
Mount the whole top assembly + camera on the head as shown in Figure 7 by sliding the long plate "Y" into its housing and locking it by screwing knob "W" and move the camera on the vertical plate.

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Fig. 7: When the horizontal level is leveled, the level "T" will adjust the plate "U" and the level "U" will adjust the level "U".

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Fig. 14: When the horizontal level is leveled, the level "T" will adjust the plate "U" and the level "U" will adjust the level "U".

Fig. 15: When the horizontal level is leveled, the level "T" will adjust the plate "U" and the level "U" will adjust the level "U".

Fig. 16: When the horizontal level is leveled, the level "T" will adjust the plate "U" and the level "U" will adjust the level "U".

Fig. 17: When the horizontal level is leveled, the level "T" will adjust the plate "U" and the level "U" will adjust the level "U".

Fig. 18: When the horizontal level is leveled, the level "T" will adjust the plate "U" and the level "U" will adjust the level "U".

Fig. 19: When the horizontal level is leveled, the level "T" will adjust the plate "U" and the level "U" will adjust the level "U".

Fig. 20: When the horizontal level is leveled, the level "T" will adjust the plate "U" and the level "U" will adjust the level "U".

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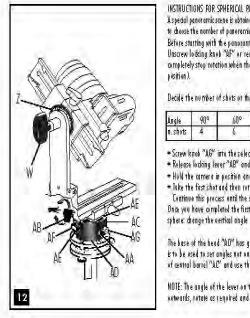
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## INSTRUCTIONS FOR SPHERICAL PANORAMAS 12

A spherical panoramic image is obtained by adding together panoramic sequences taken at different angles from the horizontal. That you will need to know 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, always the initial vertical angle using the level scale "Z" (Fig. 12).

Increase locking knob "W" or camera's completely if you do not need it to be locked completely stay rotation when the head is used in its vertical position, it is not any accidental movement of the head in any position.

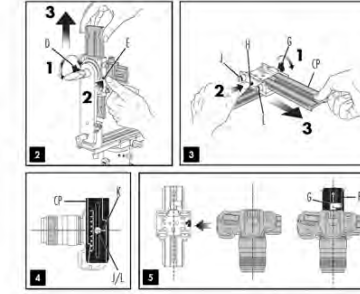
Decide the number of shots or the angle of rotation between each shot for the first panoramic sequence (see the chart below):	
shots	40° 60° 80° 90° 100° 120° 150° 180° 190° 200° 225° 270°
shots	4 6 8 10 12 15 18 24 36 48 72

- Screw knob "W" into the indicated setting knob "Z".
- Release locking knob "W" and rotate the camera on top plate "S" to the position of the first shot.
- Hold the camera in position and rotate the camera (lock "S" with the first "click") if needed, then lock knob "W".
- Take the first shot and then rotate the camera to the next "click" without releasing "W" and take the next shot.
- Continue this process until the entire sphere is covered.

Once you have completed the first complete panoramic sequence, you can start with the other panoramic sequences made to cover the sphere change the vertical angle using knob "W" and repeat the operation described above for each full sequence.

The lens of the head "W" has graduated scale markings from the 300° and a reference index "AE" on the normal level "SC". This is to be used to set angles not on the chart. To use the head in this way, with knob "Z" to disengage the "click stop", bring rotation of normal level "SC" and use the locking knob "W" to lock the position during shooting.

**NOTE:** The angle of the lever on the universal "SPH" can be regulated as required without affecting the lock ball. Pull the lever upwards, rotate as required and release and pull back in the new position.



## Mounting the camera 3

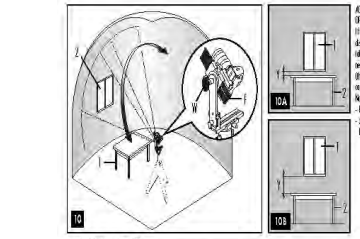
Remove the top assembly (Fig. 7) by releasing knob "O". To slide it completely out of the housing, push safety button "P".

Remove camera plate "CP" (Fig. 2) by releasing knob "O". To slide it completely out of the housing, push safety button "P".

You will find two screws attached to the top assembly: screw "T" (Fig. 2) and screw "U" (Fig. 2). 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 this screw to align the lens with the center of the plate indicated by letter "C".

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" screw. Lock in place using knob "G" under locking, take care to align the lens with the long plate "Y" - the lens axis must be perfectly above the slot of the plate as shown in Figure 5.

The angle of the lever on the universal lock "T" can be regulated as required without affecting the lock ball. Pull the lever upwards, rotate as required and release and it will lock in the new position.



## Mounting the camera 10

The new bag that makes it easy to carry allows you to push when the bag is being closed. Release the top of the "Middle Point" mechanism to push down the vehicle.

Note: The "Middle Point" mechanism is not intended for use as a carrying handle.

Use the "Middle Point" mechanism to push down the vehicle.

Use the "Middle Point" mechanism to push down the vehicle.

## Mounting the camera 10

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