E.6.0 Camera matching – Type 4 visualisations

E.6.1 Cityscape Digital's database

Cityscape Digital has built up a comprehensive database of survey information on buildings and locations in central London; the database contains both GNSS survey information and information regarding the dimensions and elevations of buildings gathered from architects and other sources.

The outlines of buildings are created by connecting the surveyed points or from the information obtained from architects' drawings of particular buildings. By way of example of the high level of detail and accuracy, approximately 300 points have been GNSS surveyed on the dome of St. Paul's.

The database 'view' (as shown in Figure E.14) is 'verified' as each building is positioned using coordinates acquired from GNSS surveys. In many instances, the various coordinates of a particular building featured in one of the background plates are already held by Cityscape as part of their database of London. In such cases the survey information of buildings and locations provided by the surveyor (see Section E.3.2) is used to cross-check and confirm the accuracy of these buildings. Where such information is not held by Cityscape, it is, where appropriate, used to add detail to Cityscape's database.

The survey information provided by the surveyor is in all cases used in the verification process of camera matching.

E.6.2 Camera matching process

The following information is required for the camera matching process:

- Specific details of the camera and lens used to take the photograph and therefore the field of view (see Section 1);
- The adjusted or corrected digital image i.e. the 'background plate' (see Section E.2);
- The GNSS surveyed viewpoint coordinates (see Section E.3.2);
- The GNSS surveyed coordinates of points within the the background plate (see Section E.3.2);
- Selected models from Cityscape's database (see Section E.6.1);
- The GNSS surveyed coordinates of the site of the proposed scheme (see Section E.3.2);

The data is combined in a 3D software package and is then used to situate Cityscape's virtual camera such that the 3D model aligns exactly over the background plate (as shown in Figures E.15, E.16 and E.17) (i.e. a 'virtual viewer' within the 3D model would therefore be standing exactly on the same viewpoint from which the original photograph was taken (Figure E.3). This is the camera matching process.

Figure E.14: Selected GPS located models (yellow) from Cityscape's database, situated on Cityscape's London digital terrain model

Figure E.15: The background plate matched in the 3D GPS located models

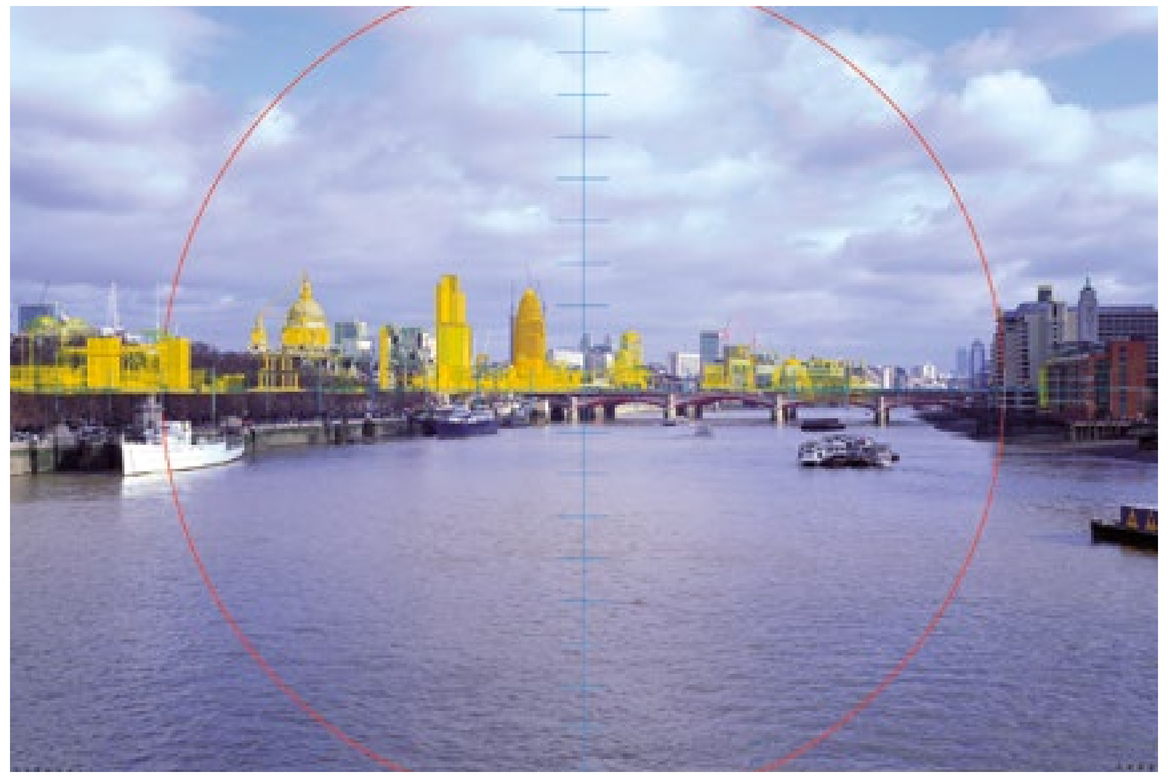


Figure E.16: Background plate matched to the 3D GPS located models

Figure E.17: The camera matched background plate with an example of a proposed scheme included in red

E.7.0 Camera matching – Type 3 visualisations

E.7.1 Cityscape's context models

Cityscape have purchased available 3D city models of large parts of London and other parts of the UK that are modelled to within 25cm accuracy. Where available this data is used to create camera matches for Type 3 visualisations, or additional data is purchased.

In addition, or where 3D city models are not available, DSM data is used for camera matching (see Section E.4).

E.7.2 Camera matching process

The following information is required for the camera matching process:

- Specific details of the camera and lens used to take the photograph and therefore the field of view (see Section E.1);
- The adjusted or corrected digital image i.e. the 'background plate' (see Section E.2);
- 3D city model and/or DSM context model (see Section E.4);
- Selected models from Cityscape's database (see Section E.6.1);
- A 3D model of the proposed scheme (see Section E.5)

The data is combined in a 3D software package and is then used to situate Cityscape's virtual camera such that the 3D model/Digital Surface Model (DSM) aligns exactly over the background plate (as shown in Figure E.20) (i.e. a 'virtual viewer' within the 3D model would therefore be standing very close to the same viewpoint from which the original photograph was taken (Figure E.3). This is the camera matching process.

Figure E.18: Background plate: digital photograph, size and bank corrected as described in Section 2

Figure E.19: Render: DSM model render, camera matched

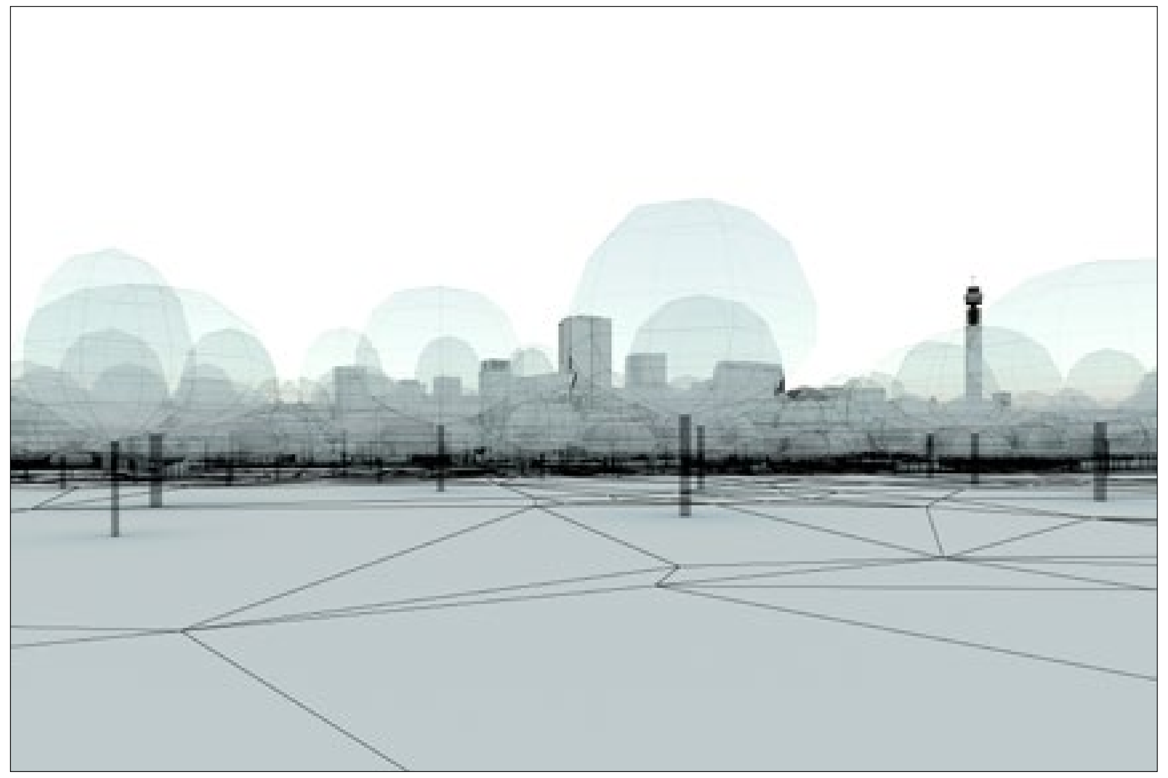
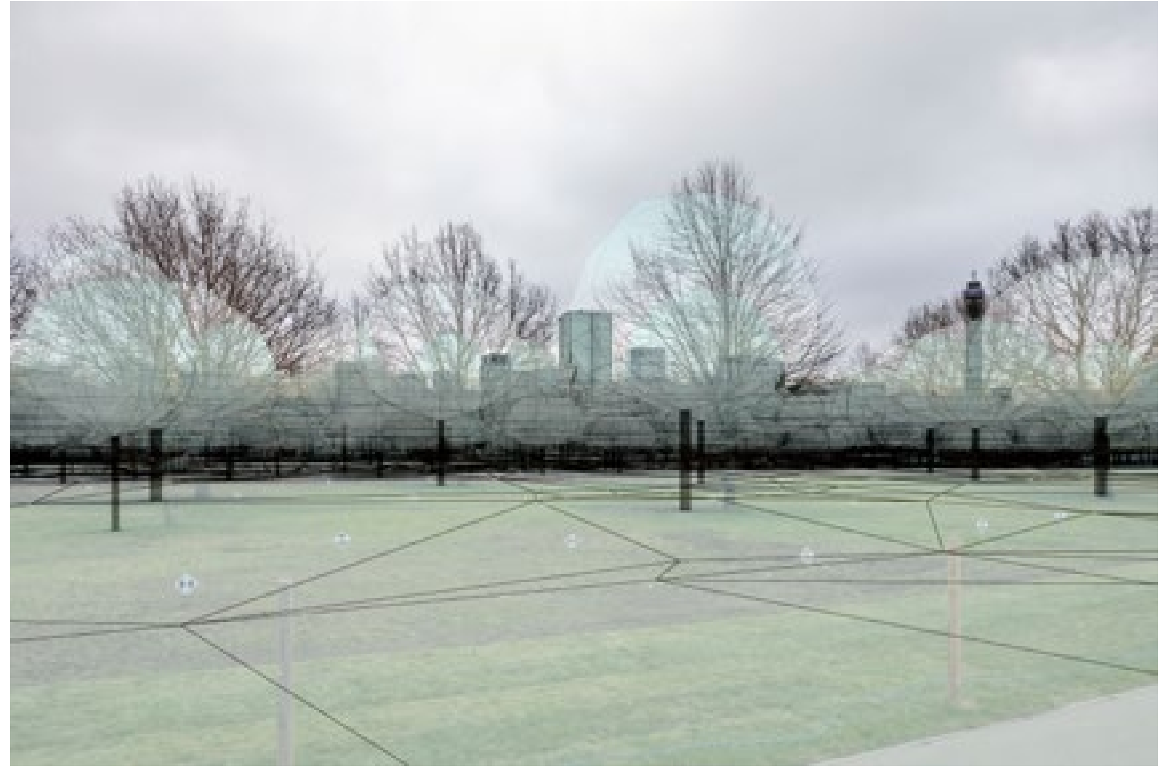


Figure E.20: Camera matching: the background plate matched in DSM TIN mesh



E.8.0 Rendering

E.8.1 Wireline image (AVR 0/1)

The proposed developments are shown using a constant thickness wireline. The line is generated from a computer rendering of the 3D model and follows an 'inside stroke' principle.

Rendering is a technical term referring to the process of creating a two dimensional output image from the 3D model. The 'inside stroke' principle is followed so that the outer edge of the line touches the outline of the render from the inside, fairly representing the maximum visibility.

The camera matching process is repeated for each view and a wireline image of the proposal from each viewpoint is then produced. The wireline image enables a quantitative analysis of the impact of the proposed scheme on views.

E.8.2 Rendered image (AVR 3)

In order to assist a more qualitative assessment of the proposals, the output image needs to be a photo-realistic reflection of what the proposed scheme would look like once constructed. This is called an AVR3.

E.8.3 Texturing

The process of transforming the wireframe 3D scheme model into one that can be used to create a photorealistic image is called texturing[12].

Prior to rendering, Cityscape requires details from the architect regarding the proposed materials (e.g. type of glass, steel, aluminium etc.) to be utilised.

Cityscape also use high resolution photographic imagery of real world material samples, supplied by the client or the manufacturer, to create accurate photorealistic textures for use in all our images. This information is used to produce the appearance and qualities in the image that most closely relates to the real materials to be used (as shown in Figure E.21).

E.8.4 Lighting and sun direction

The next stage is to light the 3D model to match the photographic environment. The date, time of the photograph and the latitude and longitude of the city are input (see Figure E.22) into the unbiased physically accurate render engine. Cityscape selects a 'sky' (e.g. clear blue, grey, overcast, varying cloud density, varying weather conditions) from the hundreds of 'skies' held within its database to resemble as closely as possible the sky in the background plate.

The 3D model of the proposed scheme is placed within the selected sky (see Figure E.23) and using the material properties also entered, the computer calculates the effects of the sky conditions (including the sun) on the appearance of the proposed scheme.

12 Texturing is often referred to as part of the rendering process, however, in the industry, it is a process that occurs prior to the rendering process.

Figure E.21: Screenshot of some materials in the 3D rendering package.

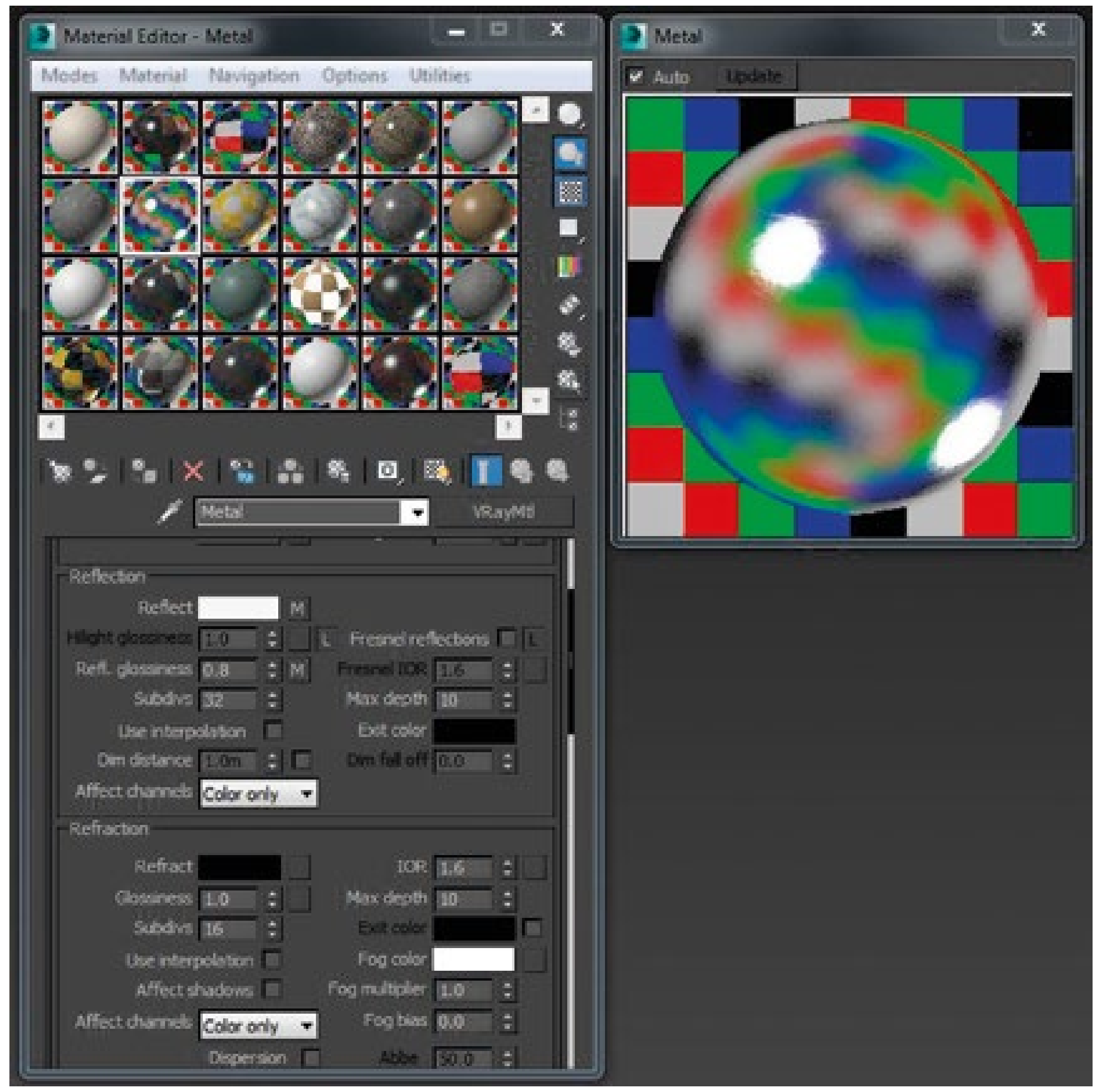


Figure E.22: Screenshot of environment information (time, date and year) entered to locate the sun correctly (see Section 7.

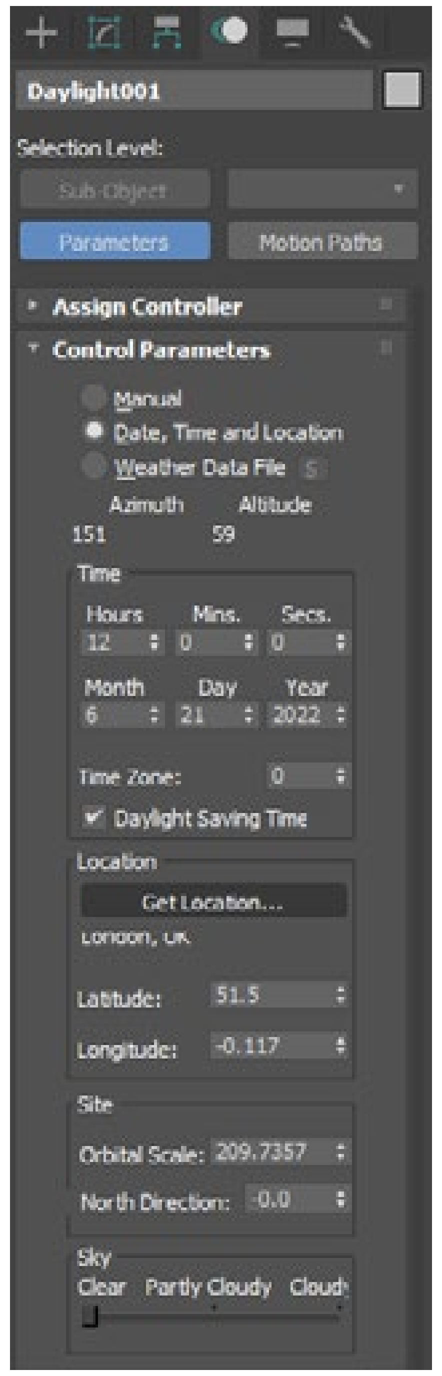
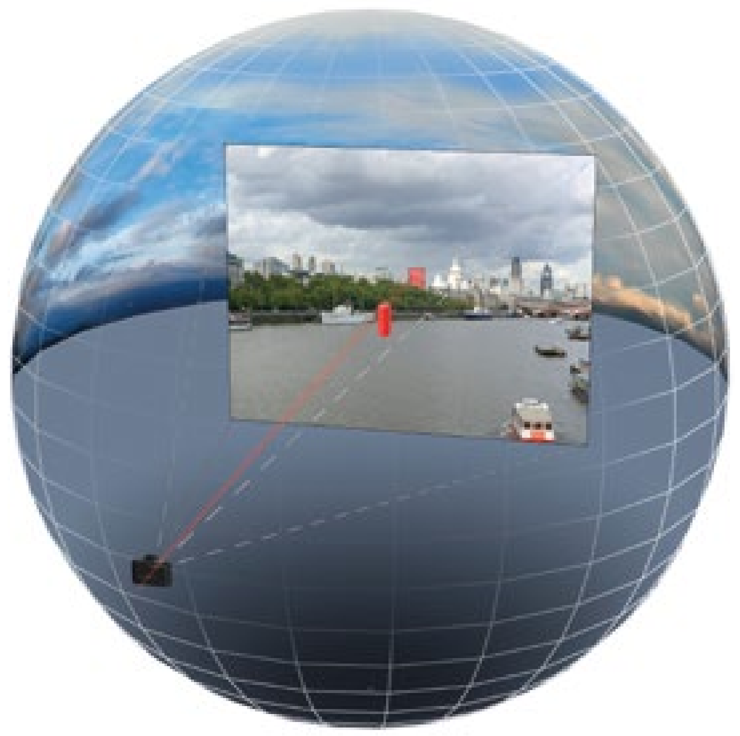


Figure E.23: Example of a proposed scheme highlighted in red within the selected sky and rendered onto the background plate



E.9.0 Post production

E.9.1 Post production

Finally, the rendered image of the scheme model is inserted and positioned against the camera matched background plate.

Once in position, the rendered images are edited using Adobe Photoshop®. Masks are created in Photoshop where the line of sight to the rendered image of the proposed scheme is interrupted by foreground buildings (as shown in Figure E.24).

The result is a verified image or view of the proposed scheme (as shown in Figure E.25).

Figure E.24: Process red area highlights the Photoshop mask that hides the unseen portion of the render

Figure E.25: A photo-realistic verified image

Appendix F Camera Position Images

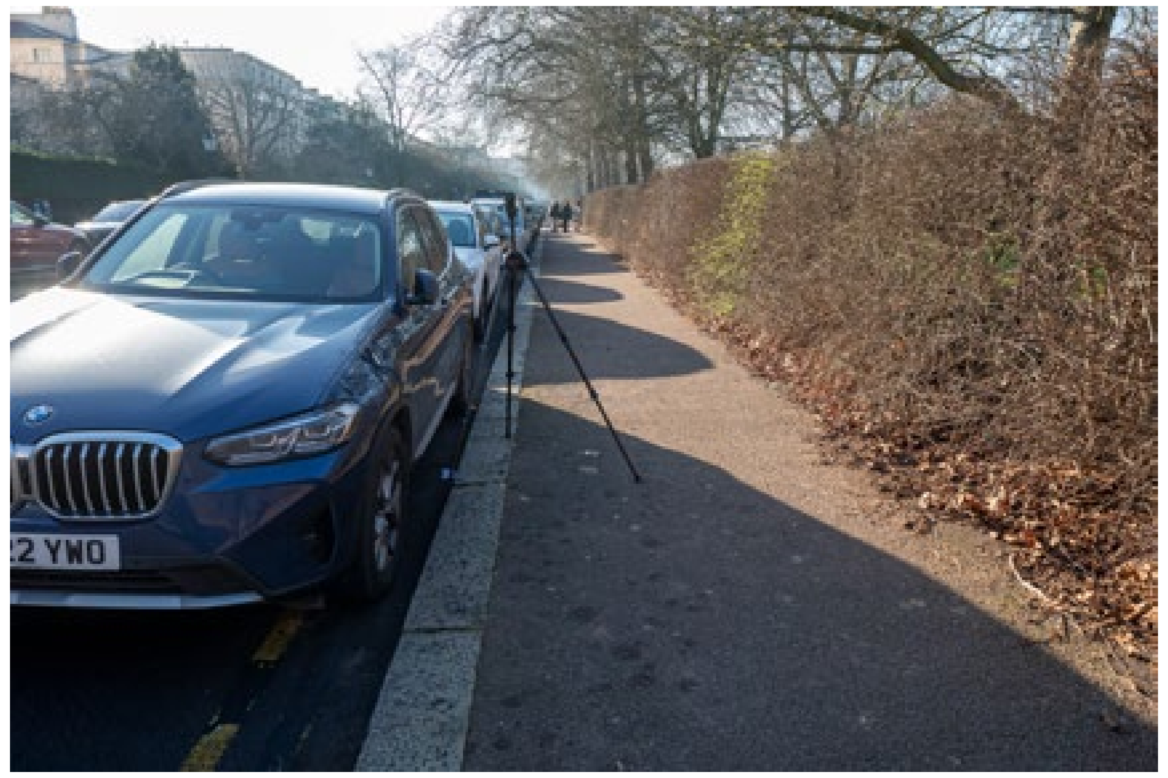

View 2


View 3


View 4


View 5


View 6


View 7


View 8


View 9


View 10


View 11

View 12

View 13

View 14

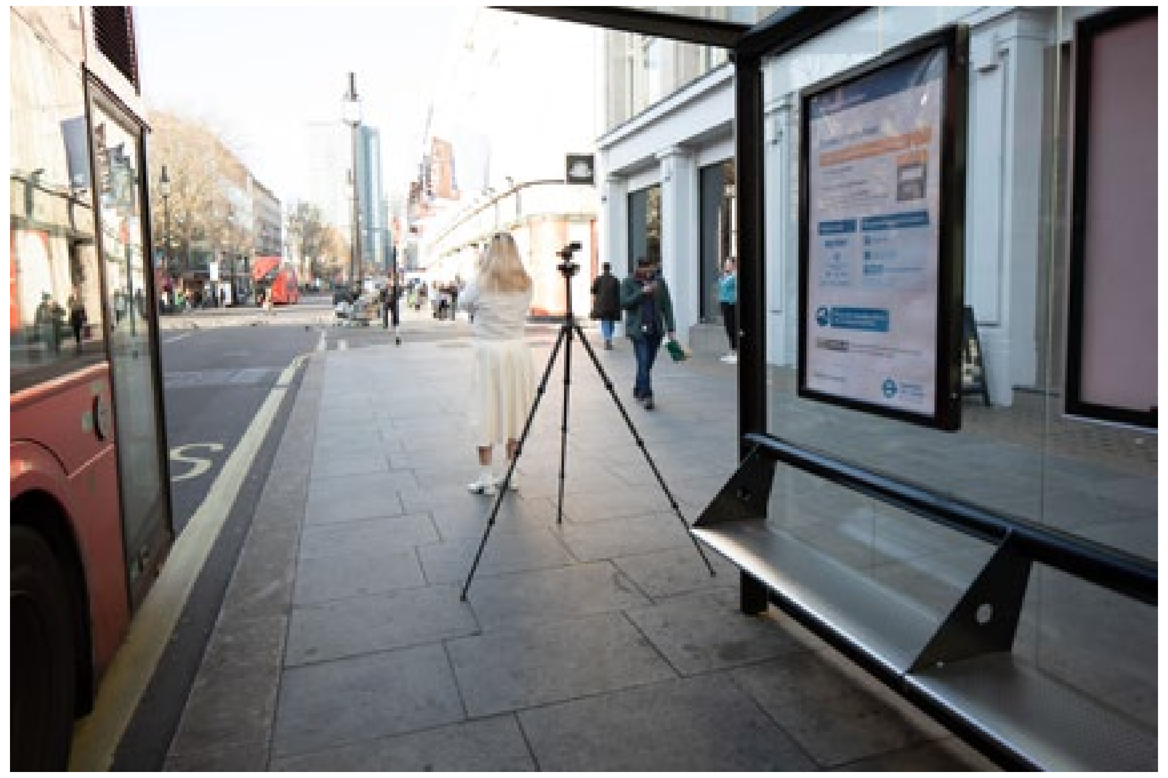
View 15

View 16

View 17

View 18

View 19



View 20

View 21

View 22

View 23


View A1


View A2


View A3


View A4


View A5


View A6


View A7


View A8


View A9


View A10


View A11


View A12


View A13


View A14


View A15


View A16


View A17


View A18

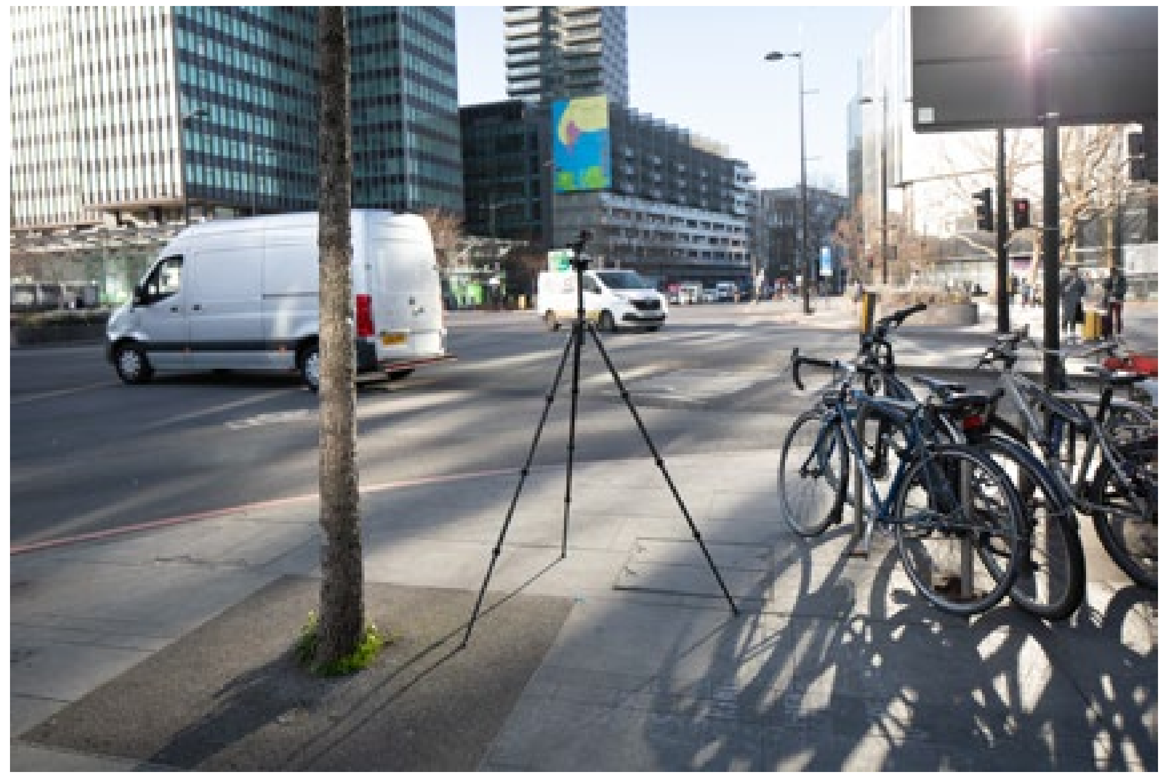

View A19


View A20


View A21


View A22


View A23


View A24

View B1

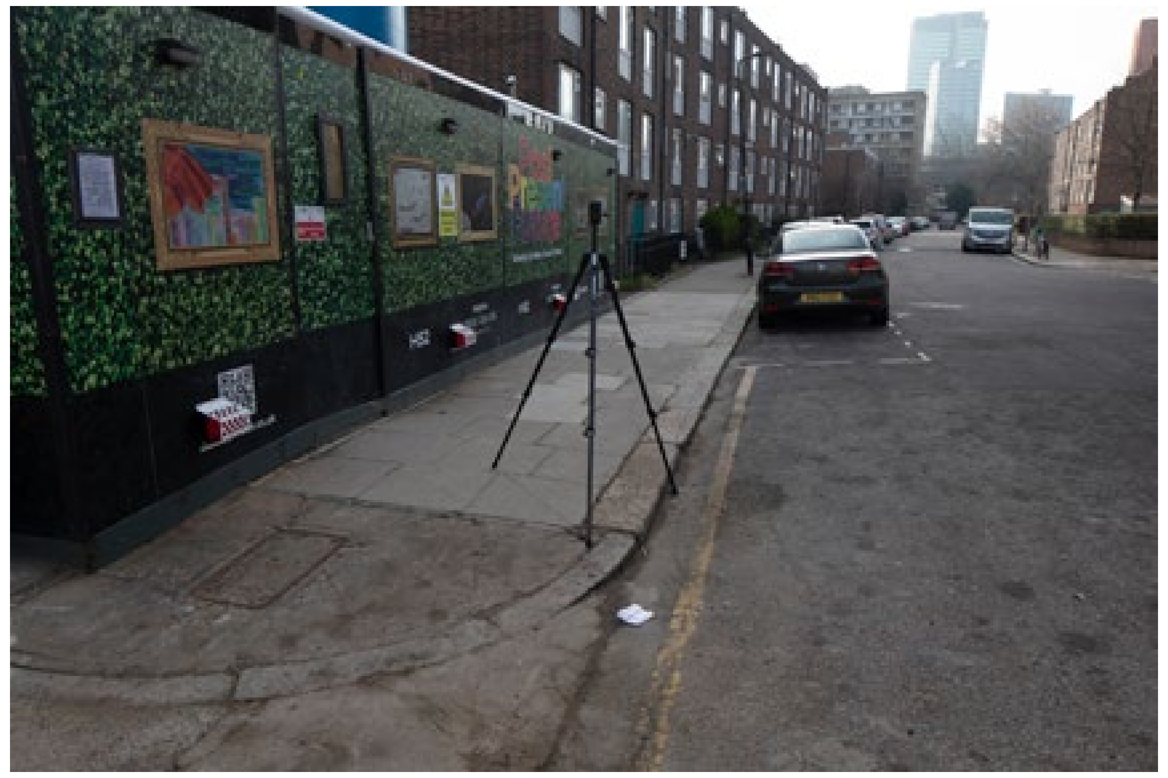
View B2

View B3

View B4

View B5

View B6



View B7

(Model view used due to inaccessibility
of the view position within HS2 site area.)

View B8

View B9

View B10

View B11

View B12

View B13

View B14

View B15

View B16

View B17

View B18

View B19

View B20

View B21

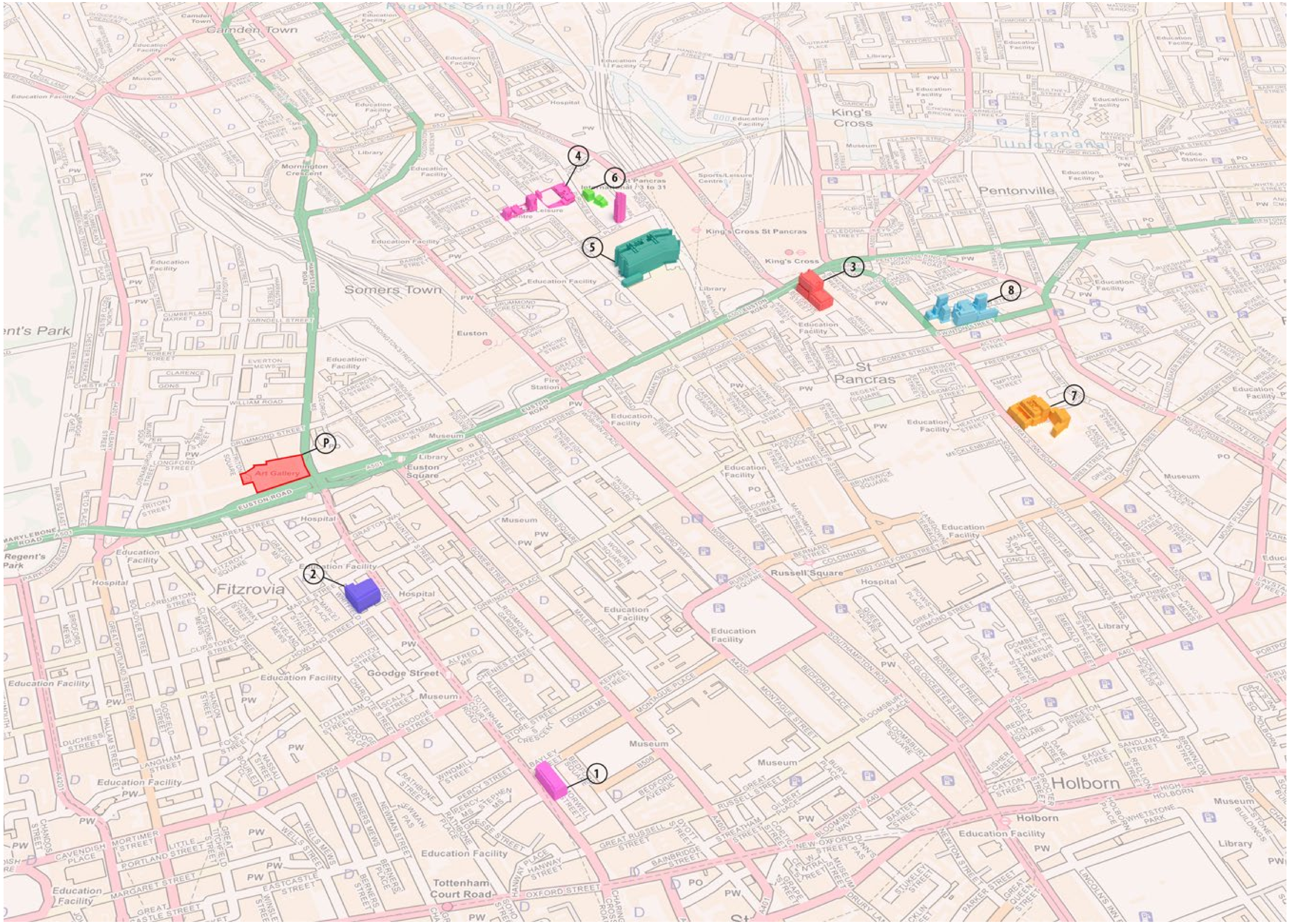
View B22

View B23

View B24

Appendix G Consented Schemes Key

Consented	
1	237 - 247 Tottenham Court Rd 1 - 3 Bayley St 1 - 4 Morwell St London W1 2023/1155/P
2	Network Building 76-80 Whitfield St and 88 Whitfield St 2020/5631/P
3	Belgrove House Belgrove St 2022/1515/P
Future Baseline	
4	Central Somers Town 2015/2704/P
Emerging	
5	Land to the North of the British Library, 96 Euston Rd 2022/1041/P
6	Central Somers Town Plot 5 & 6 2023/3830/P
7	Eastman Dental Hospital Site and Buildings 2021/1809/P
8	Royal National Throat Nose And Ear Hospital 330 Gray's Inn Rd 2023/0904/P



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