TECHNICAL REPORT

Group 17

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1 Project Information

1.1 Project Purpose

This project will provide a comprehensive analysis of site T at the University of Wales Trinity Saint David in Lampeter, which in great part constitutes the surroundings of the Sports Hall.

The project will allow for the completion of a few deliverables, within the allocated time:

- The present Technical Report
- Hand drawn sketches of controlled area, 2 cross-sectional height sketches of the site, plus additional computer-aided mapping of the site's feature details.
- The client will also receive a folder, containing all the work done by the surveying team over the surveying period, including rough obtained results, risk assessments, daily and kit logs, near misses.

1.2 Contact Details

1.2.1 Client Contact and Representative (in respective order)

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1.3 Project Address

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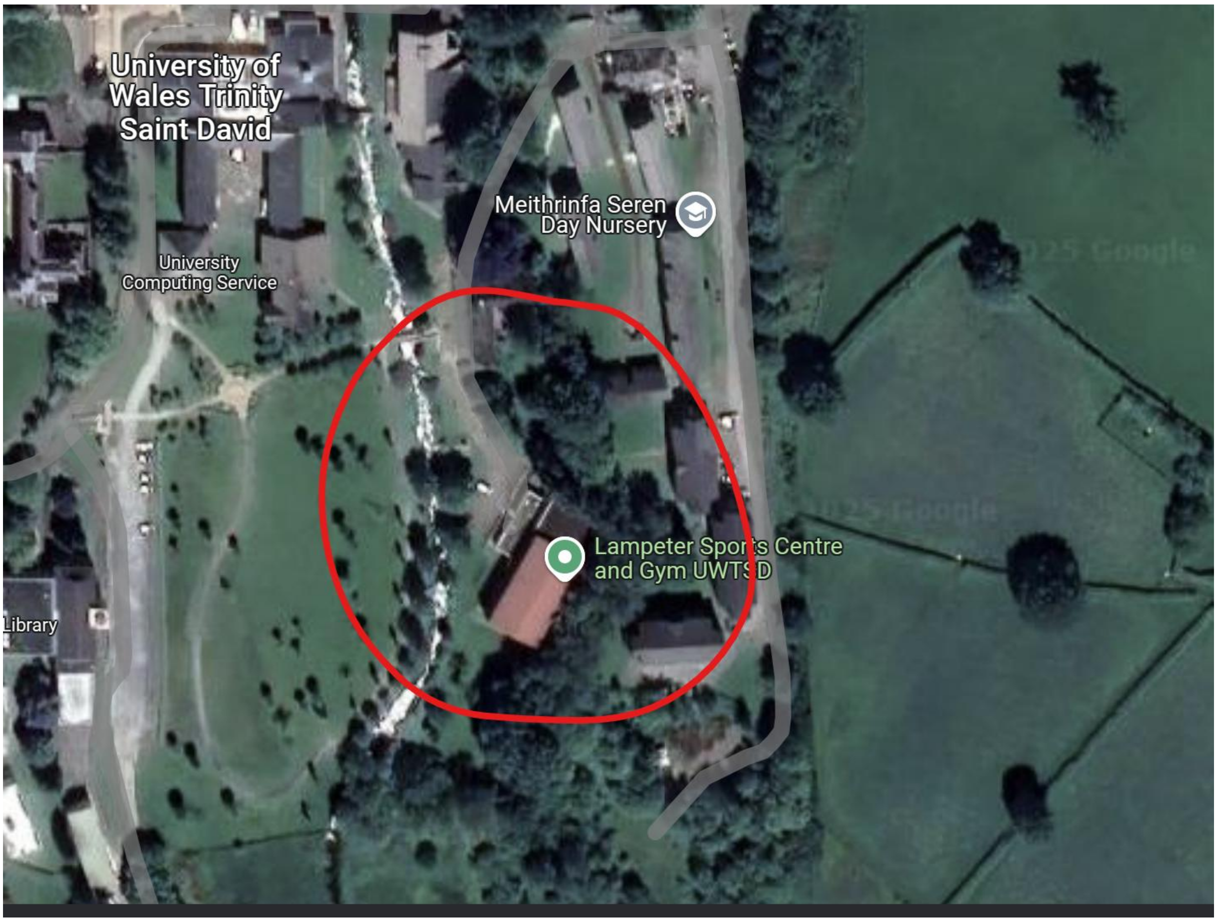


Fig.1: Rough Localisation of Site T through Google Maps (see Map Overview for more accurate localisation).

1.4 Survey Location and Project Constraints

1.4.1 Survey Location

The survey takes place in the immediate area surrounding the Campus' Sports Hall, which should be entirely contained within the survey area. In addition, the site extends from the main façade of the building to the river, therefore including the parking lot there. Finally, the site includes the area north of the aforementioned (the exiting road) until the closest bridge that allows to cross the river.

1.4.2 Project Constraints

The project will need to work around the relatively high volume of traffic going through the area, and particularly of motorised vehicles. This traffic requires the team to always be alert, such that the equipment is not moved nor damaged. This will be particularly true in the afternoon times under warm weather, and in the opening hours of the gymnasium, or 8:00-21:00 during most of the week.

The project also needs to account for large amounts of somewhat dangerous vegetation (such as brackens) on the south-eastern face of the building, as space is very constricted at that point. This requires the team to be more coordinated, such that no member trips and falls into the vegetation, as it could lead to very serious injury.

1.5 Project Scale

The Client requires the team to provide a complete surveyed map at the scale of 1:500. The team has not considered minor adjustments too small for the scale during the detailed surveying phase as these points would prove to be unnecessary for the task given. Doing so allows the Surveying Team to provide a completed work without delays.

1.6 Client Provisions

The Client provides the team with a bird's eye view of the site, which include the location of control points, such that the surveying work can be carried out successfully. The Client further provides accommodation for the entire team during the length of the survey within walking distance off the site, allowing efficient work to be done.

2 Instrumentation and Software

2.1 Equipment Overview

2.1.1 Specifications

For this project, we used a Leica total station to measure both angles and distances, which allowed us to record accurate 3D coordinates of the site features. For levelling work, we used a Leica NA730 automatic level, which is reliable for getting precise height differences. We also used standard tripods, prisms, measuring tapes, and a prism pole throughout the survey.

2.1.2 Care

All equipment was transported in hard cases and handled carefully on-site. We made sure tripods were properly levelled and set up on firm ground. Instruments were never left unattended, and in wet conditions, boxes were left closed, and equipment as well, when applicable. To prevent mould, humidity was let out at night, ensuring equipment preservation and precision. At the end of each day, lenses were wiped with a clean cloth and devices were packed securely.

2.1.3 Total Station Firmware

The total station used by the team (Leica TS07 5’’) used firmware version X.

2.2 Software

2.2.1 Microsoft Excel

Excel (version 2505) was used to organize field data and perform calculations such as levelling adjustments, traverse coordinates, and misclosure checks.

2.2.2 Microsoft Word

This report and other documents, including field notes and risk assessments, were compiled using the latest Word version (version 2505).

2.2.3 AutoCAD

All final maps and cross-sections were drawn in AutoCAD2025. Measured points were imported into CAD and connected using line tools to build the 1:500 scale drawing.

2.2.4 ArcGIS Pro

ArcGIS(2024) was used to overlay our survey results on OS base maps. It helped us check spatial accuracy and confirm our data matched real-world positions.

2.3 Calibration Checks

2.3.1 Automatic Level

We performed a two-peg test before using the level. The calculated collimation error was 0.002m, which is well within acceptable limits of 0.005m by an order of 2.5. This ensured the level was accurate enough for height measurements.

2.3.2 Total Station

Several checks were carried out to ensure the instrument's reliability throughout the project. The trunnion axis test showed no measurable error, with identical face left and face right readings of 82.9 cm. The horizontal collimation error was 0°00'12", which falls within the acceptable threshold of less than 10". Similarly, the vertical collimation error measured 0°00'05", also within the accepted range. The index error from the three-peg test was 0.0097 m. All tests were verified and confirmed that the instrument was performing reliably during the project.

3 Horizontal and Vertical Control Provisions

3.1 Survey Grid

3.1.1 Reference System

The Survey Team has utilised data in accordance with UK standards, the Ordnance Survey. Local elevation was taken from the Ordnance Datum Newlyn, to create an eased reading of the site's changes in elevation.

3.1.2 Pre-existing Control Points

From the Client's resources, the team was able to efficiently locate two control points that had known coordinates in relation to the Ordnance Survey. Furthermore, as the Client provided clear descriptions of each Control Point, the team was able to ensure their usability.

The team has as a result used Control Points ST119 and ST120.

3.1.2.1 Location in Relation to Reference System and Site

ST119 can be found at coordinates (258075.326, 248153.095), in the Ordnance Survey. It can be found on the northernmost point of site T, near a lamppost and manhole cover. ST120 has Ordnance Survey coordinates (258052.191, 248148.405). It is located outside of the main site, though used as an initial benchmark for all the Surveying Team's calculations. It is located on the south-east inner corner of a manhole cover, on the right bank of the nearby river.

3.1.2.2 Reliability of Control Points

It is required to consider that both markers might present some variation to indicated data, and especially so for ST120. This control point does not have a physical appearance and relies solely on the existence of the manhole cover for its location. This makes it unreliable to some extent as it is not possible for the team to reliably measure small variations of the cover (such as gaps, which may have widened over time, or even thermal expansion of the manhole cover).

On the other hand, control point ST119 is much more reliable. It is a fixed survey nail and washer in the kerb of the road going into site T. This makes it unlikely for it to move, unless if the kerb of the road were to be broken over time or moved in some form. Furthermore, the Surveying Team can much more effectively pinpoint the exact location of the Control, and therefore potentially obtaining much more accurate results.

When taking these factors into account, the team is still expected to have minor discrepancies with real values and can therefore be ignored without causing major issues.

3.1.3 Design Rationale

The Surveying Team has decided to use Control Points ST119 and ST120 as they were the most appropriate for the work given. Indeed, the team required to use at least one of these points as a benchmark, from which calculations could be made for all other points. ST119 being within Site T therefore was ideal for this purpose and was used as the initial benchmark for all measurements subsequently taken.

However, the Surveying Team required another benchmark Control Point (ST120), as it would not be possible to proceed forward with calculations without it. It was chosen due to its proximity to site, ensuring ease in setting sight lines with ST119. It is the only Control Point that is close enough for benchmarking, whilst being at a height that is sight able from ST119. Other points were either too far to obtain accurate measurements, or out of sight. See Map Overview of all stations in the Team's Folder.

3.1.4 Team-established Permanent Markers

3.1.4.1 Marker A

Marker A was established in line of sight between ST119 and Marker B and can be located via a wooden peg placed by the team at that point. Its location has proven to be somewhat of a challenge for the team, due to the very restricted space in which it was possible to operate.

Full information on Marker A can be found in Appendix A.

3.1.4.2 Marker B

Marker B was established on the furthest point of the site from ST119, or in other words, behind the Sports Hall. More precisely, Marker B is situated on the outermost corner of the manhole cover that can be found there. Gravel at that permanent marker has proven to be difficult to work with, and the surveying team has taken additional precaution to ensure accurate readings.

Complete data for Marker B can be found in Appendix B.

3.1.4.3 Marker C

Marker C is in direct line of sight of Marker B and ST119. It can be found on the outer corner of the pavement surrounding the Sports Hall. The team had to ensure stability of the slope at that point, as measurements were taken in wet weather. Furthermore, the team ensured that readings taken at that point were checked multiple times, due to the difficulty of taking the former on a high angled slope.

Data including coordinates and height for Marker C can be found in Appendix C.

3.2 Survey Methodology

The Surveying Team carried out the control survey methodically and ensured that checks were in place to minimise the risk of error. By using a total station, first set up at a point of known coordinates (ST 119), the team was able to find external angles of the quadrilateral linking all the Team's permanent markers and ST119. Before moving to a new point, the team verified the sensibility of recordings, to determine whether a remeasure was necessary.

In conjunction with this, slope lengths between two control points were taken multiple times, and averaged after the fact, to ensure that the Surveying Team could work with as accurate of readings as possible. When using vertical angles, also obtained from the total station, it was possible to determine the horizontal length between these two points mathematically. This was helpful as a double check of the station's result, and the Team could effectively compare mathematical and practical results.

With this methodology, it was possible for the Team to obtain accurate results that were as close as possible to real locations.

Bearing errors were fixed by accessing visual representation of the Control Points on ArcGIS.

4 Results of Control Survey

4.1 Table of Coordinates of Control Points

Station Name	Adjusted Change in E	Adjusted Change in N	Final Eastings	Final Northings
ST119	-	-	258075.326	248153.095
A	-45.282	36.900	258120.608	248116.195
B	24.240	36.888	258096.368	248079.307
C	17.634	-11.149	258078.734	248090.456
ST119	3.410	-62.639	258075.324	248153.095

4.2 Allowances

4.2.1 Angular Misclosure

The angular misclosure allowed was of 30" per angle so for the 5 angles the total angular misclosure allowed was of 2 30". The Survey Team obtained a decimal misclosure of 0.01444 throughout the entirety of the traverse lines, representing an angular misclosure of 51.88" .

4.2.2 Linear Misclosure

The Survey Team having obtained a linear misclosure of 0.0114312

obtaining a final fractional linear misclosure of16284.23395.

4.2.3 Levelling Misclosure

After surveying, the Team has calculated an overall vertical misclosure of 0.001 m which is under the allowed misclosure

4.2.4 Final Statement on Client Specifications

All measurement results meet the client's specified requirements. The angular misclosure was −51.98", which is within the 2'30'' tolerance set by the client. The fractional linear misclosure was 1 in 16,284.23, exceeding the minimum requirement of 1:10,000. The levelling misclosure was 1 millimetre, well within the client's limit of 8.94 millimetres. Therefore, our survey results fully comply with the client's specifications.

The principle of independent check involves verifying survey results through a separate method or data source to ensure the accuracy and integrity of the measurements. In this project, data was collected using a total station, which provides high-precision angle and distance measurements suitable for detailed mapping and engineering applications. To perform an independent check, we compared our total station measurements with existing mapping datasets from Digimap.

5 Detail Survey Methodology

5.1 Client Deliverables

5.1.1 Detailed Map of Site T

As required by the client, our main output is a full site map of Site T made in AutoCAD at a 1:500 scale. This includes all key physical features around the Sports Hall – such as buildings, roads, trees, and river edges – plotted accurately based on survey data. Two cross-sectional drawings are also included to show elevation changes, both drawn by hand.

The full detailed map can be found in Appendix D.

5.2 Planimetric Information

5.2.1 Scale at Client's Specifications

All features were captured with the 1:500 scale in mind. Focus was therefore put on larger structures such as building outlines, curbs, fences, and tree lines. Smaller details that wouldn't appear clearly at this scale were skipped or generalised.

5.2.2 Captured Information

The Surveying Team captured building corners, kerbs, road edges, tree trunks, fence lines, and manholes. Vegetation areas, especially on the south-east side, were outlined rather than surveyed in full. We also picked up several spot heights across open areas to help with elevation data.

5.3 Data Capture Methodology

5.3.1 Utilised Equipment and Specific Techniques

A total station was used to take capture the location of points across the area, working from known control points (like ST119 and ST120) and stations the Surveying Team set up. Data was collected with a prism and pole, and heights were calculated trigonometrically using the slope distance given by the machine and the vertical angle.

5.3.2 Limitations

5.3.2.1 Generalisations

Some dense vegetation zones were too complex to measure point-by-point(unpracticable), so we outlined them roughly with a few spot points and filled in details later during CAD work.

5.3.2.2 Obstructions

Parked cars or moving people could blocked lines of sight, in those cases, we could sometimes put the tripod higher or we c<had to come back later or estimated the positions using nearby visible points.

5.3.2.3 Health and Safety

We avoided dangerous places such as steep slopes or places where ferns grew. If a point could not be reached safely, we either skipped it or measured from a safer angle. We also wore high vis jacket and safety boots to avoid any accident.

5.3.2.4 Limited Accessibility

Some locations, like fenced-off areas or behind dense trees, couldn't be accessed. For those, we estimated positions using visible references or aerial views the client gave us.

5.4 Quality Assurance

5.4.1 Cross-reference with Concurrent Teams

The team compared the AutoCAD output with Ordnance Survey MasterMap data. Most features matched closely, with only minor differences (within a few centimetres), acceptable at this scale.

5.4.2 Cross-reference with MasterMap Data

We compared our CAD outputs with Ordnance Survey MasterMap data. Most features matched closely, with only minor differences (within a few centimetres), which is acceptable at this scale.

5.4.3 Additional Checks

During each setup, we double-checked orientation by measuring to a known point (e.g. back to a control station). We also used tapes to verify some key distances like the Sports Hall's length. These all matched closely with the total station data.

6 Deliverables

6.1 AutoCAD Plan Production (map in appendix D)

After performing the detailing of each important point in our area, the team transferred the data from the total station to a laptop computer using a USB key. We then organized the data in an Excel sheet to prepare it for use in AutoCAD. We then created a scr file to import the data into AutoCAD, which displayed all the points of our area. After that, we connected the points to form the shapes and outlines of our area. For each category of point, we assigned a different layer with a distinct colour to differentiate between the various features. After all that we added a template and created a legend to explain what the symbols and colour represents. Then we annotated the map we obtained and put the north arrow.

6.2 Cross-Sections Creation

Cross-sectional hand drawings were also produced to the Client's demand, to provide an idea of the changes in elevation throughout the site major axes. For this purpose, the Team has been authorised to change these axes, such that they do not cut the Sports Hall in a diagonal manner, as it was believed that cutting through the Sports Hall axes would be much more effective for the Client to get an idea of the shape and heights of the Site.

The sketches are provided on graphing paper, at a scale of 1:100, providing the most accurate amount of detail per unit size. Refer to provided Folder.

6.3 Out-of-Site Activities

The Surveying Team has carried out activities outside of the Site. Pre-emptively before arrival, an Excel spreadsheet had been created, to allow for very fast and accurate calculation of the location of Control Points on Ordnance Survey data. As a result, any data obtained on one day was processed within the same evening, permitting efficient work.

The team also took account of Near-Misses, which will be provided in a Report in Appendix F. Appendix F also contains an Accident Log, a duplicate of the one present in the Folder, though no accidents were recorded throughout the length of the survey.

7 Appendices

7.1 Appendix A: Full Description of Station A

UCL

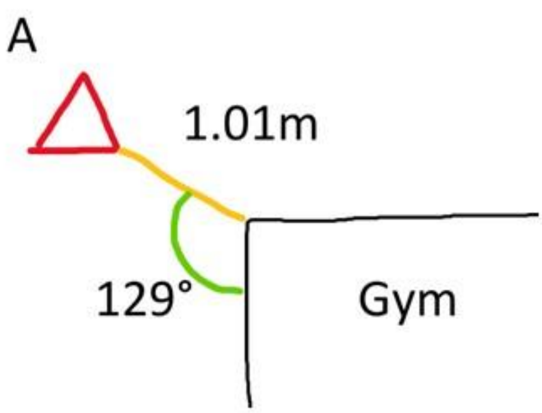
Station Description Sheet

Station Identifier:	A
Project:	SURV_LAMP
Date:	04/06/2025
Coordinates	
Easting	258120.608
Northing	248116.195
Height	116.03475
Coord. System:	Ordnance Survey (Newlyn)
Notes:	Wooden peg in ground in the northeast of the Sports Hall.
Image of Marker:	

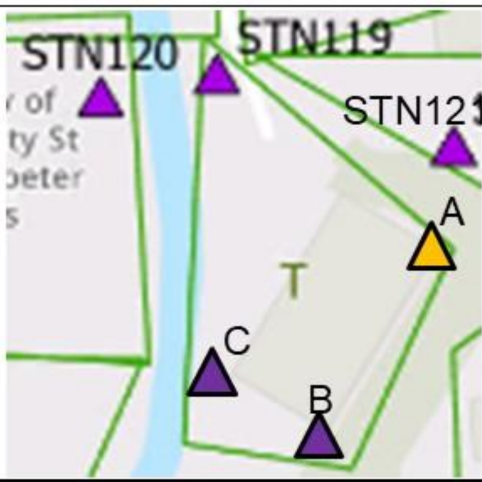
Station Image

Location Sketches

Detail



Overview



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7.2 Appendix B: Full Description of Station B

UCL

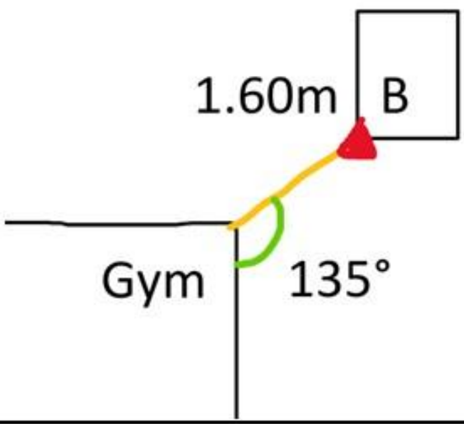
Station Description Sheet

Field	Value
Station Identifier:	B
Project:	SURV_LAMP
Date:	04/06/2025
Coordinates	
Easting	258096.368
Northing	248079.307
Height	115.9515
Coord. System:	Ordnance Survey (Newlyn)
Notes:	Outermost corner of manhole cover southeast of the Sports Hall.
Image of Marker:	

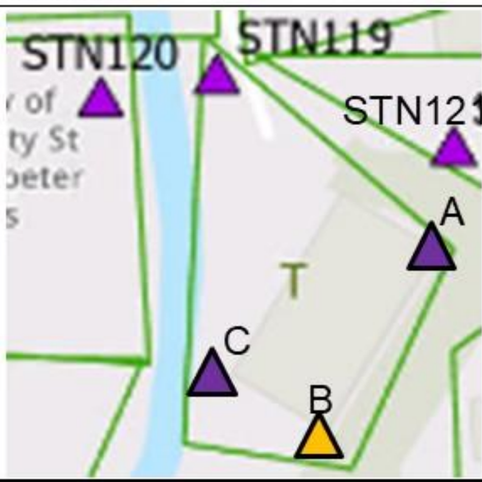
Station Image

Location Sketches

Detail



Overview



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7.3 Appendix C: Full Description of Station C

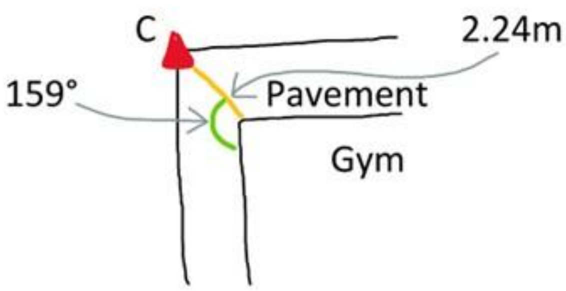
UCL

Station Description Sheet

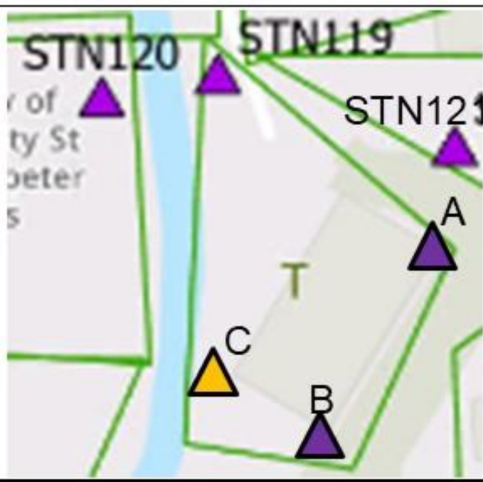
Station Identifier:	C	**Station Image**
Project:	SURV_LAMP	
Date:	04/06/2025	
Coordinates		
Easting	258078.734	
Northing	248090.456	
Height	116.13925	
Coord. System:	Ordnance Survey (Newlyn)	
Notes:	Outer corner of pavement southwest of the Sports Hall.	
Image of Marker:		

Location Sketches

Detail



Overview



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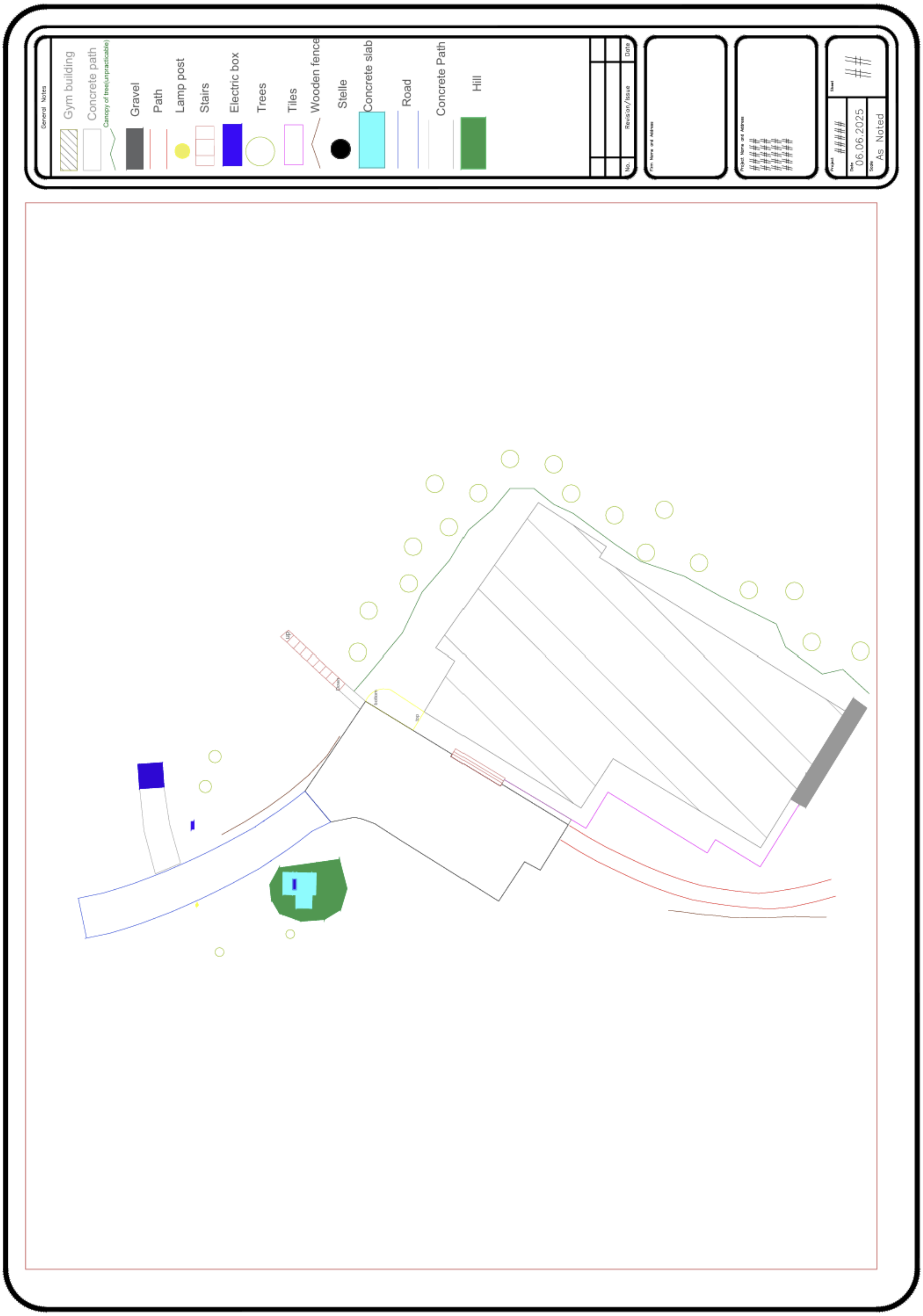
7.4 Appendix D: Final AutoCAD Deliverable Map



7.5 Appendix E: Lesson Learned Report

During this project, we learned the importance of planning, teamwork, and staying alert in the field. At first, we didn’t assign clear roles, which slowed things down. Once we split tasks more evenly, our workflow improved a lot.

We also realised how much ground conditions matter. Some points were hard to reach due to slopes or dense vegetation, especially near the southeast side. In those cases, it was better to stay safe and estimate than to risk unstable footing.

One big mistake we made was accidentally leaving the total station set up in the middle of the road during a break. Thankfully, no damage occurred, but it reminded us to always stay aware of our surroundings — especially in high-traffic areas.

We learned to double-check equipment setups, especially tripod stability, and to clean lenses regularly. We also saw how helpful clear communication is — even small misunderstandings led to wrong measurements, like confusing building corners.

Lastly, we learned not to rush. Fatigue caused a few avoidable errors, so taking breaks helped improve accuracy.