

Cork County Council

Cork to Kinsale Greenway

Topographic, Hydrographic and Structures Surveys Service Requirements

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1. Introduction

1.1 Background

Cork County Council is developing the Cork to Kinsale Greenway. This project, which is funded by Transport Infrastructure Ireland (TII), aims to provide a greenway to serve the communities between Cork City and Kinsale. Arup has been appointed by Cork County Council to provide multi-disciplinary engineering and other specialist consultancy services to progress the project through Phases 1–4 in line with the TII Project Management Guidelines.

1.2 Project Location

The project has been split into three distinct sections. This specification applies exclusively to Section 1 (Cork City to Crossbarry via Halfway) and Section 3 (Riverstick to Kinsale via Belgooly).

The specific extents of each of the surveys has been illustrated within Appendix B (CKG-ARP-PMG-P3-DR-001).

1.3 Survey Requirements

This document sets out the requirements for topographic, hydrographic and structures surveys. The survey requirements for each can be found within the following chapters of this specification in greater detail:

- Chapter 4 – Topographic and Hydrographic Survey Requirements
- Chapter 5 – Structural Survey and Inspection Requirements

The survey extents for each survey type are described below and illustrated in Appendix B (CKG-ARP-PMG-P3-DR-001).

1.3.1 Topographic and Hydrographic Survey Extents

The topographic and hydrographic survey requirements, detailed in Chapter 4, apply exclusively to Section 3, extending approximately 10 km from Riverstick through Belgooly to Kinsale.

The survey extents are illustrated in Appendix B (CKG-ARP-PMG-P3-DR-001). The total topographic and hydrographic survey area is approximately 106.5 hectares and includes rural and urban environments, rivers and streams, existing roads and bridges, historic railway structures, and utility infrastructure.

A total of nine structures are to be surveyed as part of the topographic and hydrographic surveys. These structures are listed in Table 1-1 and their locations are shown in Appendix B (CKG-ARP-PMG-P3-DR-001).

Table 1-1 Structures to be surveyed as part of the topographic and hydrographic surveys

Structure ID	Section	Description	GPS Location	Structures to be surveyed as part of:
THS-01	3	River crossing near Riverstick Wastewater Treatment Plant – form unknown	51.766555, -8.493991	Topographic & Hydrographic Surveys
THS-02	3	R600 river crossing – form unknown	51.765169, -8.497416	Topographic & Hydrographic Surveys
THS-03	3	Coillte trail river crossing – form unknown	51.764548, -8.498347	Topographic & Hydrographic Surveys
THS-04	3	R600 river crossing – form unknown	51.764528, -8.497687	Topographic & Hydrographic Surveys
THS-05	3	R600 river crossing – form unknown	51.760041, -8.496644	Topographic & Hydrographic Surveys

Structure ID	Section	Description	GPS Location	Structures to be surveyed as part of:
THS-06	3	L7226 river crossing – form unknown	51.753227, -8.497342	Topographic & Hydrographic Surveys
THS-07	3	R600 river crossing – form unknown	51.747932, -8.491960	Topographic & Hydrographic Surveys
THS-08	3	Aghafantaun Bridge – existing masonry arch bridge	51.740425, -8.487880	Topographic & Hydrographic Surveys
THS-09	3	Belgooly Bridge crossing River Stick – existing masonry arch bridge	51.735114 -8.48729	Topographic & Hydrographic Surveys

1.3.2 Structures Survey Extents

The structures survey requirements are detailed in Chapter 4 of this Specification. The purpose of the structures surveys is to obtain accurate geometric, photographic and condition data for the identified existing structures to support subsequent engineering assessments by the Project Team. The surveys comprise a combination of structural inspection, LiDAR scanning, photogrammetry and, where applicable, bathymetric surveying. Survey data shall be captured to a level of detail sufficient to develop accurate 3D models, obtain key structural dimensions, identify visible defects and provide a comprehensive record of the existing structures and their surrounding environment.

A total of five key structures have been identified for detailed structural survey and inspection. These structures will be surveyed independently of the topographic and hydrographic surveys to facilitate a preliminary assessment of their condition and suitability for reuse as part of the proposed greenway. In addition, one structure (THS-09) has been identified as requiring a structural condition assessment and inspection in addition to the topographic and hydrographic survey.

The structures are located across Section 1 (Cork City to Crossbarry via Halfway) and Section 3 (Riverstick to Kinsale via Belgooly). A summary of the structures is provided in Table 1-2, with their locations illustrated in Appendix B (CKG-ARP-PMG-P3-DR-001).

Table 1-2 Existing Structures to be Surveyed

Structure ID	Section	Description	GPS Location	Structures to be surveyed as part of:
STS-01	1	Chetwynd Viaduct – existing cast iron arch bridge	51.860702, -8.527923	Structures Surveys and Inspections
STS-02	1	Halfway Viaduct – existing masonry arch bridge	51.806029, -8.570228	Structures Surveys and Inspections
STS-03	3	Lybe Road near Belgooly – existing masonry arch bridge	51.735940, -8.484165	Structures Surveys and Inspections
STS-04	3	Existing road bridge on R600 - form unknown	51.721908, -8.488874	Structures Surveys and Inspections
STS-05	3	Former R600 bridge - existing cast-iron bridge	51.717791, -8.496183	Structures Surveys and Inspections
THS-09	3	Belgooly Bridge crossing River Stick – existing masonry arch bridge	51.735114 -8.48729	Structural Inspections

1.4 Purpose of the Surveys

The topographic and hydrographic surveys are required to collect accurate spatial, terrain and watercourse data to inform the planning, design and development of the Cork to Kinsale Greenway. The survey outputs

will support engineering design, environmental assessment, option development and stakeholder engagement activities throughout the project lifecycle.

The structural surveys and inspections are required to undertake preliminary condition assessments of existing structures that may be repurposed as part of the greenway. The findings will inform the anticipated function of each structure, identify any constraints or defects, and support the development of robust cost estimates for any modifications, rehabilitation works or maintenance interventions required to facilitate their future use.

2. Scope of the Services

2.1 General

1. The Contractor shall undertake detailed topographic and hydrographic surveys within the areas enclosed by the survey boundary shown on Contract Drawings CKG-ARP-PMG-P3-DR-001.
2. The Contractor shall undertake full detailed topographical surveys in accordance with this specification and the relevant sections of SUR-SVW-0001 (TII Route Topographical Survey at 1:200 Map Scale General Service Requirement) referenced within this specification and included in Appendix A.
3. The Contractor shall undertake an inspection for assessment and condition assessment of each existing structure identified in Table 1-2, as per Chapter 5 of this specification.
4. The Contractor shall undertake detailed LiDAR and photogrammetry surveys of each existing structure, where applicable, as per Chapter 5 of this specification.
5. The Contractor shall undertake bathymetric survey where required as per Chapter 5 of this specification.
6. Hydrographic Surveys to be carried out as set out in Chapter 3.2. The Contractor shall undertake full detailed watercourse surveys in accordance with this specification.
7. Surveys of features associated with underground services shall be undertaken as described in Chapter 3.1.14.
8. The Contractor shall manage and make provision to carry out any and all traffic safety and management requirements necessary to undertake the survey on public roads in accordance with all relevant statutory regulations. The Contractor shall bear all cost for traffic management implementation, management, operation, removal, including any associated road closure fees. For further information refer to Chapter 7 of the Specification.
9. The Contractor shall be responsible for ensuring that work areas are left in a safe and tidy manner following the conclusion of works.
10. The Contractor shall not interfere with hedgerows, boundaries or leave gates open during the course of the surveying or cause interference with activities. Where it is unavoidably necessary and agreed with the Client's Representative, for the purposes of the survey to cut through hedges, the gaps shall be filled, and the boundaries effectively restored immediately following the completion of surveying operations.
11. The amount of cutting of shrubbery, hedging etc. should be kept to the minimum required to obtain the necessary information and no lasting damage is to result. At all times, the integrity of the boundaries shall be preserved. The extent of shrubbery to be removed shall be agreed in consultation with and by approval of the Client's Representative.
12. Surveying staff shall have identification badges clearly displayed which shall include personnel name, photograph, company name, logo and date. The Contracting Authority shall provide letters of authority for the Contractor's staff as necessary. Contractor's staff entering such properties shall carry this letter of authority and individual proof of identity supplied by the Contractor.

13. The Tenderer shall conduct a site visit in order to satisfy themselves of the scope of services listed above. If during the site visit omissions from the scope of services are identified, notification of such items shall be submitted to the Client's Representative.
14. Certain sections of the survey area may be difficult to obtain access due to local constraints. In such instances, alternative means of surveying these areas such as unmanned aerial vehicle surveying or similar suitable alternative approaches may be permitted. Where unmanned aerial vehicle surveying, or similar suitable alternative approaches are utilised, the data produced shall be capable of integration with survey data obtained via traditional means. If the use of drones or other aerial devices by or on behalf of the Contractor are required in the undertaking of this appointment, the Contractor shall provide written confirmation from their Employer's and Public Liability insurers that the use of such equipment is covered or alternatively that the Contractor shall provide evidence of separate Aviation Liability insurance in respect of such drones with an indemnity limit of not less than €6.5million and including a notation of an indemnity to the Contracting Authority. This shall be carried out prior to the use of drones or other aerial devices on the Project.
15. Areas deemed inaccessible due to overgrowth shall be brought to the immediate attention of the Client's Representative at Tender Stage for discussion. Subsequent topographical drawings supplied by the Contractor with areas devoid of elevations and topographical detail with vague descriptions akin to "dense vegetation" shall not be accepted.
16. An agreement between the Client's Representative and the Contractor shall be made during the first (online) meeting to determine the level/ layer setup and colouration and should be agreed upon prior to survey execution.
17. Additional survey works services may be requested by the Client's Representative in and around the study area, for Contracting Authority use.
18. Temporary pegs installed during the survey shall be so located and protected so that they do not cause damage or obstruction to farming activities and they shall be removed on completion. Failure to comply with this requirement may render the Contractor liable for damage to farming activities or for injury to third parties. The Contractor shall avoid placing temporary pegs in the hard surfaces of private driveways or using permanent spray paint on these surfaces without the land or property owners' consent.

2.2 Site Access and Landowner Consent Requirements

1. Access to the site shall be pre-arranged through the Project Liaison Officer for the Cork to Kinsale Greenway Project. Contact details will be provided in advance to the Contractor.
2. The Contractor shall be required to liaise with landowners, householders and members of the public with regard to access to the various parts of the demarcated site area. The Contractor must endeavour to foster good relations with all parties throughout the survey period.
3. The Contractor shall notify the Project Liaison Officer before gaining entry and agree with them dates, times and all routes and means of access. A notice period for the Project Liaison Officer of 6 working days prior to planned entry. Where access to the Contractor is refused, the Contractor shall immediately notify the Client's Representative.
4. The Contractor shall provide a single point of contact to liaise with both landowners / occupiers and the Project Liaison Officers on all matters relating to landowner liaison and access.
5. The Client will provide letters of authority for the Contractor's staff, as necessary. Contractor staff entering such properties shall carry this letter of authority and individual proof of identity supplied by the Contractor.

2.3 GDPR Requirements

1. The Contractor shall enter into a Data Processing Agreement and any other data sharing arrangements required by the client.

2. The Contractor will be required to demonstrate compliance under GDPR and provide details for managing, storing, and disposing of personal data (landowner details) provided to them. Where personal data is collected or shared during the services it shall be "adequate, relevant and not excessive" for the purpose for which it is required. This means that the data from such processing shall be limited to what is strictly necessary to achieve the specific purpose defined in this Specification.

2.4 Working Hours

1. Normal working hours shall be as follows:
 - Monday to Friday (08:00 – 18:00)
 - Saturday (08:00 – 16:00)
2. The Contractor shall note that due to existing traffic arrangements, restrictions imposed by landowners, the Garda Síochána, the local authorities, out of hours (i.e. weekend or night-time) working may be required.
3. Should out of hours working be envisaged, the Contractor shall inform the Client's Representative not less than six working days prior to the proposed works being undertaken.
4. The Contractor shall allow in its total fee all additional costs that it may incur as a result of unsocial working hours.

2.5 Start-up Meeting

1. As soon as is practicable after award of the Contract the Contractor shall meet with the Client's Representative online in order to explore procedures for anticipating and reporting, avoiding or minimising, monitoring, recording, well managing generally and properly any changes or impediments to the performance of the services or their progress that may arise. Any agreements reached shall be recorded and agreed procedures shall be implemented by the Contractor and its sub-contractors and the Client's Representative throughout the Contract so as to fulfil their purposes.
2. The Contractor shall liaise continuously with the Client's Representative during performance of the Services, to report progress and to deal expeditiously with queries and problems while the survey team/s are on site. Advance and proof copies of Survey Drawings and data shall be provided for discussion and approval before the survey deliverable is finalised.
3. The Contractor shall nominate, in its tender submission, a key person who shall act as the liaison between the Contractor and the Client's Representative. If replacement of this key person is necessary, such replacement shall be agreed with the Client's Representative prior to the change taking place.

2.6 Calibration and Checking of Equipment

1. The Contractor shall be responsible for the calibration of all survey and positioning equipment. Valid Calibration Certificates for equipment shall be produced by the Contractor before the start of the survey, and at any point during the execution of the work as requested by the Client's Representative.
2. If any damage liable to affect the calibration of the survey instruments is suspected during the course of the contract, the instrument shall be recalibrated.
3. The Contractor shall submit a Method Statement and Risk Assessment detailing their survey techniques two weeks prior to the commencement of the survey works for approval by the Client's Representative.

2.7 Survey Records Retention

1. The Contractor shall retain all survey records for a period of no less than seven years from the date of Contract completion.

3. Topographic and Hydrographic Survey Requirements

3.1 Topographic Survey Requirements

3.1.1 Frequency of Survey Points

1. Survey points shall be taken along main features at maximum intervals of 10m. However, this interval shall be reduced depending on factors such as complexity of street geometry, e.g. plan radius, rate of change of gradient, general ground conditions, etc. Curved features, such as kerb lines, shall be surveyed as a curve such that the chord to arc distance shall not be greater than 50 mm.
2. Spot levels and their co-ordinate positions shall be taken along road centrelines, pavements, carriageways, hard shoulder edges, top of kerbs, bottom of gutters (channels), at intervals as previously described above. Spot levels shall also be taken where distinct changes in direction/gradient occur. A sufficient density of spots shall be obtained in order to produce an accurate Digital Ground Model (DGM).
3. The Contractor shall record junction layouts, including residential and private accesses (lane markings, signage, service locations, crown lines, drainage furniture, traffic islands, safety barriers etc.).
4. Areas with different surface cover (paved areas, rock outcrops etc.) shall be identified and the boundary extent of such areas provided.

3.1.2 Control Points

1. Survey control station points shall be surveyed in accordance with the TII Specification SUR-SVW-0001 Route Topographical Survey at 1:200 Map Scale General Service Requirement SUR-SVW-0001 and adhere to the following:
 - a. A horizontal and vertical control network shall be established by the Contractor from which to base the topographical survey. Control points shall be established in such a manner that their location shall allow effective future use and their construction shall be sufficient to withstand at least five years of normal usage, taking into account the surroundings at each location. The types of material used shall be such that their impact upon the environment and any normal activities at each location is minimised.
 - b. Plan control shall be based on ETRS89 coordinate system with computed coordinates projected into Irish Transverse Mercator (ITM). Ellipsoidal heights shall be transformed into orthometric height to Malin Head Datum using the Ordnance Survey Geoid Model.
 - c. Secondary control points shall be connected by a closed net, which shall be tied to at least two control points positioned using GPS (Global Positioning System) referencing the Active GPS Network.
 - d. The maximum closing error for all distances between points used to determine the location of secondary control points when checked by precise measurement shall not exceed 1/100,000 or between adjacent site survey control points ± 5 mm.
 - e. Connection to the Ordnance Survey of Ireland (OSi) Active Network is required.
 - f. All survey control stations shall be referenced to the surrounding detail. The Contractor shall prepare location diagrams for each control station such that it can be relocated without the need of survey instrumentation.
 - g. A location diagram shall be prepared for each permanent ground marker. Ground markers to be used shall be agreed with the Client's Representative as per Figure 3.1 below.
2. On completion of the fieldwork and adjustment, a comprehensive control report shall be prepared detailing the methods used, a full network adjustment report, checks applied and any problems encountered.

3. An advance copy of the reports, together with copies of the horizontal control network diagram, schedule of stations, and station location diagrams shall be submitted to the Client's Representative for approval. On approval, this shall form part of the final detailed survey report.

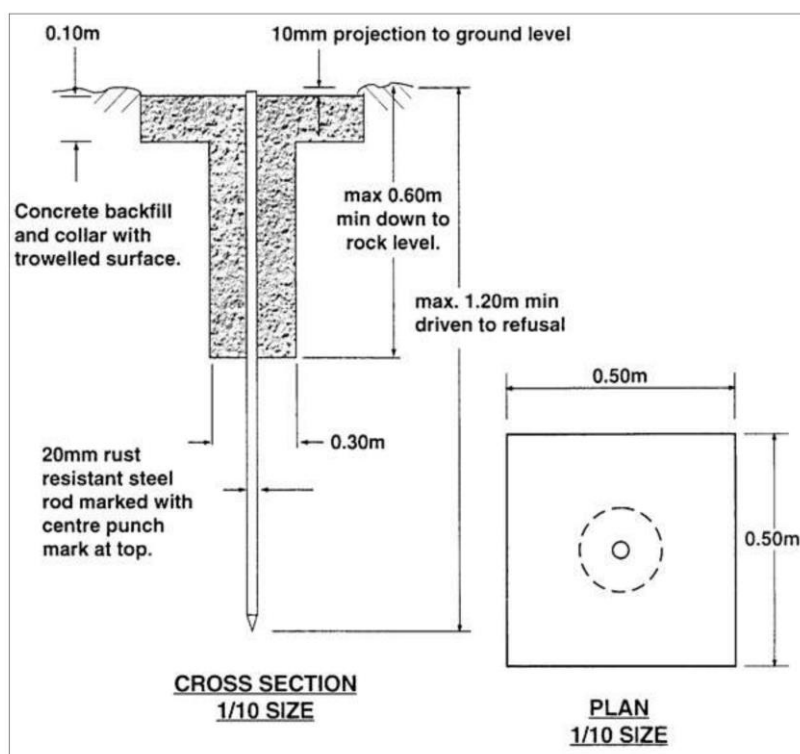


Figure 3.1. Permanent Ground Marker (For Non-Agricultural Sites and Unpaved Surfaces)

3.1.3 Building Structures

In addition to the features specified in TII Specification SUR-SVW-0001, the following topographic features and details (general layout, floor levels, apex levels, etc.) shall be surveyed: (a) Retaining walls (b) Other relevant features (to include historic railway structures).

3.1.4 Boundary Features

All boundary features, roads, tracks and footpaths shall be surveyed in accordance with TII Specification SUR-SVW-0001. In addition to the features specified in TII Specification SUR-SVW-0001, the following topographic features and details shall be surveyed:

- a. Crown lines or any change in crossfall / longfall on the pavement surface
- b. Lane demarcations e.g. hard shoulder, slow lane, fast lane, start of overtaking, end of overtaking, slip lanes etc.
- c. Changes in surface materials / type (tarmac, concrete grass etc.)

3.1.5 Street Furniture and Visible Surface Features

All street furniture and visible surface features shall be surveyed in accordance with TII Specification SUR-SVW-0001. In addition to the features specified in TII Specification SUR-SVW-0001, the following topographic features and details shall be surveyed:

- a. Safety barriers / Road restraint systems
- b. Benches
- c. Shelters
- d. Road side cabinets
- e. Other relevant features

3.1.6 Railways and Light Rail

Railways shall be surveyed in accordance with TII Specification SUR-SVW-0001

3.1.7 Water, Drainage and Coastal Features

All water, drainage and coastal features shall be surveyed in accordance with TII Specification SUR-SVW-0001. In addition to the features specified in TII Specification SUR-SVW-0001, the following topographic features and details shall be surveyed:

- a. Headwalls
- b. Stormwater network, including cover and invert levels

Date-stamped soffit, invert, bed and water levels, where safe and practicable, shall be undertaken for all water, drainage and coastal features. Those considered by the Contractor to be not possible, shall be brought to the immediate attention of the Client's Representative at Tender Stage for discussion. The Contractor shall obtain the necessary safety training, permissions, work permits, etc., from the appropriate authorities, to perform the work safely and accurately.

3.1.8 Slopes and Earthworks

All slopes and earthworks shall be surveyed in accordance with TII Specification SUR-SVW-0001. In addition to the features specified in TII Specification SUR-SVW-0001, the following features shall be surveyed:

- c. Ornamental slopes
- d. Barrows
- e. Peat beds
- f. Archaeological mounds
- g. Industrial waste and refuse tips
- h. Adits and mineshafts
- i. Other relevant features

3.1.9 Woods, Trees and Recreation Areas

Woods, Trees and Recreation Areas shall be surveyed in accordance with TII Specification SUR-SVW-0001.

3.1.10 Industrial

Industrial areas shall be surveyed in accordance with TII Specification SUR-SVW0001.

3.1.11 Grid of Elevations

Grid of Elevations shall be in accordance with TII Specification SUR-SVW-0001.

3.1.12 Three Dimensional (3D) Strings

Three-dimensional (3D) break line strings shall be completed in accordance with TII Specification SUR-SVW-0001.

3.1.13 Contours

Contours shall be completed in accordance with TII Specification SUR-SVW-0001.

3.1.14 Underground Services Surveys

All visible features associated with underground utilities shall be surveyed by the Contractor within the designated Topographical Survey areas as shown on Contract Drawings (CKG-ARP-PMG-P3-DR-001). The general utility survey shall include the following utility infrastructure:

- a. Watermains, valves, meters, manholes etc.
- b. Foul Drainage / Surface Water / Storm Water Drainage manholes, gullies, gratings, etc.
- c. Pumping stations and associated features
- d. Electricity
- e. Gas
- f. Communications
- g. Combined Service Ducts
- h. Street Lighting

i. Other Underground Buried Features

3.2 Hydrographic Survey Requirements

Arup have undertaken a desk-study exercise to identify likely extents of hydrographic survey and these are shown on CKG-ARP-PMG-P3-DR-001.

3.2.1 Hydrographic Survey General Requirements

The extents of survey required are shown on CKG-ARP-PMG-P3-DR-001. Where a watercourse is encountered which is not identified in these extents, cross-sections should be surveyed from 1km downstream to 0.5km upstream of the centreline of Corridor. Survey cross-sections shall be generated at 30m intervals.

All hydrographic survey including cross sections, structures, culverts, weirs etc should be surveyed in accordance with the current version of the Office of Public Works Survey Specification, Flood Risk Management Projects, 2023 (<https://assets.gov.ie/static/documents/opw-frm-survey-spec-version-30.pdf>), and in particular Chapter 4, Survey Requirements.

The deliverables should also be provided in accordance with the OPW Survey Specification, particularly Chapter 5, Survey Deliverables.

3.3 Data Integrity and Accuracy

The requirements in respect of data integrity and accuracy for the topographical and hydrographic surveys shall be in accordance with Chapter 3 (Data Integrity and Accuracy) of TII Specification SUR-SVW-0001 Route Topographical Survey at 1:200 Map Scale General Service Requirement.

The Contractor shall present the proofing of the topographical survey data in a report format. This report at a minimum shall include:

- A description and results thereof of the proofing analysis undertaken.
- Recommendations and conclusions on the validity and accuracy of the topographical survey data. Conclusions on the accuracy of the data shall be provided.

3.4 Contractor's Reports

The Contractor shall prepare Status Reports, Progress Reports and a final Project Report (including the utilities report) for the topographical and hydrographic surveys in accordance with the requirements of Chapter 4 (Contractor's Reports) of TII Specification SUR-SVW-0001 Route Topographical Survey at 1:200 Map Scale General Service Requirement.

In addition to the two interim progress reports specified in TII Specification SUR-SVW-0001, the Contractor shall provide an electronic weekly summary of progress versus programme for each individual work package as outlined in the Pricing Document to the Client's Representative.

3.5 Format of Survey Data

The format and structure of survey data produced by the Contractor for the topographical and hydrographic surveys shall be in accordance with Chapter 5 (Format of Survey Data) and Chapter 6 (Structure of Survey Data) of TII Specification SUR-SVW-0001 Route Topographical Survey at 1:200 Map Scale General Service Requirement. A copy of all the survey data prepared in a CAD format shall also be provided in GIS format (.gdb, .sde or shapefile) with the same level of graphical detail and associated attribute information.

3.6 Deliverables Required

As well as the Surveying Control Report, a final Project Report for the topographical and hydrographic surveys shall describe the methods, techniques and equipment used in the survey, and the software parameters and methods used in the data validation and processing.

All survey data produced is subject to the terms of the Data Protection Agreement included in the Tender Documents. The required Topographic and Hydrographic deliverables shall include:

- a. A brief Project report recording planned and actual delivery dates and costs, any problems encountered and any changes or variations to the original contract requirement.
- b. A schedule of all drawings produced.
- c. A copy of all original survey data in 3D CAD drawing file supplied on digital fileshare. See SUR-SVW-0001 Survey Appendix 1 and sample 3D Topographical CAD drawing file for the CAD drawing structure.
- d. A copy of the survey data in MX GENIO format generated from the 3D CAD drawing file supplied on digital fileshare. For MX string naming convention see SUR-SVW-0001 Survey Appendix 5.
- e. A copy of all the survey data prepared in a CAD format shall also be provided in GIS format (.gdb, .sde or shapefile) with the same level of graphical detail and associated attribute information.
- f. Schedule of location, depths, nature, type, condition, diameter etc. of all services located in accordance with Chapter 3.1.14.
- g. All watercourse survey data should be provided in x,y,z (hard), z(soft) and id and reference, comment (bed material, vegetation type, etc.) with date and time format.
- h. For the hydrographic survey, a long section should be produced showing the talweg invert, water elevation and left and right bank top levels in addition to toe and crest of levees / flood embankments / walls if present.
- i. A hard copy (A4 portrait) and a digital copy supplied on digital fileshare of all survey control location diagrams. See station schedule section and SUR-SVW-0001 Survey Appendix 6.
- j. Digital copy of the ground control survey adjustment and results.
- k. CAD drawing providing all of the survey control points (primary and secondary).
- l. Information of all survey equipment used including: equipment listing, specification and calibration certificates.
- m. A description of safety incidents, and landowner/occupier incidents.
- n. A list of external factors affecting the survey.
- o. Signed self-certification check lists.
- p. A report presenting the proofing of the topographical survey data.
- q. Certificate confirming that the survey control and drawings have been validated by the Contractor and conform to the specification and all service requirements.

4. Structural Survey and Inspection Requirements

4.1 General

4.1.1 Primary Objectives

The primary objectives of the structural inspection for assessment include:

- Inspection of the structural components and assessment of their condition, including details and quantities of any identified defects.

- Record and document a full geometric inventory of the structure including site measurement of key geometric parameters and member sizes to enable structural assessment

The primary objective of the structural survey is to capture accurate 3D data of the existing structure and surrounding environment, using the most appropriate survey methodology (see Chapter 4.1.4), to assist in the condition assessments and preliminary structural assessment. The survey data shall provide sufficient detail and accuracy to support these objectives. Where practicable, the survey shall comprehensively capture the entire structure and all relevant features, enabling the development of a high-fidelity 3D model from which detailed geometric measurements and structural dimensions can be reliably obtained.

4.1.2 Desktop Review

The Contractor shall obtain and review available documentation relevant to the structure prior to undertaking survey works including, but not limited:

- Publicly available information on the existing structures (i.e. NBHS records)
- Previous inspection reports (MCT0596RP0001A01/November 2013)

The purpose of the review is to:

- Develop an understanding of the structure's age, form, construction, maintenance history
- Identify critical structural elements requiring detailed inspection and measurement
- Review historical defects, repairs, strengthening works, and modifications
- Develop an informed inspection and testing strategy
- Assess the constraints of the area and develop an informed geometric survey methodology
- Identify potential health and safety risks associated with the survey and inspection

4.1.3 Site Visit

1. The Contractor shall visit each site to review the site constraints and to assess if any modifications to the specification are required prior commencement of works.
2. The Contractor shall arrange a pre-survey meeting with Arup which shall take place after the site visit to ensure that all requirements of the specification are understood and achievable.

4.1.4 Methodology

1. The survey and data acquisition methodology will depend on the Contractor's equipment and experience. The Contractor should propose an optimal methodology to survey each existing structure in sufficient detail to allow for preliminary structural assessment considering the effects of vegetation, access, lighting etc. The proposed methodology shall be included as part of the method statement (see Section 4.1.5). The suggested methodology for each existing structure is summarised in Table 4-1.
2. Digital photogrammetry may be used in combination with terrestrial or airborne LiDAR if appropriate to derive 3D elevation data and colour imagery. In cases where multiple survey methods are used, the results should be merged to produce a single consistent dataset
3. The Contractor shall employ personnel and sub-contractors, where appropriate, who are skilled and experienced in carrying out works of the nature described in this Specification and who are both experienced and competent.
4. The Contractor is responsible for arranging vegetation removal around the existing structures with the relevant landowners and authorities prior to survey works.
5. The Contractor shall employ all reasonable and practicable measures, including the use of supplementary survey methods, alternative access arrangements, repeat site visits where justified, and additional data capture techniques, to minimise areas of missing or incomplete survey data. Any areas not captured due to access restrictions, vegetation, water levels, shadowing, line-of-sight limitations, or obstructions shall only be accepted where the Contractor can demonstrate that all reasonable efforts have been made to obtain the information. Such areas shall be identified on the survey drawings and within the survey

report. The Contractor shall quantify any data gaps, describe the efforts undertaken to mitigate them, and assess their potential impact on the proposed structural assessment.

Table 4-1 Proposed Survey Technique Specified for each Structure

Structure ID	Proposed Methodology
STS-01	- Combined terrestrial + UAV LiDAR for geometric point cloud - Photography for structural inspection - Structural inspection and condition assessment (Refer Appendix D)
STS-02	- Combined terrestrial + UAV LiDAR for geometric point cloud - Combined terrestrial + UAV Photogrammetry for structural inspection, supplemented with photography - Structural inspection and condition assessment (Refer Appendix D)
STS-03 STS-04 STS-05	- Combined terrestrial + UAV LiDAR for geometric point cloud - Combined terrestrial + UAV Photogrammetry for structural inspection, supplemented with photography - Bathymetric survey - Structural inspection and condition assessment (Refer Appendix D)
THS-09	Structural inspection and condition assessment (Refer Appendix D)

4.1.5 Method Statement

The Contractor shall prepare a method statement to be submitted for approval at least one week in advance of any works proceeding. The method statement shall provide details to illustrate the form, sequencing and programming of all major work elements including key constraints and critical path items. The programme shall be clearly organised and shall include the start and completion dates for each activity and their inter-relationships and shall contain sufficient detail to assure the Employer's Representative of the feasibility of the plan and approach proposed by the Surveyor.

The method statement should also detail the investigation sequencing, location of access for all labour and equipment, direction of workflow, equipment facilities, investigation methods, special specification restraints, provision of resources, health and safety issues etc.

The Contractor shall ensure that all their staff (and those of their sub-contractors if any), and any other personnel are aware of the requirements of this specification and any requirements requested by the local authority, Irish Rail or any other applicable stakeholder.

4.1.6 Applicable Standards

The inspection for assessment is to be carried out to the advice notes and directives supplied in the relevant standards:

- AM-STR-06054 - *EIRSPAN Bridge Management System Principal Inspection Manual*
- AM-STR-06002 - *The Assessment of Road Bridges and Structures*
- AM-STR-06026 - *The Assessment of Road Bridges and Structures (including Erratum No. 1, dated December 2014)*
- AM-STR-06056 - *Stage 1 Structural Assessment of Road Structures*
- AM-STR-06031 (BD 44): *The Assessment of Concrete Road Bridges and Structures*
- AM-STR-06035 (BD 56): *The Assessment of Steel Road Bridges and Structures*
- AM-STR-06037 (BD 61): *The Assessment of Composite Road Bridges and Structures*
- AM-STR-06039 (BD 79): *The Management of Sub-standard Road Structures*
- AM-STR-06042 (BD 101): *Structural Review and Assessment of Road Structures*
- AM-STR-06057: *Stage 2 Structural Assessment of Sub-Standard Road Structures*
- AM-STR-06010 (BA 44) *The Assessment of Concrete Road Bridges and Structures*
- AM-STR-06012 (BA 51): *The Assessment of Concrete Structures Affected by Steel Corrosion*
- AM-STR-06015 (BA 55): *The Assessment of Bridge Substructures and Foundations, Retaining Walls and Buried Structures.*

4.2 Structural Inspection for Assessment Requirements

4.2.1 Requirements of Inspector

1. The contractor shall ensure the individual undertaking the structural condition assessment is suitably qualified and experienced in the inspection of structures. As a minimum, the inspector shall satisfy the educational, training and experience requirements specified by the TII Bridge Management Section, including attendance at the TII EIRSPAN Training Workshop.
2. The contractor shall submit the curriculum vitae (CV) and details of relevant qualifications, training and experience of the proposed inspector at least 14 days prior to commencement of the works. The condition assessment shall not proceed until the proposed inspector has been accepted by Arup.

4.2.2 Inspection and Testing Requirements

Guidance on the structure specific requirements for inspection and testing is included in Appendix D.

4.2.3 Condition Assessment

1. A condition assessment of the structure shall be undertaken to assess the physical condition of the bridge components and identify any defects, damages or maintenance issues that exist.
2. Assessment of structural components and their condition shall be undertaken using the standard condition rating system defined in AM-STR-06054.
3. A condition rating is to be assigned and reported for the structure and each of its components and any necessary repair works shall be stated for each standard component.

4.2.4 Defect Identification

1. The Contractor shall identify defects visible from the survey data, photographs and visual inspection. Identified defects and deterioration of structural components shall be recorded, identifying the extent of deterioration. Defects concealed by access limitations, vegetation, water, debris or other obstructions shall be reported.
2. Possible defects to be identified include but are not limited to cracks, corrosion, spalling, settlement, defective materials, impact damage, water ingress etc. The extent of deterioration (i.e. loss of section) shall be recorded for all identified defects.
3. All defects shall be schematically recorded, mapped out and photographed within the inspection report. Sufficient detail is required to facilitate a preliminary structural assessment by a structural engineer to evaluate their impact on the safety and integrity of the structure.
4. Where a component cannot be accessed for measurement, approximate size, location and a brief description of the defect shall be recorded
5. The changes in defect since the previous inspection are to be recorded where relevant.

4.2.5 Photographic Record Requirements

1. The condition assessment inspection report shall include photos which record the current condition of the existing structure. At a minimum, the required photos to be captured are as outlined in Chapter 3.10 of AM-STR-06054.
2. All instances where defects or deterioration are identified for a structure should be recorded photographically.
3. All photos shall be date-stamped, and number referenced if more than one photograph is required for any component.
4. Photographic records shall be captured in a systematic and structured manner to ensure full traceability between each photograph and the corresponding bridge element or structural member. Photographs shall be suitably referenced, labelled, and organised to enable the location, orientation, and subject of each image to be readily identified and correlated with the survey data, inspection records, and 3D model.

4.2.6 Intrusive and Non-Intrusive Investigations

The contractor shall assess the need for specific testing of certain structural parameters as per the guidance in Chapter 3 of AM-STR-06056.

4.2.7 Specialist Access Equipment

1. The Contractor shall review the list of structures and determine which structure(s) require specialised access equipment for inspection.
2. The contractor shall organise their own access if specialist equipment is required and request and obtain consent from relevant authorities where required.

4.3 Photogrammetry Requirements

4.3.1 General

1. The extents of survey should be appropriate to sufficiently capture geometric details of the existing structure as per the scope in this specification and should enable creation of a photogrammetric model for visualisation purpose. This should specifically include the existing structure from all angles (above, below, both sides). Please refer to Appendix C for more information.
2. In locations where trees overhang the road, flight paths and camera angles may need to be adjusted to ensure proper acquisition of the scene.
3. The imagery is to be captured using a tripod-mounted or drone-mounted camera or a combination of both.
4. When capturing photographs to be used for photogrammetry, the Contractor shall take the photographs from a range of angles, with successive images having at least 70% overlap with the previous image, and each subject point being captured in at least 8 images.
5. The survey data shall be georeferenced to ITM (EPSG:2157) horizontally and referenced to the OSGM15 geoid model with Malin Head datum vertically, and include the boundaries of surrounding roads, structures, walls, buildings, or other identifiable features.
6. The survey shall include a number of control points for geolocating the survey, checking the accuracy of the 3D surface model, and providing reference points for any future surveys.
7. Weather conditions should be similar during each survey. Surveys should not be undertaken in rain or at wind speeds >10 m/s. The time of survey should be the same each day to maintain similar light conditions.
8. For structures over water, the photographic survey should be completed at low tide to ensure the maximum visibility of the structure.
9. The contractor is to ensure that the photography data and overall coverage of the survey are as per the specification. If any submitted deliverable is found to be in noncompliance with the specification or not fit for purpose, the Contractor shall resubmit the deliverables to the required specification at their own expense.
10. Survey data must be referenced to ground control points to maximize the absolute accuracy. This is achieved by survey crews establishing photo ground control within the project area. Targets should be placed so that the location of the point is easily identified on the imagery. The field measurement of the horizontal and vertical elevation (X, Y and Z) of the control points will be used in the downstream processes of photogrammetry and/or point cloud calibration to register the data sets to field survey values. Elevations must be provided at surface grade.

4.3.2 Camera Setup

The below table outlines some parameters for camera setup required for the photograph survey.

Table 4-2 Camera Setup

Parameter	Requirement
Aperture	See Chapter 3.1 of Appendix C
Shutter Speed	1/120 Seconds (Minimum) to avoid motion blur - See Appendix C
ISO	See Chapter 3.3 of Appendix C

4.3.3 Image Precision

1. Ground Control Points coordinates absolute accuracy shall be +/-10mm
2. Image Precision (P) is assumed as 2x of relative resolution of an image in mm of distance on ground per pixel i.e. ground sampling distance
3. The minimum image precision for this survey shall be 5mm/pixel for STS-02 to STS-04 and 3mm/pixel for STS-05. Refer to 5.2 of Appendix C for more details.

4.4 LiDAR Scanning Requirements

4.4.1 General

1. The Contractor shall undertake LiDAR scanning with RGB point cloud.
2. Point cloud density shall be sufficient to resolve all structural elements required for assessment and measurement. The average point spacing on the bridge structure shall not exceed 5mm for STS-02 to STS-04, and 3 mm for STS-01 and STS-05. The Contractor should advise on alternatives following the site visit to ensure that the resolution is optimal whilst minimising the effects of oversampling.
3. For STS-01 and STS-05, the accuracy of the scan should be sufficient to pick up geometric imperfections in members (crookedness, member bow etc.) and details of damaged and repaired sections.
4. The contractor shall nominate the use of terrestrial (tripod-mounted), drone-mounted or a combination of to undertake LiDAR scanning of the existing structure.
5. The Contractor should propose an optimal methodology to survey all exposed faces of the existing structure considering the effects of vegetation, access, and, where applicable, survey stations should achieve an appropriate scan overlap (~60%). For all scan-to-target locations, multiple scans, perpendicular to the orientation of the structures are required to achieve full line-of-sight scanning and to minimise the creation of areas which are occluded.
6. The use of LiDAR using multiple signal returns is preferred to enable penetration of vegetation and maximise resolution.
7. Weather conditions should be similar during each survey. Surveys should not be undertaken in rain or at wind speeds >10 m/s. The time of survey should be the same each day to maintain similar light conditions.
8. The survey data shall be georeferenced to ITM (EPSG:2157) horizontally and referenced to the OSGM15 geoid model with Malin Head datum vertically, and include the boundaries of surrounding roads, structures, walls, buildings, or other identifiable features.
9. The survey shall include a sufficient number of control points for geolocating the point cloud, checking the accuracy of the point cloud, and providing reference points for any future surveys. Independent, accurately surveyed ground control points are required to ensure the highest level of spatial accuracy and to compare the accuracy of the results of the survey. The number and spacing are to be recommended by the Contractor.
10. The point cloud shall be classified such that each point is assigned a category from the following list: ground, road surface, vegetation, existing structure.

4.4.2 Resolution and Accuracy

1. For LiDAR surveys, angular resolution should be optimised for resolving the geometry and defects in the wall and to produce an accurate point cloud.
2. The horizontal and vertical absolute accuracy shall be +/-5mm for hard detail and +/- 25mm for soft details such as changes in vegetation and surface changes. For all scan-to-target locations, multiple scans, perpendicular to the orientation of the face of the existing structures are required to achieve full line-of-sight scanning and to minimise the creation of areas which are occluded.
3. All plotted detail shall be field completed. The plan position of plotted detail shall be such that no point of well-defined detail shall contain a co-ordinate error of more than 0.5 mm at mapping scale when measured from the nearest grid line, permanent ground marker or ground control point. The distance on the drawing between any two well defined points of detail when checked by horizontal ground measurement, shall not contain an error of more than 0.025% plus 0.5mm.
4. The spatial accuracy of the survey should be reported when submitting deliverables.

4.5 Requirements for Data capture using drones (UAVs)

This section is applicable when drones may be used to capture any of the data specified elsewhere in this document, e.g. photographs, videos or LiDAR scans. For specification of the required survey data to be obtained and details of the deliverables, please refer to the relevant sections of this specification.

4.5.1 Insurances, Licensing and Permission

1. The Contractor shall have adequate insurance in place for invasion of privacy.
2. The Contractor shall have no less than 2 years' commercial UAV experience specific to the type of task to be undertaken.
3. The Contractor shall provide evidence that adequate aviation liability insurance is in place with express confirmation that the policy specifically covers the operation of drones.
4. The drone survey shall be carried out in accordance with the local aviation laws and regulations. The safety of people and property shall be considered at all times.
5. The Contractor's personnel shall have all the relevant licenses to undertake the activities required for the survey in accordance with the current legislation. Drone operators are to have successfully completed a Remotely Piloted Aircraft System (RPAS) course and hold a Pilot Competency Certificate (or approved equivalent) with one of the Irish Aviation Authority's (IAA) registered Training Facilities or any other special licensing requirements.
6. The location of UAS geographical zones should be noted before survey work commences and the Contractor shall obtain and ensure they have the required permissions from all relevant parties to complete this survey before any UAV is operated in the area. Relevant UAS zones are tabulated below.

Table 4-3 UAS Zones

UGZ Name	UGZ ID
Cork Control Zone (CTR) - Red Zone	U33
Cork Control Zone (CTR) - Amber Zone	U61_B
Cork Control Zone (CTR) - Green Zone	U66

4.5.2 Flight Plans

Prior to any aerial survey the surveyor shall submit a flight plan showing the proposed flight lines on a topographic map of the project area or in a digital file that can be geo-referenced with existing mapping or a web-based GIS application.

The Contractor is responsible for ensuring that the proposed plan assures adequate aerial survey coverage to produce the results required for the specification. The flight plan should include:

- Flight lines identified to show flight height or nominal Ground Sample Distance (GSD).
- Camera calibration report and calibration file as appropriate to sensor(s) planned.
- Manufacturer's Specification sheets for digital cameras.

It should be noted that these plans may be required to be submitted to the relevant stakeholders for authorisation regarding the UAZs above.

4.5.3 Aerial Control Points and Coordinate

1. The Contractor will implement a number of control points appropriate for this survey in the form of targets. The target design shall be symmetrical and centred on the aerial control point.
2. Natural target features may be used in lieu of artificial targets provided that a reasonably large angle of intersection exists to positively identify a point. Examples include sidewalk intersections, corner of concrete slabs, existing paint markings on asphalt, or other clearly visible feature from which a precise location can be interpreted. The elevation should be measured at the hard element at the point location.
3. If paint is used to target aerial control point locations, it must be of a type that is biodegradable and washes away within six months.
4. To maintain proper public relations all man-made target material placed over aerial control points shall be removed and the site cleaned up within seven days of confirmation that aerial survey was successfully acquired, and no re-flights are necessary
5. All aerial control horizontal surveys shall be referenced to and tied into the Irish Transverse Mercator ITM geographic coordinate system (EPSG Code: 2157) as defined by Ordnance Survey Ireland (OSi) and the Ordnance Survey of Northern Ireland (OSNI).
6. All aerial control vertical surveys shall be referenced and tied to OSGM15 geoid model, Malin Head datum in Ireland. GPS altitude type (Sea level or WGS 84 ellipsoid) should be confirmed by Contractor.

4.6 Bathymetric Survey Requirements

1. Where required, the Contractor shall undertake a bathymetric survey of the watercourse beneath and adjacent to the bridge structure to establish the existing underwater topography. Bathymetric Survey is required for Structure STS-03, STS-04 and STS-05 (Refer Table 5.1).
2. The bathymetric survey shall determine:
 - The existing riverbed levels and channel geometry
 - Establish bed levels and water levels in the vicinity of bridge piers and abutments
 - Identify any exposed foundations, pilecaps or other submerged structural elements where visible
 - Water level during survey observation including date and time of observation
3. The survey shall extend across the full width of the watercourse and at least 5m beyond top of bank, and 25m upstream and downstream of the bridge.
4. The Contractor shall ensure the survey methodology is designed to acquire sufficient data to ensure high-resolution mapping of the riverbed.
5. Points along the cross-section are to be surveyed at an interval which accurately depicts the shape of the channel.

6. The survey shall include detailed coverage around bridge piers and abutments.
7. All survey data shall be provided with datum details and co-ordinate systems to integrate with the topographic and hydrographic surveys carried out as per this Specification.
8. The Contractor shall submit a detailed method statement and H&S risk assessment in advance of commencement of survey fieldwork. The method statement shall provide details on the proposed survey methodology and quality assurance of the data. This should detail equipment and personnel to be used to complete the survey along with addressing the necessary statutory requirements relating to risk assessments and safe operating procedures.
9. All Ground Control Points established for the works shall be included and referenced.

4.7 Deliverables Required

1. Upon completion of the inspections, the final deliverable will be an inspection for assessment report compiled for each existing structure, encompassing all data obtained in Chapter 4.2 and Appendix D.
2. Upon completion of the LiDAR surveys, the Contractor shall provide
 - The cleaned point cloud model, correctly registered in .e57 and .las format
 - Details of control points
 - 2D Reference Drawing/Key Plans, and elevations of the structure documenting areas scanned and legend of point cloud scan datasets
3. Upon completion of the photogrammetry surveys, the Contractor shall provide
 - Photographic Images
 - Scalable / adoptive detail mesh model (i.e. 3sm, 3mx)
 - The aero triangulation metadata for the photographs and aero triangulation quality report.
 - Details of control points
4. Upon completion of the bathymetric survey, the Contractor shall provide
 - A survey report including methodology, survey dates, weather and river conditions, accuracy assessment and limitations encountered.
 - Raw data (Individual bathymetric survey points and depths) in excel format and text file format
 - Bathymetric Drawings showing survey extents, structure locations, riverbed contours, water levels and any identified scour features
 - CAD drawings of the underwater bathymetric contours set at 1m intervals
 - Digital Terrain Model in .asc format;
5. It is anticipated that LiDAR and photogrammetry survey will tie into each other where applicable and into the topographic survey that is being undertaken as part of this Specification.
6. Where multiple survey techniques are used, a single integrated mesh model shall be produced from the combined datasets where practicable.
7. Survey undertaken with UAV shall include an Aerial Survey Report (Refer to Appendix C).

4.8 Data Validation

1. The Survey Contractor shall undertake the following quality checks to provide confidence that the quality requirements of are fulfilled:
 - Positional Accuracy

- Spatial Distribution and Regularity
 - Pulse Density
 - Pulse Classification
 - Data Voids
 - Relative Accuracy
2. The Contractor shall undertake a completeness review of the point cloud and photogrammetry model before demobilisation. Any voids or areas of inadequate coverage affecting the structural assessment shall be re-surveyed.
 3. The Contractor shall verify the completed survey against independently surveyed check points not used in model generation. An accuracy report shall be submitted detailing residual errors and statistical measures of model accuracy.

5. Programme of Services

6. It is a condition of this Contract that the Contractor shall deliver survey data to the Client's Representative at intervals during the work period. A programme of the Services shall be agreed with the Client's Representative before the survey begins.
7. The Contractor's project programme shall be accompanied by a method statement outlining the Contractor's technical and logistical approach to the project, including a resource allocation schedule for the duration of the project. This programme shall be agreed with the Client's Representative prior to field work commencing.
8. The method statement and programme shall detail the form, sequencing and programming of all major investigation work elements including key constraints and critical path items. The programme shall be clearly organised and shall include the start and completion dates for each activity and their inter-relationships and shall contain sufficient detail to assure the Client's Representative of the feasibility of the plan and approach proposed by the Contractor.
9. The method statement should also detail the investigation sequencing, location of access for all labour, plant and materials, direction of workflow, equipment facilities, investigation methods, materials handling, special design or specification restraints, provision of resources or temporary services etc.
10. There is, and will be, persistent vehicular and pedestrian traffic volumes on the proposed sites during the course of the Contract. The Contractor shall include in its Total Fee all additional costs that it may incur in order to complete the services under such circumstances.
11. The entire survey contract (including all field and drawing work) is to be carried out over a 11-week time period.
12. Following Contract Award, a 2-week period shall be allowed for Method Statement preparation and mobilisation. The Topographic, Hydrographic and Structures Surveys shall then be completed over a 5-week period, with all survey deliverables, as described in Chapters 3.6 and 4.7, are to be submitted to the Client's Representative no later than 4 weeks after completion of the survey. Table 5-1 below outlines a provisional programme for the Contract.

Table 5-1 Provisional Programme – Cork to Kinsale Greenway Project - Topographical and Hydrographic Survey Services

Description	Start Date	Completion Date
Advertise on e-Tenders	15/09/2026	02/10/2026
Tender Assessment	05/10/2026	09/10/2026

Description	Start Date	Completion Date
Letter of Appointment	12/10/2026	12/10/2026
Method Statement / Mobilisation (2 weeks)	12/10/2026	23/10/2026
Topographic, Hydrographic and Structures Surveys (5 weeks)	26/10/2026	27/11/2026
Topographic, Hydrographic and Structures Survey Deliverables (4 weeks)	30/11/2026	24/12/2026

6. Health and Safety

1. The Contractor shall be responsible for all issues related to health and safety that may be associated with the services, works or equipment to be used on site and shall perform their duties in accordance with the Safety, Health and Welfare at Work Act, 2005 and all relevant construction regulations.
2. A signed copy of the Contractor's Health and Safety Statement shall be submitted to the Client's Representative prior to survey field work commencing. The Contractor shall ensure that all statutory safety procedures are rigorously adhered to. The Contractor shall strictly adhere to all safety legislation applicable to these works.
3. The Contractor shall ensure that its employees meet all site safety requirements and shall discharge its own responsibilities with respect to safety in accordance with its own safety policy plan and method statements, which it will provide to the Client's Representative prior to the commencement of any of the Services on site.
4. The Tender Total shall include all costs, which may be incurred by the successful Tenderer in complying with its obligations pursuant to the Health and Safety Regulations.

7. Traffic Management

1. The proposed survey works will require traffic management schemes to ensure the safety of all road users, to minimise disruption to all road users and to ensure full compliance with relevant legislation and best practice. The Contractor shall be responsible for the planning, design, construction, maintenance, alteration and removal of the Traffic Safety and Management measures required in order to facilitate and complete the survey. Measures shall be taken in accordance with any statutory requirements and recommendations contained within the Traffic Signs Manual 2019 - Chapter 8, Temporary Traffic Measures and Signs for Roadworks, Temporary Traffic Management Design Guidance and Temporary Traffic Management Operations Guidance. The Contractor shall bear all costs for traffic management implementation, management, operation, removal, including any associated road closure fees.
2. The Contractor shall submit traffic management scheme drawings and method statements for approval by the Client's Representative a minimum of one week before proposed commencement of the works. The proposed traffic management schemes will need to consider and to mitigate the impact of the scheme on all road users and affected frontages (businesses and residential).
3. The proposed traffic management schemes must maintain appropriate access for road vehicles, including pedal cycles and pedestrian traffic, with particular attention to the disabled and mobility impaired. Access to and servicing of affected frontages must be maintained at all times.
4. All necessary traffic safety precautions shall be undertaken by the Contractor to ensure the safety of all traffic and pedestrians using the existing roads adjacent to the Site and connecting minor roads

during the execution and completion of the survey, and all precautions shall be taken to minimise disruption to the local residents. The Contractor shall maintain access at all times to land and property affected by or adjacent to the Works.

5. The Contractor shall ensure that no item of plant, goods or equipment (including stores or offices) shall be placed or parked on the public roadway or its verges in a manner which shall / may result in danger to the personnel on the Site or members of the public, or which shall / may restrict sight distances on all accesses to the Site or on public roads.
6. The Contractor shall provide details to the Client's Representative of his programme requirements with respect to traffic management.
7. The Contractor shall arrange for the necessary permits and the Gardaí attendance / approval. They shall also liaise with relevant local authorities and road maintenance authorities and advise of any assistance needed in setting up the traffic management plan.
8. The Contractor shall appoint a Traffic Safety and Control Officer. The principal Traffic Safety and Control Officer, or one of his deputies, shall be available at any time of the day or night and shall be in a position to put into immediate effect any traffic measures considered necessary by the Client's Representative or Garda Síochána to ensure the safety of the public.
9. The Contractor shall note that applications for footpath / lane closures should be made to the various local authority traffic departments. It shall be the Contractor's responsibility to determine the various local authority's particular requirements in relation to effecting of lane / footpath closures, to apply for and execute such closures and to implement any such traffic management regimes as may be necessary to facilitate the execution of the Contract. All costs associated with these works, including the application fee, shall be deemed to be included in the tender price.
10. The Contractor shall seek early approvals from relevant authorities and service providers when surveying. This includes but is not limited to Iarnród Éireann, MMaRC Third Party Approvals, TII Indemnity and road authority notifications in addition to consent from utility providers (i.e. for opening manhole covers etc.).
11. All necessary approvals must be in place prior to the commencement of the relevant surveys.

Appendix A

SUR-SVW-0001

Route Topographical Survey at 1:200 Map Scale General Service Requirement

SUR-SVW-0001

January 2020

DOCUMENT HISTORY LOG

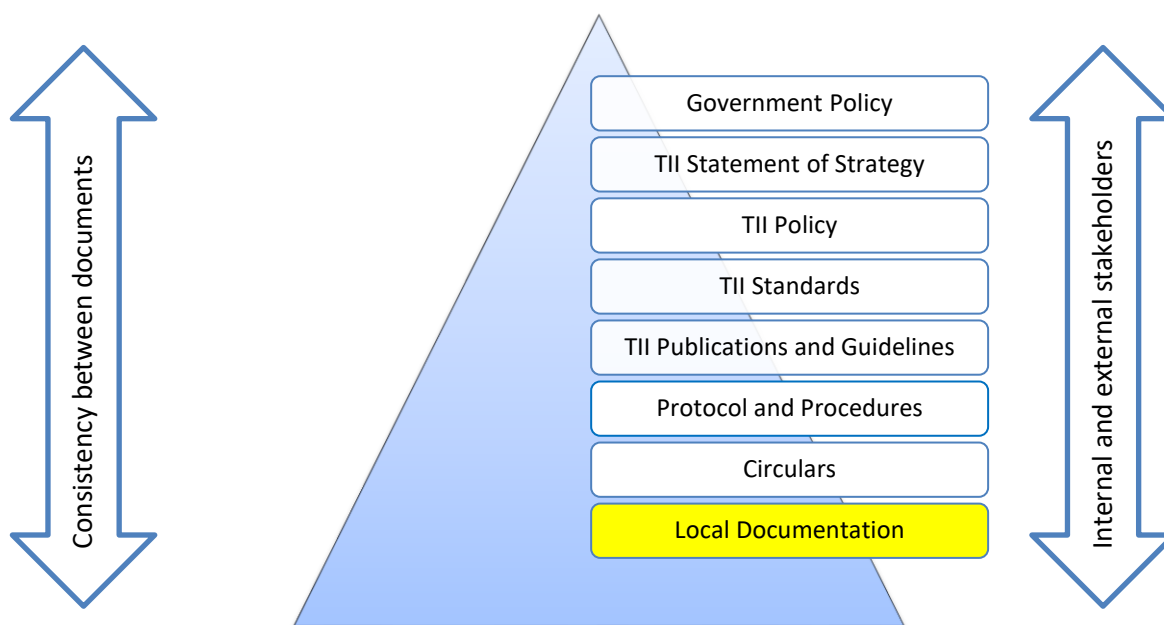
Version	Date	Description	Prepared	Reviewed	Approved	QA
03	20-Jan-2020	GDPR & TII UAV Usage Policy	S.Moore	G.Linnane	G Linnane	M Healy
02	03-May-2018	Minor Alterations	J Bowe	S Moore	G Linnane	M Healy
01	10-Oct-2016	Original Issue	J Bowe	S Moore	G Linnane	M Healy

SYNOPSIS

This document outlines the method to be used by the Consultant for the production of a route topographical survey at a map scale of 1:200.

POSITION OF THIS DOCUMENT IN DOCUMENT HIERARCHY

This document is positioned with the Local Documentation in the document hierarchy.



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1 SURVEY CONTROL GENERAL REQUIREMENTS

Control Network stations related to Irish Transverse Mercator grid (ITM), each with associated reference numbers, Easting, Northing, Elevation values and scale factors, shall be used by the Consultant as control points for the ground survey. Existing Project Control stations, where available, shall be provided by the Client. The Consultant shall be responsible for the verification of the Clients survey control. The Consultant shall check and agree the co-ordinates and elevations of the survey control stations prior to topographical survey field work.

Where existing primary and/ or secondary survey control is provided by the client, alternative determinations of ITM Grid, including Ordnance Survey control points shall not be introduced for the purposes of control adjustment and particular attention shall be paid to the level datum used. All elevations shall be related to the existing Project Control provided, i.e. Ordnance Survey bench marks and/or Ordnance Survey Geoid Models shall not be introduced for the purposes of levelling adjustment.

Where existing primary or secondary survey control is not provided by the client, then, a horizontal and vertical control network shall be established by the consultant on which the topographical survey shall be based. Control points shall be established in such a manner that their location shall allow effective future use and their construction shall be sufficient to withstand at least 5 years of normal usage, taking into account the surroundings at each location. The types of material used shall be such that their impact upon the environment and any normal activities at each location is minimised. Connection to the Ordnance Survey of Ireland (OSi) Active Network and related to the Irish Transverse Mercator grid (ITM) is required. All elevations shall be related to the latest Ordnance Survey Geoid Model.

1.1 Horizontal Control Network

1.1.1 Framework

The horizontal control network shall consist of a framework of permanent ground markers related to Irish Transverse Mercator Grid (ITM), to provide a suitable foundation for the production of a reliable and accurate topographical survey.

The framework shall comprise of the following elements:

- 1) Pairs of Primary Control Points approximately 200m apart with an interval of 1km between adjacent pairs which are directly connected into the Ordnance Survey of Ireland Active Network.
- 2) Secondary Control Stations shall be spaced approximately 100 - 150m apart between the pairs of adjacent Primary Control Points.

The horizontal control network shall be designed in such a way as to enable the re-establishment, in terms of the Ordnance Survey of Ireland (OSi) Coordinate Systems, of any or all of the permanent control markers should they happen to be destroyed. As such the horizontal control network, in terms of geometry, baselines and observation times, shall comply with the principles of good network design.

1.2 Global Navigation Satellite Systems (GNSS)

1.2.1 GNSS Network

All new GNSS control points shall be tied to at least four existing project GPS control points where available. Details of GNSS control shall be discussed and agreed with the Client prior to commencement of the field survey. The Client shall provide details of existing project control where available.

1.2.2 Accuracy Acceptance Criteria

Minimum geometric accuracy shall be 1 part in 100,000 for all GNSS control (at a 95% confidence level). Centring accuracy of the GNSS antenna over each station point shall be to $\pm 1\text{mm}$. All centring devices and plumbing devices shall be checked prior to the execution of the GNSS control and on completion. Where possible, checks on plumbing shall accompany the measurement process.

1.2.3 GNSS Report

A final GNSS report shall be submitted as documentation of the successful completion at the conclusion of the control work. Included as a minimum shall be the following:-

- 1) A narrative description of the project which summarises the project conditions, objectives, methodologies, and conclusions.
- 2) Details of the observation plan, equipment used, satellite constellation status and observables recorded.
- 3) Description of the data processing performed. Note the software used, the version number, and the techniques employed.
- 4) Provide a summary and detailed analysis of the minimally-constrained and over-constrained least squares adjustments performed. List the observations and parameters included in the adjustment. List the absolute and standardised residuals, the variance of unit weight, and the relative confidence for the coordinates and coordinate differences at the 95% (2-sigma) confidence level.
- 5) Identify any data or solutions excluded from the network with an explanation as to why it was rejected.
- 6) Include a diagram for the project stations and control at an appropriate scale. Descriptions for each of the control stations shall be included in hardcopy and digital form.

Data files, including observations (RINEX format), computed baselines, adjustments, and coordinates shall be submitted with the final GNSS report.

Documentation for the procedures and processing validation network shall be included in the final GNSS report.

1.3 Traverse Control

1.3.1 Traverse Network

- 1) Traversing shall be carried out with an authorised calibrated and documented electronic total station with all traverse readings recorded electronically.
- 2) All secondary control surveys shall be performed by either closed loop or link traverse between pairs of the route primary control stations and shall be measured as a single geometric entity.
- 3) The geometric shape of all traverses shall be as strong as possible with the distance between subsequent traverse stations (traverse leg) to be in the range of 100 to 150 metres. Shorter legs shall be avoided. Traverse observation breaks at the end of working days shall be avoided but if unavoidable shall be taken on the longest possible lines with extra care taken with centring instruments and targets from one day to the next.
- 4) Constrained centring (aka forced centring) using the three tripod method shall be utilised for all secondary control traversing. Traverse data shall also be observed and electronically recorded in three dimensions (i.e. instrument heights, target heights, zenith angle and slope distances), providing an independent gross error check on the control levelling.
- 5) Each traverse leg shall be obtained with a minimum of four sets of observations. Distances shall be measured in both forward and backwards directions with a minimum of four sets for each traverse setup. Angles, both horizontal and vertical, shall be repeated, observing direct and reverse positions (face1 and face2) of the telescope for each target position, providing a minimum of four sets for each traverse setup.
- 6) Traverse closing errors shall be adjusted using least squares or a recognised mathematical adjustment procedure, in order to provide maximum sympathy between the route Primary Control Stations.
- 7) Combined (3D) local scale factor shall be determined for each traverse control station based on the route Primary Control Stations.
- 8) All ancillary equipment including tripods, tribrachs, centring systems, carriers/stems, targets/prisms and instrument height measuring devices shall be checked and adjusted before, during and on completion of the control traversing.

1.3.2 Accuracy Acceptance Criteria

Maximum closing error for each control traverse shall not be worse than 1: 60,000 prior to adjustment using least squares. Closing errors worse than this shall be notified to the Client immediately to determine a course of action.

Centring accuracy over each station point shall be to $\pm 1\text{mm}$.

1.3.3 Traverse Report

As part of the final project report the Consultant shall submit a full network adjustment report.

Traverse data shall be submitted in both raw and reduced data formats. The reduced data format shall be suitable for three dimensional adjustments in StarNet (see TII Survey Appendix 8).

1.4 Planimetric Control

The Consultant shall establish plan control at a density sufficient to achieve the specified accuracies. The survey stations shall be of stable construction and the Consultant shall choose the most appropriate station marker for each location.

1.5 Level Datum

All elevations shall be related to the existing Project Control where provided. Ordnance Survey bench marks and/or Ordnance Survey Geoid Models shall not be introduced for the purposes of levelling adjustment. The Client shall provide details of existing Project Control where available. Where no existing Project Control is provided by the client, then, all elevations shall be related to the latest Ordnance Survey Geoid Model.

1.6 Levelling Network

- 1) Automatic digital levels and bar code staves shall be used for all height determinations. Data shall be electronically recorded and downloaded to a computer.
- 2) All levelling throughout the selected routes shall be a closed double level run and in metric units.
- 3) Elevations shall be given for all horizontal control stations. Project control stations shall be established on existing stable features which offer a unique level point at distances of not greater than 150 metres along the route.
- 4) Control station levelling shall be proven geometrically and independently consistent prior to connection to the project datum.
- 5) Each level run shall go through two primary control stations at the start, on to the next primary control station pairing and return to the first two primary control stations. The closed level loop shall include any secondary stations established on both the outward and inward level run.
- 6) The use of intermediate sights is not acceptable for survey elevation control. Only back sight and foresight readings shall be permitted.
- 7) Instruments shall be checked for adjustment prior to levelling run. Two-peg test or similar instrument manufacture checks shall be employed.

1.6.1 Accuracy Acceptance Criteria

Height misclosures for the purpose of the project levelling networks shall not be greater than $3\sqrt{K}$ millimetres (where K is the length of level run in kilometres), or ± 3 millimetres, whichever is the greater. The maximum allowable error between any two adjacent stations shall not exceed 1.5mm.

1.6.2 Levelling Report

A schedule of the route control stations and/ or bench marks used for levelling shall be provided complete with reference diagrams and the source of the data indicated.

A levelling report shall be provided which quantifies all assumptions made, approximate length of each level leg and run and indicate all circuit misclosures with residual differences after adjustment.

1.7 Survey Stations

- 1) All survey control stations shall be driven, or otherwise constructed, flush or near flush with the ground surface, to avoid becoming trip hazards and being disturbed.

- 2) All stations shall have an unambiguous centring point suitable for the acceptance of the ferrule of a centring rod or for optical plumbing.
- 3) Reference diagrams shall be provided by the Consultant to the Client to aid in the relocation of survey control stations. See Survey Appendix 6. These diagrams shall be recorded at the time of establishment by the Consultant by manually taped measurements and date stamped photography. Third party photography/images are not acceptable. All control stations shall be numbered in a logical fashion. The numbering system shall be agreed with the Client in advance, so as to avoid conflict with the numbering of existing or new project control stations elsewhere.
- 4) Control Stations shall be of an approved proprietary make, such as ground anchors or PK/MAG nails (or similar) drilled and set in concrete using epoxy resin, as appropriate. See “RICS Measured surveys of land, buildings and utilities” for examples of appropriate permanent ground markers (PGMs). Proposed PGM types shall be approved by the Client before installation. Stations driven into existing pavement cracks, expansion joints or into soft tarmac shall be avoided where possible. The Consultant shall be aware of all underground utilities and services when establishing PGMs.
- 5) PGMs shall be used to define the position of the control network survey stations in soft ground. Their location shall be selected to provide the strongest possible geometry for the system.

1.8 Station Schedule

A schedule shall be supplied, in both softcopy and hardcopy, of all final values of the survey stations giving at minimum the following details:

- a) the alphanumeric reference name of each station
- b) the Easting and Northing Project Grid co-ordinate values
- c) the reduced elevation of each station
- d) the local combined scale factor (3D) at each station
- e) the horizontal distance of each traverse leg
- f) the traverse and levelling misclosures of the control network
- g) the schedule shall also be accompanied by a complete softcopy and hardcopy of GNSS and traverse computations showing, inter alia, appropriate input data, statistical summaries, residuals, error ellipses and network diagrams.

1.9 Station Location Diagrams

A station description sheet shall be prepared for each permanent control station with an overview map showing its general location, with a date-stamped photograph (taken by the consultant) of a tripod set over the station and also showing recognizable features in the vicinity. For data protection reasons, vehicle registration plates and faces of members of the public shall not be collected or displayed, **(See GDPR, section 10, page 18)**. A station locator sketch showing manually taped dimensions to a minimum of 3 easily recognisable and durable points (post mapping CAD dimensions are not acceptable), to enable the station to be easily found. The description sheet shall also include as a minimum the station's designation, Project Grid co-ordinates, reduced elevations, combined scale factor, positional accuracy, lineage, project classification, date established, verbal description of type and location. The Consultant shall only use the Client issued Station Description Sheet templates provided in Survey Appendix 3 and shown in Survey Appendix 6 which is the minimum standard of presentation required of the station description sheets.

Survey control stations shall be available at spacing of no greater than 150m. However, a minimum number of intermediate temporary stations shall be created by the Consultant in order to carry out validation or in-fill detail topographic survey. Survey control station establishment shall be carried out and final coordinates and station description sheets agreed with the Client prior to the commencement of detail survey field work i.e. topographical surveying/modelling.

Two hard copies of the station description sheets shall be submitted, one being bound and laminated. Soft copies in word and pdf format shall also be supplied.

2 DETAIL GROUND SURVEY GENERAL REQUIREMENTS

2.1 Frequency of survey points

Survey points shall be taken along main features at intervals of at most 10m along and at right angles to the proposed alignment. However this interval shall be reduced depending on factors such as complexity of street geometry, e.g. plan radius, rate of change of gradient, general ground conditions, etc. Curved features, such as kerb lines, shall be surveyed as a curve such that the chord to arc distance shall not be greater than 50 mm.

Generally points shall be taken as far as the building line on both sides of each street (unless otherwise stated), or at least 30m beyond the line of the proposed route reservation in open spaces.

Spot levels and their co-ordinate positions shall be taken along road centrelines, pavements, carriageways, hard shoulder edges, top of kerbs, bottom of gutters (channels), at intervals as previously described above. Spot levels shall also be taken where distinct changes in gradient occur. A sufficient density of spots shall be obtained in order to produce an accurate Digital Ground Model (DGM).

The order in which points shall be recorded is not of great importance as cross sections shall be generated from the Digital Ground Model using Bentley MX Moss and not directly from surveyed cross sections.

General guidelines for point frequency parallel to the proposed alignment are 5m to 10m in city street areas and 10m in open suburban areas or on disused rights of way.

The Survey shall be extended to include the following:-

- (i) Junctions of all major or minor roads, lanes, vehicle access or alleyways that intersect the proposed route corridor. The survey shall be extended at least 50m from the nearside channel line of the principal route along all major or minor roads, and 30m along lanes and alleys.
- (ii) All private, commercial and industrial entrances, gates, doorways, platforms or ramps.

The survey shall provide the general ground floor level and doorway threshold level where this is possible.

Survey of overhangs, gardens, yards or buildings inside walls and railings shall require the use of a reflectorless survey instrument.

2.2 Items of Significance

The topographical ground survey shall be performed to produce new mapping at 1:200 mapping scale.

The following is a non-exhaustive list of items or features of note that shall be recorded. The Consultant shall liaise with the Client to ensure that the survey is comprehensive in its recording of all significant features.

2.2.1 Control Points

Survey control station points shall be surveyed.

2.2.2 Building Structures

The following topographic features and details shall be surveyed: -

- a) Bridges
- b) Names, numbers and number of floors of all buildings, trade premises or plots
- c) Open sides of buildings
- d) Pre-fabricated houses
- e) Outbuildings
- f) Hutments and camps
- g) Garden sheds
- h) Covered passages and archways
- i) Internal property divisions between abutting buildings where visible externally
- j) Ruins or partially demolished buildings or foundations - by the walls and masonry visible at the time of the survey
- k) Glasshouses
- l) Buildings under construction
- m) The parapet (or roof) line of all permanent buildings
- n) Overhangs and canopies
- o) Other relevant features

2.2.3 Boundary Features

The following features and details shall be surveyed:

- a) Top and bottom of retaining walls along railway cuttings including also changes in profile
- b) Walls - showing type and width
- c) Fences (showing type)
- d) Hedges - showing type and width
- e) Stiles
- f) Gates
- g) Boundary markers
- h) Other relevant features

2.2.4 Roads, Tracks and footpaths

The following features and details shall be surveyed:-

- a) Road markings (double yellow lines, white lines etc.)
- b) Road text and directional arrows - true to shape, size, and orientation and draped onto the road surface
- c) Kerb line or edge of surfacing to carriageways
- d) Channel line
- e) Tracks and bridle paths
- f) Rides and drives
- g) Footways
- h) Pedestrian crossings
- i) Steps
- j) Traffic islands
- k) Paths in public and private grounds
- l) Tunnels and/or underpasses
- m) Changes of paved surface materials
- n) Bridges and subways
- o) Other relevant features

2.2.5 Street Furniture and Visible Service Features

The following features and details shall be surveyed:

- a) Phone boxes - type identified, e.g. telecom provider, etc.
- b) Post/Letter boxes
- c) Bus stops
- d) Lamp posts
- e) Telecommunication poles
- f) Electricity poles
- g) Vent pipes
- h) Road signs
- i) Road and street name boards
- j) Hoardings
- k) Notice boards
- l) Traffic signal and control boxes
- m) Vehicle detector pads / scat loops
- n) Drains or gullies
- o) Fire hydrants
- p) Stop valves and stop cocks
- q) Manhole and inspection covers
- r) Covers or lights to cellars
- s) Parking meters and ticket machines
- t) Barriers
- u) Bollards

- v) Marker posts
- w) Other relevant features

2.2.6 Railways and Light Rail

The following features and details shall be surveyed:-

- a) Gauge faces of railway running rails (rail shoe minimum required)
- b) Points and cross-overs
- c) Level crossings
- d) Buffers
- e) Platforms (top edge and associated bottom formline/breakline)
- f) Bridges
- g) Signal boxes
- h) Signals
- i) Telephone points
- j) Height gauges
- k) Overhead electrification gantries - with heights
- l) Tunnels
- m) Air shafts
- n) Water troughs
- o) Warning signs
- p) Cable troughs and runs
- q) Point/signal operating rods/wires
- r) Other relevant features

Where topographical survey is required within the corridor and/or swept path of heavy or light rail, then the consultant shall obtain the necessary PTS/LPS safety training, permissions, work permits, etc, from the appropriate rail operator, to perform the work safely and accurately.

2.2.7 Water, Drainage and coastal features

The following features and details shall be surveyed:-

- a. Lakes
- b. Ponds
- c. Reservoirs
- d. Rivers & streams including the direction of flow of all rivers, streams and water courses
- e. Water courses & ditches
- f. Canals and towpaths
- g. Wells & Springs
- h. Marshes
- i. Locks
- j. Aqueducts
- k. Water towers

- l. Culverts
- m. Millraces
- n. Siphons
- o. Sluice gates
- p. Weirs & waterfalls
- q. Fords
- r. Mooring posts
- s. Pumps, troughs, tanks & fountains
- t. Sewer outfalls
- u. Piers, jetties and landing stages
- v. Harbour walls and breakwaters
- w. Groynes and sea defences
- x. Tunnels
- y. Hydraulic rams
- z. Other relevant features

Date-stamped soffit, invert, bed and water levels, where safe and practicable, shall be undertaken for all water, drainage and coastal features. Those considered by the Consultant to be not possible, shall be brought to the immediate attention of the Client at Tender Stage for discussion. The consultant shall obtain the necessary safety training, permissions, work permits, etc., from the appropriate authorities, to perform the work safely and accurately.

2.2.8 Slopes and Earthworks

The following features and details shall be surveyed:

- 1. Cuttings and embankments
- 2. Terraced slopes
- 3. Retaining walls
- 4. Mounds
- 5. Open pits
- 6. Quarries
- 7. Rock outcrops
- 8. Tips
- 9. Adits and mineshafts
- 10. Other relevant features

2.2.9 Woods, trees and recreation areas

The following features and details shall be surveyed:-

- a) Trees with a trunk girth (diameter) equal to or over 250mm. The survey shall include all of the following information as a minimum for each tree:-
 - (i) Crown Spread diameter (indicated by a circular point symbol/block plotted to scale in metres & with text annotation)
 - (ii) Girth (indicated by a circular point symbol/block plotted to scale in metres & with text annotation)
 - (iii) Distance of lowest branch to ground level i.e. Clearance height (indicated by text annotation)

(iv) Tree Crown Tip Elevation (indicated by spot symbol/block & text annotation)

(v) Tag number details if present (old and/or new)

See Survey Appendix 3 for sample 3D Topographical CAD drawing.

b) Trees with a trunk girth (diameter) less than 250mm. The survey shall include all of the following information as a minimum for each tree:

(i) Crown Spread diameter (indicated by a circular point symbol/block plotted to scale)

(ii) Girth (indicated by a circular point symbol/block plotted to scale)

(iii) Tag number details if present (old and/or new)

See Survey Appendix 3 for sample 3D Topographical CAD drawing.

c) Wooded areas

(i) Unless otherwise agreed, all trees to be surveyed individually.

(ii) Individual trees with a trunk diameter of 250mm and above in wooded areas (see (a) above)

(iii) Individual trees or staked saplings with trunk diameter less than 250mm in wooded areas (see (b) above)

(iv) Wooded areas shall also be contained by surveyed continuous vegetation strings surveyed at ground level to enable land usage area/surface calculations.

See Survey Appendix 3 for sample 3D Topographical CAD drawing.

d) Overgrowth - Areas deemed inaccessible due to overgrowth shall be brought to the immediate attention of the Client at Tender Stage for discussion. Subsequent topographical drawings supplied by the Consultant with areas devoid of elevations and topographical detail with vague descriptions akin to “dense vegetation” shall not be accepted.

e) Playgrounds and sports facilities

f) Parks and open spaces

Girth (Diameter at Breast Height - DBH) is the stem diameter in metres tape measured at approximately 1m above adjacent ground level (on sloping ground to be taken on the upslope side of the tree base) or immediately above the root flare for multi-stemmed trees.

Crown Spread (Spread) is a tape measurement of the crown diameter from drip line to centre to drip line, and is given in metres. For uneven crowns, an approximate average is given.

Tree Crown (Tree Elev) is a direct reflectorless measurement of the highest branch / tip of the tree. This symbol (at its correct elevation) is then centred on the trunk for display purposes. I.e. an estimated height is unacceptable.

See Survey Appendix 3 for sample 3D Topographical CAD drawing for appropriate layering and texting approach.

2.2.10 Industrial

The following features and details shall be surveyed:

- a) Tanks
- b) Conduits and pipe covers, ducts and conduits
- c) Valve chambers
- d) Filter beds

- e) Transformers
- f) Electricity sub-stations and switch boxes
- g) Pylon bases and reference numbers
- h) Overhead lines and cables
- i) Flag staffs and masts
- j) Gas storage vessels and pipes
- k) Other relevant features

Note: All manholes, gullies and all linear services shall be surveyed and shown at their true horizontal and vertical orientation and size, and as a 3D continuous closed polyline (see Survey Appendices 1, 3 and 5).

2.3 Grid of Elevations

Elevations shall be supplied on a regular grid of 10-15 metres. The positions of individual points may be varied to avoid structures and other obstructions. On peaks and in hollows which are more than 0.5m above or below the surface defined by the grid elevations, additional spot heights or 3D break line strings shall be supplied.

Grids of elevations shall not be interpolated.

2.4 Three Dimensional (3D) strings

Three-dimensional (3D) break line strings shall be recorded as a series of three-dimensional co-ordinates to supplement the grid of elevations points in the following locations:

- (i) Break lines in the terrain
- (ii) Tops of banks, lakes, ponds, rivers, canals, streams and ditches wider than 1.0m at the water or bed line.
- (iii) The centre line of any visible dry watercourses.
- (iv) Tops and bottoms of slopes, embankments and cuttings greater than 0.5m in height.
- (v) Centre lines and edges of roads and tracks.
- (vi) Retaining walls more than 1.0m in height defined by two strings representing the levels at the top and bottom of the wall. The strings shall be separated in plan to avoid overhangs.
- (vii) Large buildings where the ground level varies by 1m or more in height, and/or where abutted by a retaining wall.
- (viii) Structures above ground level, such as elevated bridges, shall be placed on separate CAD levels/layers for exclusion from the digital ground model (DGM) / triangular irregular network (TIN).
- (ix) Invert and bed levels shall be taken at intervals not greater than 15 metres and at significant changes in level and direction.
- (x) Other locations where the grid and supplementary spot heights are inadequate to generate 0.50m contours without ambiguity.
- (xi) Any special features detailed in these Service Requirements.

2.5 Contours

Contours shall be interpolated at 0.50m vertical intervals, including an index contour at 1.0m intervals labelled with an approved contour interpolation package using all validated height data.

Contours shall be mathematical and not enhanced (e.g. not spline curve or fit curve contours).

Contour text shall be displayed above the contour line. Contour lines shall not be broken/gapped to display associated text.

2.6 Drawing/ Model Annotation

- 1) Digital three-dimensional drawings produced shall be to a consistent style and all the features specified shall be presented on the final dataset to a neat and legible standard.
- 2) The style of presentation for this survey project shall be based on typical samples provided by the Client (see Survey Appendix 3 for sample 3D Topographical CAD drawing file).
- 3) Conventional symbols and abbreviations shall be based on a list provided by the Client. All features are to be identified using a legend and text reference at the feature. See TII Survey Appendix 1 and 2 for level structure and text formats and Appendix 3 for sample 3D Topographical CAD drawing file.

2.7 Underground Services

It is sufficient for the purposes of this terrestrial topographical ground survey, that the routing of underground services on site be determined from access chambers and surface markers. It is critical that ownership, or the responsible statutory authority, is identified for each service manhole cover and access chamber. Where there is doubt about the extent or routing of an underground service, this is to be noted on the topographical survey model. Location of underground services by lifting covers, by excavation or by electronic means is not required for this contract.

2.8 Overhangs, underground chambers/ objects

The survey drawing shall show building outline at ground level. In addition, overhanging parts of buildings and other structures shall be indicated e.g. eaves, balconies, canopies, bridges, tunnels, passageways, etc. Similarly, the extent of below ground chambers should be indicated, where these can be measured without excavation. Where the presence of significant underground chambers, objects, voids etc. are suspected they shall be noted on the plot survey drawing for future investigation.

2.9 Adjacent Structures

The survey drawing shall provide the location and height of the nearest part of structures on adjacent sites. If direct measurement is not possible, the information shall be provided by indirect means, such as by use of a reflectorless instrument, or from other verified survey drawings. Where outlines are approximated, this should be stated on the survey drawing model and placed on the appropriate Non-DTM CAD level/layer.

2.10 Detail Mapping

- 1) The survey grid shall be Irish Transverse Mercator Grid (ITM) as defined by project control.

- 2) The survey shall cover the area enclosed by the survey boundary outlines shown on separate drawings provided by the client. Adjacent structures and levels of gardens and landscaped areas inside walls and railings along these boundary outlines shall also be shown on the survey drawings produced by the Consultant ('Survey Drawings').
- 3) The Survey Drawings shall show all the details noted previously in paragraphs 2.1 to 2.9 i.e. all features shall be shown on the Survey Drawings. Where text (feature and elevation) becomes crowded, then discussions with the Client as to what text to omit shall be required. Basic drawing format shall be A0. Basic map scale shall be 1:200.
- 4) Upon final delivery and acceptance of the 1:200 scale mapping corridor requests for additional topographic 1:200 mapping of varying sizes may be required along the proposed route corridor. The additional mapping areas required shall comply with these Service Requirements and shall not exceed a total area as detailed in separate documentation supplied by the client.

3 DATA INTEGRITY AND ACCURACY

The Consultant shall ensure that the integrity of the information is maintained during the whole lifecycle of the project, from data collection to data processing to final deliverables to data storage.

The survey shall be carried out to the following root mean squared error (r.m.s.e) accuracy standard when checked from the nearest permanent control station:-

- (i) The absolute planimetric accuracy of any well-defined surveyed points shall be correct to within $\pm 0.015\text{m}$ when checked from the nearest permanent control station.
- (ii) The elevations of surveyed points shall be correct to within $\pm 0.005\text{m}$ on carriageways and hard surfaces and correct to within $\pm 0.015\text{m}$ on other surfaces (except on ploughed or otherwise broken surfaces), when checked from the nearest permanent control station.
- (iii) In cases where topographic features cannot be surveyed to the specified accuracy without extensive clearing, the Consultant shall discuss and agree with the Client a suitable course of action prior to commencement of the survey.

4 CONSULTANTS REPORTS

4.1 Status Reports

The Consultant shall submit weekly status reports which will include schedule and activity status, resource status and difficulties encountered. This shall allow the Client to adequately review the progress of the project and adherence to the specification and agreed programme.

4.2 Progress Reports

The Consultant shall submit at least two interim progress reports. The first upon completion of the survey control to include closed traverse and closed loop levelling data (StarNet formats), adjustment results, methodology and a list of external factors affecting the survey. This shall be provided in advance of the detail survey field work commencing to ensure compliance with data integrity and data accuracy requirements.

The second interim report is required during CAD processing of the survey to include advance and proof copies of the final CAD drawing and GENIO files. The interim progress reports shall be submitted for the purposes of checking by the Client or its appointed representatives. This shall allow the Client to adequately review the progress of the project and adherence to the specification.

In a narrative report accompanying the two interim progress reports, the Consultant shall:-

- a) Compare actual progress against anticipated progress in relation to the sequence, quantities, duration, cost and resource details defined in the Scope of Services;
- b) Include provision for decisions made with the Client in respect of programming or sequencing of the survey;
- c) Identify and describe any current and anticipated problems that may affect the performance of the survey, the factors causing the problem, and their impacts on the survey project;
- d) Make particular reference to critical path activities and shall include delay mitigation proposals where appropriate; and
- e) Include new or revised programme activities/assumptions to be employed in achieving timely completion of the survey.

4.3 Project Report

A project report shall be submitted on the completion of the survey project. The project report shall include:-

- a) A brief project report recording planned and actual delivery dates and costs, any problems encountered and any changes or variations to the original contract requirement.
- b) A schedule of all drawings produced.
- c) A copy of all original survey data in 3D CAD drawing file supplied on Compact Disk. See Survey Appendix 1 and sample 3D Topographical CAD drawing file for the CAD drawing structure.
- d) A copy of the survey data in MX GENIO format generated from the 3D CAD drawing file supplied on Compact Disk. For MX string naming convention see Survey Appendix 5.
- e) A hard copy (A4 portrait) and a digital copy supplied on Compact Disk of all survey control location diagrams. See station schedule section and Survey Appendix 6.
- f) Digital copy of the ground control survey adjustment and results.
- g) CAD drawing providing all of the survey control points (primary and secondary).
- h) Information of all survey equipment used including: equipment listing, specification and calibration certificates.
- i) A description of safety incidents, and landowner/occupier incidents.
- j) A list of external factors affecting the survey.
- k) Signed self-certification check lists.
- l) Certificate confirming that the survey control and drawings have been validated by the Consultant and conform to the specification and all service requirements.

5 FORMAT OF SURVEY DATA

- 1) The Consultant shall produce a 3D CAD drawing file according to the level structure, line types, weights, and text formats provided in Survey Appendices 1, 2 and 3. Any deviation or variation shall be agreed with the Client prior to survey work commencing. The survey drawing shall be

constructed i.e. drawing level/layer structure, such that it can be used to generate an accurate digital terrain model (i.e. it is partnered with the Mx Genio format) and also be used to generate high quality cartographic drawing plans.

- 2) The Consultant shall produce an MX GENIO file from the CAD drawing in order to generate the MX TIN model, and an MX DRAW input file for the purposes of producing cartographic quality DPW files, see Survey Appendix 5. This data shall delineate all surface discontinuities over the area of the survey, e.g. channel lines, top of kerbs, back of footpaths etc. The integrity of this data to form the MX model is critical, since this data shall be used to generate cross sections and other derived information.
- 3) Traverse data shall be provided in a 3D StarNet format, suitable for adjustment in 3D. Data shall include the weighting and projections used for traverse adjustment (see Survey Appendix 7 for minimum sample 3D StarNet input file required).
- 4) Levelling data shall be provided in both Microsoft Excel format and StarLev format, showing backsights, foresights, delta height, elevation, leg distances, adjustment and final reduced elevation for all level runs.
- 5) Survey station descriptions sheets shall be provided in Microsoft Word Document and Adobe Acrobat PDF format as per Survey Appendix 6 and template provided in Survey Appendix 3.

6 STRUCTURE OF SURVEY DATA

- 1) The 3D drawing file and MX GENIO file shall not contain crossing break lines, duplicate XY co-ordinates with different elevations or 2D points within a 3D string. All 3D strings shall be 3D continuous polylines or similar.
- 2) There shall be no discrepancies in horizontal position and heights of survey features between the MX GENIO model and its associated CAD drawing file.
- 3) The MX string naming convention that shall be used is detailed in Survey Appendix 5. Any variations on the standard TII MX convention shall be proposed to, discussed with, and agreed with the Client, in advance of changes being made.
- 4) Contours shall be drawn as continuous polylines or similar and shall not cross.
- 5) All survey features shall be represented as either continuous polylines or point entities. Blocks/symbols shall not be used to represent linear features, such as hedges, fences, gullies, inspection covers etc. Features shall only be represented in accordance with the conventions provided in Survey Appendices 1, 2, 3 and 5. Combinations of linear and point feature representation is not permitted on the same level/layer in CAD unless agreed in advance with the Client.
- 6) All survey features shall be shown at ground elevation with the exception of tree apex elevation, overhead cables, foot bridges, flyovers and pipes crossing rivers or between buildings, etc., or otherwise agreed with the Client. See Survey Appendix 5 for DTM/TIN excluded features.
- 7) Elevation and feature text must be displayed for all manholes, inspection covers, road edge, road centreline, building corners, walls and fence lines, etc. See Survey Appendix 3, Sample 1:200 3D Topographical Survey Drawing for style of presentation required. There shall be sufficient text annotation to permit the use of the drawing on film/paper plots at a plot scale of 1:200.

- 8) Services such as manholes, gullies, telecommunication covers, etc. shall be annotated in accordance with Survey Appendices 1, 2, 3 and 5.
- 9) All text annotation shall be drawn at the feature elevation and assigned to the appropriate text level/layer provided in Survey Appendices 1, 2 and 3. Text annotations for street names and building names and descriptions must be accurate and represent information found on existing Ordnance Survey Ireland mapping. This street and building text shall also be duplicated to obey the 1/200 and 1/500 additional text rules. Interrogate the Survey Appendices 3, Sample 1:200 3D Topographical Survey Drawing, to view format and form of application.
- 10) All feature text annotation, including feature name, description, attribute information etc. shall be placed on the appropriate “_FTR” level/layer, in accordance with Survey Appendix 1. Feature text shall not be placed on the feature/objects level/layer (see Survey Appendix 3 for sample 3D Topographical CAD drawing file).
- 11) All elevation text annotation shall be placed on the appropriate “_ELEV” level/layer, in accordance with Survey Appendix 1. Elevation text shall not be placed on the feature/objects level/layer (see Survey Appendix 3 for sample 3D Topographical CAD drawing file).
- 12) It is a condition of this contract that the Consultant demonstrates the ability to input the survey results into MX, Microstation and AutoCAD on the Client’s computer system.

7 CALIBRATION OF SURVEY EQUIPMENT

- 1) The Consultant shall use, maintain and calibrate all field instruments, measuring and processing systems and plotters to be utilised on the project in accordance with the manufacturers’ recommendations prior to the start of and during the project.
- 2) All survey equipment used on the project shall be calibrated within three months of the project start. Copies of the calibration reports/certificates shall be supplied to the Client prior to field work commencement.
- 3) All levelling instruments shall be checked for collimation errors using the standard 2-peg test procedure or manufacturer’s recommendations. Checks shall be carried out at the beginning of each day in which the levelling instrument is used, with the observations and adjustments recorded electronically.
- 4) If any damage liable to affect the calibration of the survey instruments is suspected during the course of the contract, the instrument shall be recalibrated.
- 5) If up to six months after completion of this contract, significant changes in calibration are found, the Consultant shall inform the Client.

8 OVERGROWN AREAS

The method, extent and timing of the clearance shall be approved by the Client before clearance is begun. The amount of cutting of shrubbery, hedging etc. should be kept to the minimum required to obtain the necessary information and no lasting damage is to result. At all times, the integrity of the boundaries shall be preserved.

9 PROGRAMME OF SERVICES AND METHODOLOGY

- 1) It is a condition of this Contract that the Consultant shall deliver survey data to the Client at intervals during the work period. A programme of the Services shall be agreed with the Client before the survey begins.
- 2) The Consultants project programme shall be accompanied by a method statement outlining the Consultant's technical and logistical approach to the project, including a resource allocation schedule for the duration of the project. This programme shall be agreed with the Client prior to field work commencing.
- 3) There is, and will be, persistent vehicular and pedestrian traffic volumes on the proposed sites during the course of the Contract. The Consultant shall include in its Total Fee all additional costs that it may incur in order to complete the services under such circumstances.
- 4) The Consultant shall include in its Total Fee all additional costs that it may incur as a result of unsocial working hours, site clearance and traffic management.
- 5) The Consultant may be asked to prioritise certain areas when drawing up its programme of Services. Detailed survey information shall be required on such sections at an early stage in the Contract.

10 GENERAL DATA PROTECTION REGULATION (GDPR) & UNMANNED AERIAL VEHICLE (UAV) USE

The General Data Protection Regulation (GDPR) was implemented on the 25th of May 2018. It is a regulation in EU law on data protection and privacy for all citizens of the European Union (EU) and the European Economic Area (EEA). It also addresses the export of personal data outside the EU and EEA areas. Controllers of personal data must put in place appropriate technical and organisational measures to implement the data protection principles.

The consultant, in performing its services, whether directly or indirectly on behalf of Transport Infrastructure Ireland, may collect and process personal data during the course of surveying including, but not limited to, images and footage of data subjects.

The consultant, in order to ensure compliance with data protection law, will be required to enter into and agree to the Data Protection Terms and Conditions as set out by Transport Infrastructure Ireland. This agreement will be required in advance of any survey work.

In addition to this, where the consultant proposes to employ the use of Unmanned Aerial Vehicles (UAV) as part of performing its services, then this must be brought to the attention of the client at the earliest opportunity. The consultant will be required to sign up to the UAV usage policy as set out by Transport Infrastructure Ireland in advance of any survey work.

11 PROJECT MANAGEMENT

The Consultant shall nominate, in its tender submission, a key person who shall act as the liaison between the Consultant and the Client. If replacement of this key person is necessary, such replacement shall be agreed with the Client prior to the change taking place.

The Consultant shall not use the Client for any references unless permission is given in writing.

The Consultant shall comply with all relevant legislation and byelaws when carrying out the survey.

12 GEO-SPATIAL QUALITY ASSURANCE REQUIREMENTS

The Consultant shall implement approved quality management procedures to ensure that the information and materials supplied comply with the Conditions of Contract, these Service Requirements and are fit for purpose in terms of quality, completeness, standard of presentation and timely delivery.

The Consultant shall be responsible for implementing full validation procedures at each stage of the project to ensure that errors, mistakes and omissions are identified and corrected prior to delivery of results. Survey information shall not be deemed delivered until received by the Client in a form that is complete and complies with these Service Requirements.

Survey data shall be free of gross errors (blunders) so as to ensure that the user(s) of the survey have confidence that the work has been carried out diligently. The Consultant shall ensure that it detects and corrects systematic errors by checking and calibrating equipment used and checking the complete measurement system.

The Client may perform quality system audits or spot checks on the Consultant during the progress of the Contract. The Consultant shall provide reasonable access and facilities for the Client to carry out the audits.

All the Consultant's documents shall be compatible with the format of the Client's documents (currently Microsoft Office, Adobe Acrobat, Microstation, AutoCAD and StarNet). The Consultant shall use documents and forms (including title blocks and templates) if supplied by the Client.

13 SELF-CERTIFICATION CHECK LISTS

In order to assist the Client in the validation of the survey, the Consultant shall submit signed self-certification check lists. Specimen check-lists are provided in Survey Appendix 4.

14 SAFETY OF THE CONSULTANTS PERSONNEL AND THE PUBLIC

The Consultant shall be responsible for all issues related to health and safety that may be associated with the works or equipment to be used on site and shall perform their duties in accordance with the Safety, Health and Welfare at Work Act, 2005 and all relevant construction regulations. A signed copy of the Consultant's Health and Safety Statement shall be submitted to the Client prior to survey field work commencing. The Consultant shall ensure that all statutory safety procedures are rigorously adhered to. The Consultant shall strictly adhere to all safety legislation applicable to these works.

15 PUBLIC RELATIONS

The Consultant shall ensure that behaviour compatible with the cornerstones of the Client's public relations policy, i.e. honesty, openness, sensitivity and courtesy, is exhibited by all their employees and sub-contractors in all dealings with the public.

16 ACCESS TO PROPERTIES

Access to the properties adjoining the proposed routes shall be negotiated and arranged where necessary by the Consultant prior to the commencement of the Services. The Client shall provide letters of authority for the Consultant's staff as necessary. Consultant's staff entering such properties shall carry this letter of authority and individual proof of identity supplied by the Consultant.

17 CONTRACTOR TO MEET CLIENT

As soon as is practicable after award of the Contract the Consultant shall meet with the Client in order to explore procedures for anticipating and reporting, avoiding or minimising, monitoring, recording, well managing generally and properly any changes or impediments to the performance of the services or their progress that may arise. Any agreements reached shall be recorded, and agreed procedures shall be implemented by the Consultant and its sub-contractors and the Client throughout the Contract so as to fulfil their purposes.

18 LIAISON WITH CLIENT

The Consultant shall liaise continuously with the Client during performance of the Services, to report progress and to deal expeditiously with queries and problems while the survey team/s are on site. Advance and proof copies of Survey Drawings and data shall be provided for discussion and approval before the survey deliverable is finalised.

19 APPENDIX 1 TOPOGRAPHICAL LEVEL STRUCTURE

CAD Layer/ Level Name	Element Type	Level No.	Level Description
ABUTMENT	Polyline Element	100	Bridge Abutment
ABUTMENT_FTR	Text Element	101	Bridge Abutment Feature text at 1:200 scale
ABUTMENT_ELEV	Text Element	102	Bridge Abutment Elevation text at 1:200 scale
AIRCON_VENT	Polyline Element	103	Air Conditioning vents
AIRCON_VENT_FTR	Text Element	104	Air Conditioning vents Feature text at 1:200 scale
AIRCON_VENT_ELEV	Text Element	105	Air Conditioning vents Elevation text at 1:200 scale
AIRVALVE	Point Element	106	Air Valve
AIRVALVE_FTR	Text Element	107	Air Valve Feature text at 1:200 scale
AIRVALVE_ELEV	Text Element	108	Air Valve Elevation text at 1:200 scale
BANKBOTTOM	Polyline Element	120	Bottom of Embankment
BANKBOTTOM_FTR	Text Element	121	Bottom of Embankment Feature text at 1:200 scale
BANKBOTTOM_ELEV	Text Element	122	Bottom of Embankment Elevation text at 1:200 scale
BANKTOP	Polyline Element	123	Top of Embankment
BANKTOP_FTR	Text Element	124	Top of Embankment Feature text at 1:200 scale
BANKTOP_ELEV	Text Element	125	Top of Embankment Elevation text at 1:200 scale
BASEMENT_COVER	Polyline Element	126	Basement Cover
BASEMENT_COVER_FTR	Text Element	127	Basement Cover Feature text at 1:200 scale
BASEMENT_COVER_ELEV	Text Element	128	Basement Cover Elevation text at 1:200 scale
BEDLEVEL	Point Element	129	Bed Level
BEDLEVEL_FTR	Text Element	130	Bed Level Feature text at 1:200 scale
BEDLEVEL_ELEV	Text Element	131	Bed Level Elevation text at 1:200 scale
BIN	Polyline Element	132	BIN
BIN_FTR	Text Element	133	BIN Feature text at 1:200 scale
BIN_ELEV	Text Element	134	BIN Elevation text at 1:200 scale
BOLLARD	Point Element	135	Bollard
BOLLARD_FTR	Text Element	136	Bollard Feature text at 1:200 scale
BOLLARD_ELEV	Text Element	137	Bollard Elevation text at 1:200 scale
BOREHOLE	Point Element	138	Bore Hole
BOREHOLE_FTR	Text Element	139	Bore Hole Feature text at 1:200 scale
BOREHOLE_ELEV	Text Element	140	Bore Hole Elevation text at 1:200 scale
BRIDGE	Polyline Element	141	Bridge
BRIDGE_FTR	Text Element	142	Bridge Feature text at 1:200 scale

CAD Layer/ Level Name	Element Type	Level No.	Level Description
BRIDGE_ELEV	Text Element	143	Bridge Elevation text at 1:200 scale
BRIDGE_PIER	Polyline Element	144	Bridge Pier
BRIDGE_PIER_FTR	Text Element	145	Bridge Pier Feature text at 1:200 scale
BRIDGE_PIER_ELEV	Text Element	146	Bridge Pier Elevation text at 1:200 scale
BUILDING	Polyline Element	147	Building Outline
BUILDING_FTR	Text Element	148	Building Outline Feature text at 1:200 scale
BUILDING_ELEV	Text Element	149	Building Outline Elevation text at 1:200 scale
BUS_STOP	Point Element	150	Bus Stop
BUS_STOP_FTR	Text Element	151	Bus Stop Feature text at 1:200 scale
BUS_STOP_ELEV	Text Element	152	Bus Stop Elevation text at 1:200 scale
BASEMENT_MANHOLE_SQUARE	Polyline Element	153	Basement Manhole Square
BASEMENT_MANHOLE_FTR	Text Element	154	Basement Manhole Feature text at 1:200 scale
BASEMENT_MANHOLE_ELEV	Text Element	155	Basement Manhole Elevation text at 1:200 scale
BASEMENT_PIPE	Polyline Element	156	Basement Pipe
BASEMENT_PIPE_FTR	Text Element	157	Basement Pipe Feature text at 1:200 scale
BASEMENT_PIPE_ELEV	Text Element	158	Basement Pipe Elevation text at 1:200 scale
BASEMENT_WALL	Polyline Element	159	Basement Wall
BASEMENT_WALL_FTR	Text Element	160	Basement Wall Feature text at 1:200 scale
BASEMENT_WALL_ELEV	Text Element	161	Basement Wall Elevation text at 1:200 scale
BUILDING_FACADE	Polyline Element	162	Building Facade Outline
CANOPY	Polyline Element	164	Canopy
CANOPY_FTR	Text Element	165	Canopy Feature text at 1:200 scale
CANOPY_ELEV	Text Element	166	Canopy Elevation text at 1:200 scale
CHANNEL	Polyline Element	167	Channel Line
CHANNEL_FTR	Text Element	168	Channel Line Feature text at 1:200 scale
CHANNEL_ELEV	Text Element	169	Channel Line Elevation text at 1:200 scale
COALHOLE_COVER	Point Element	170	Coalhole Cover
COALHOLE_COVER_FTR	Text Element	171	Coalhole Cover Feature text at 1:200 scale
COALHOLE_COVER_ELEV	Text Element	172	Coalhole Cover Elevation text at 1:200 scale
CONTOUR	Polyline Element	173	Positive Normal Contour
CONTOUR_INDEX	Polyline Element	174	Positive Index Contour
CROWN	Polyline Element	175	Centre Line
CROWN_FTR	Text Element	176	Center Line Feature text at 1:200 scale
CROWN_ELEV	Text Element	177	Center Line Elevation text at 1:200 scale
CYCLE_LANE	Polyline Element	178	Cycle Lane
CYCLE_LANE_FTR	Text Element	179	Cycle Lane Feature text at 1:200 scale

CAD Layer/ Level Name	Element Type	Level No.	Level Description
CYCLE_LANE_ELEV	Text Element	180	Cycle Lane Elevation text at 1:200 scale
CONCRETE_PAD	Polyline Element	181	Concrete Pad
CONCRETE_PAD_FTR	Text Element	182	Concrete Pad Feature text at 1:200 scale
CONCRETE_PAD_ELEV	Text Element	183	Concrete Pad Elevation text at 1:200 scale
CABLE_TV	Polyline Element	184	Cable Television
CABLE_TV_FTR	Text Element	185	Cable Television Feature text at 1:200 scale
CABLE_TV_ELEV	Text Element	186	Cable Television Elevation text at 1:200 scale
DITCH	Polyline Element	192	Ditch
DITCH_FTR	Text Element	193	Ditch Feature text at 1:200 scale
DITCH_ELEV	Text Element	194	Ditch Elevation text at 1:200 scale
DAMP_PROOF_COURSE	Polyline Element	195	Damp Proof Course
DAMP_PROOF_COURSE_FTR	Text Element	196	Damp Proof Course Feature text at 1:200 scale
DAMP_PROOF_COURSE_ELEV	Text Element	197	Damp Proof Course Elevation text at 1:200 scale
DUCT	Polyline Element	198	Duct
DUCT_FTR	Text Element	199	Duct Feature text at 1:200 scale
DUCT_ELEV	Text Element	200	Duct Elevation text at 1:200 scale
ELECTRICPOLE	Point Element	206	Electricity Pole
ELECTRICPOLE_FTR	Text Element	207	Electricity Pole Feature text at 1:200 scale
ELECTRICPOLE_ELEV	Text Element	208	Electricity Pole Elevation text at 1:200 scale
ESB	Polyline Element	209	ESB Cover
ESB_FTR	Text Element	210	ESB Cover Feature text at 1:200 scale
ESB_ELEV	Text Element	211	ESB Cover Elevation text at 1:200 scale
ESB_BOX	Polyline Element	212	ESB Box
ESB_BOX_FTR	Text Element	213	ESB Box Feature text at 1:200 scale
ESB_BOX_ELEV	Text Element	214	ESB Box Elevation text at 1:200 scale
ESB_PYLON	Polyline Element	215	ESB Pylon
ESB_PYLON_FTR	Text Element	216	ESB Pylon Feature text at 1:200 scale
ESB_PYLON_ELEV	Text Element	217	ESB Pylon Elevation text at 1:200 scale
FENCE	Polyline Element	223	Fence
FENCE_FTR	Text Element	224	Fence Feature text at 1:200 scale
FENCE_ELEV	Text Element	225	Fence Elevation text at 1:200 scale
FIREHYDRANT	Polyline Element	226	Fire Hydrant
FIREHYDRANT_FTR	Text Element	227	Fire Hydrant Feature text at 1:200 scale
FIREHYDRANT_ELEV	Text Element	228	Fire Hydrant Elevation text at 1:200 scale
FLOWERBED	Polyline Element	229	Flowerbed
FLOWERBED_FTR	Text Element	230	Flowerbed Feature text at 1:200 scale
FLOWERBED_ELEV	Text Element	231	Flowerbed Elevation text at 1:200 scale
FOOTPATH	Polyline Element	232	Footpath
FOOTPATH_FTR	Text Element	233	Footpath Feature text at 1:200 scale
FOOTPATH_ELEV	Text Element	234	Footpath Elevation text at 1:200 scale
FORMLINE	Polyline Element	235	Formline/Breakline

CAD Layer/ Level Name	Element Type	Level No.	Level Description
FORMLINE_FTR	Text Element	236	Formline/Breakline Feature text at 1:200 scale
FORMLINE_ELEV	Text Element	237	Formline/Breakline Elevation text at 1:200 scale
GASVALVE	Point Element	249	Gas Valve
GASVALVE_FTR	Text Element	250	Gas Valve Feature text at 1:200 scale
GASVALVE_ELEV	Text Element	251	Gas Valve Elevation text at 1:200 scale
GATE	Polyline Element	252	Gate
GATE_FTR	Text Element	253	Gate Feature text at 1:200 scale
GATE_ELEV	Text Element	254	Gate Elevation text at 1:200 scale
GATEPOST	Point Element	255	Gate Post
GATEPOST_FTR	Text Element	256	Gate Post Feature text at 1:200 scale
GATEPOST_ELEV	Text Element	257	Gate Post Elevation text at 1:200 scale
GRATING	Polyline Element	258	Grating in footpath & building
GRATING_FTR	Text Element	259	Grating in footpath & building Feature text at 1:200 scale
GRATING_ELEV	Text Element	260	Grating in footpath & building Elevation text at 1:200 scale
GULLY	Polyline Element	261	Gully
GULLY_FTR	Text Element	262	Gully Feature text at 1:200 scale
GULLY_ELEV	Text Element	263	Gully Elevation text at 1:200 scale
GASMETER	Polyline Element	264	Gas Meter
GASMETER_FTR	Text Element	265	Gas Meter Feature text at 1:200 scale
GASMETER_ELEV	Text Element	266	Gas Meter Elevation text at 1:200 scale
HEDGE	Polyline Element	275	Hedge
HEDGE_FTR	Text Element	276	Hedge Feature text at 1:200 scale
HEDGE_ELEV	Text Element	277	Hedge Elevation text at 1:200 scale
HOARDING	Polyline Element	278	Hoarding
HOARDING_FTR	Text Element	279	Hoarding Feature text at 1:200 scale
HOARDING_ELEV	Text Element	280	Hoarding Elevation text at 1:200 scale
HYDRANT	Polyline Element	281	Hydrant
HYDRANT_FTR	Text Element	282	Hydrant Feature text at 1:200 scale
HYDRANT_ELEV	Text Element	283	Hydrant Elevation text at 1:200 scale
INSPECTION_COVER	Polyline Element	295	Inspection Cover
INSPECTION_COVER_FTR	Text Element	296	Inspection Cover Feature text at 1:200 scale
INSPECTION_COVER_ELEV	Text Element	297	Inspection Cover Elevation text at 1:200 scale
INVERTLEVEL	Point Element	298	Invert Level
INVERTLEVEL_FTR	Text Element	299	Invert Level Feature text at 1:200 scale
INVERTLEVEL_ELEV	Text Element	300	Invert Level Elevation text at 1:200 scale
KERB	Polyline Element	312	Top of kerb line
KERB_FTR	Text Element	313	Top of kerb line Feature text at 1:200 scale
KERB_ELEV	Text Element	314	Top of kerb line Elevation text at 1:200 scale

CAD Layer/ Level Name	Element Type	Level No.	Level Description
KIOSK	Polyline Element	315	Kiosk
KIOSK_FTR	Text Element	316	Kiosk Feature text at 1:200 scale
KIOSK_ELEV	Text Element	317	Kiosk Elevation text at 1:200 scale
LAMP_STANDARD	Point Element	329	Lamp Post
LAMP_STANDARD_FTR	Text Element	330	Lamp Post Feature text at 1:200 scale
LAMP_STANDARD_ELEV	Text Element	331	Lamp Post Elevation text at 1:200 scale
LANDING_AREA	Polyline Element	332	Private Landing Area
LANDING_AREA_FTR	Text Element	333	Private Landing Area Feature text at 1:200 scale
LANDING_AREA_ELEV	Text Element	334	Private Landing Area Elevation text at 1:200 scale
LIFT	Polyline Element	335	Wheel Chair Lift
LIFT_FTR	Text Element	336	Wheel Chair Lift Feature text at 1:200 scale
LIFT_ELEV	Text Element	337	Wheel Chair Lift Elevation text at 1:200 scale
MANHOLE	Point Element	346	Manhole Round
MANHOLE_FTR	Text Element	347	Manhole Feature text at 1:200 scale
MANHOLE_ELEV	Text Element	348	Manhole Elevation text at 1:200 scale
METAL_COVER	Polyline Element	349	Metal Cellar Cover
METAL_COVER_FTR	Text Element	350	Metal Cellar Cover Feature text at 1:200 scale
METAL_COVER_ELEV	Text Element	351	Metal Cellar Cover Elevation text at 1:200 scale
METAL_STRIP	Polyline Element	352	Property Line
METAL_STRIP_FTR	Text Element	353	Property Line Feature text at 1:200 scale
METAL_STRIP_ELEV	Text Element	354	Property Line Elevation text at 1:200 scale
MONUMENT	Polyline Element	355	Monument Plinth
MONUMENT_FTR	Text Element	356	Monument Plinth Feature text at 1:200 scale
MONUMENT_ELEV	Text Element	357	Monument Plinth Elevation text at 1:200 scale
MANHOLE_SQUARE	Polyline Element	358	Manhole Square
MONUMENT_WIREFRAME	Polyline Element	359	Monument Laser Scan Wireframe
OHLE_POLE	Point Element	369	OCS Pole
OHLE_POLE_FTR	Text Element	370	OCS Pole Feature text at 1:200 scale
OHLE_POLE_ELEV	Text Element	371	OCS Pole Elevation text at 1:200 scale
OVERHEAD_CABLE	Polyline Element	372	Overhead Cables
OVERHEAD_CABLE_FTR	Text Element	373	Overhead Cables Feature text at 1:200 scale
OVERHEAD_CABLE_ELEV	Text Element	374	Overhead Cables Elevation text at 1:200 scale
PARAPET	Polyline Element	386	Bridge Parapet
PARAPET_FTR	Text Element	387	Bridge Parapet Feature text at 1:200 scale

CAD Layer/ Level Name	Element Type	Level No.	Level Description
PARAPET_ELEV	Text Element	388	Bridge Parapet Elevation text at 1:200 scale
PARKING_METER	Point Element	389	Parking Meter
PARKING_METER_FTR	Text Element	390	Parking Meter Feature text at 1:200 scale
PARKING_METER_ELEV	Text Element	391	Parking Meter Elevation text at 1:200 scale
PAVING	Polyline Element	392	Paving type change
PAVING_FTR	Text Element	393	Paving type change Feature text at 1:200 scale
PAVING_ELEV	Text Element	394	Paving type change Elevation text at 1:200 scale
PILLAR	Polyline Element	395	Wall/Gate pillar
PILLAR_FTR	Text Element	396	Wall/Gate pillar Feature text at 1:200 scale
PILLAR_ELEV	Text Element	397	Wall/Gate pillar Elevation text at 1:200 scale
PIPE	Polyline Element	398	Pipe
PIPE_FTR	Text Element	399	Pipe Feature text at 1:200 scale
PIPE_ELEV	Text Element	400	Pipe Elevation text at 1:200 scale
PLATFORM	Polyline Element	401	Train/Tram Platform
PLATFORM_FTR	Text Element	402	Train/Tram Platform Feature text at 1:200 scale
PLATFORM_ELEV	Text Element	403	Train/Tram Platform Elevation text at 1:200 scale
POSTBOX	Polyline Element	404	Postbox
POSTBOX_FTR	Text Element	405	Postbox Feature text at 1:200 scale
POSTBOX_ELEV	Text Element	406	Postbox Elevation text at 1:200 scale
RAIL	Polyline Element	418	Hand Rail
RAIL_FTR	Text Element	419	Hand Rail Feature text at 1:200 scale
RAIL_ELEV	Text Element	420	Hand Rail Elevation text at 1:200 scale
RAMP	Polyline Element	421	Ramp
RAMP_FTR	Text Element	422	Ramp Feature text at 1:200 scale
RAMP_ELEV	Text Element	423	Ramp Elevation text at 1:200 scale
RETAINING_WALL	Polyline Element	424	Retaining Wall
RETAINING_WALL_FTR	Text Element	425	Retaining Wall Feature text at 1:200 scale
RETAINING_WALL_ELEV	Text Element	426	Retaining Wall Elevation text at 1:200 scale
ROAD_EDGE	Polyline Element	427	Edge of road
ROAD_EDGE_FTR	Text Element	428	Edge of road Feature text at 1:200 scale
ROAD_EDGE_ELEV	Text Element	429	Edge of road Elevation text at 1:200 scale
ROAD_MARKINGS	Polyline Element	430	Road Markings
ROAD_MARKINGS_FTR	Text Element	431	Road Markings Feature text at 1:200 scale
ROAD_MARKINGS_ELEV	Text Element	432	Road Markings Elevation text at 1:200 scale
ROAD_SCAR	Polyline Element	433	Road scar/repair line

CAD Layer/ Level Name	Element Type	Level No.	Level Description
ROAD_SCAR_FTR	Text Element	434	Road scar/repair line Feature text at 1:200 scale
ROAD_SCAR_ELEV	Text Element	435	Road scar/repair line Elevation text at 1:200 scale
ROADSIGN	Point Element	436	Road Sign
ROADSIGN_FTR	Text Element	437	Road Sign Feature text at 1:200 scale
ROADSIGN_ELEV	Text Element	438	Road Sign Elevation text at 1:200 scale
ROAD_SYMBOLLOGY	Polyline Element	439	Road marking symbology
SEAT	Polyline Element	450	Bench Seat
SEAT_FTR	Text Element	451	Bench Seat Feature text at 1:200 scale
SEAT_ELEV	Text Element	452	Bench Seat Elevation text at 1:200 scale
SECTION_TEMPLATE	Polyline Element	453	Section Template
SHELTER	Polyline Element	454	Shelter Bus/Tram
SHELTER_FTR	Text Element	455	Shelter Bus/Tram Feature text at 1:200 scale
SHELTER_ELEV	Text Element	456	Shelter Bus/Tram Elevation text at 1:200 scale
SIGN	Polyline Element	457	Sign (General)
SIGN_FTR	Text Element	458	Sign (General) Feature text at 1:200 scale
SIGN_ELEV	Text Element	459	Sign (General) Elevation text at 1:200 scale
SLUICEVALVE	Point Element	460	Sluice Valve
SLUICEVALVE_FTR	Text Element	461	Sluice Valve Feature text at 1:200 scale
SLUICEVALVE_ELEV	Text Element	462	Sluice Valve Elevation text at 1:200 scale
SOFFIT	Point Element	463	Non-DTM Elevation Point
SOFFIT_FTR	Text Element	464	Non-DTM Elevation Point Feature text at 1:200 scale
SOFFIT_ELEV	Text Element	465	Non-DTM Elevation Point Elevation text at 1:200 scale
SPOTHEIGHT	Point Element	466	Spotheight
SPOTHEIGHT_FTR	Text Element	467	Spotheight Feature text at 1:200 scale
SPOTHEIGHT_ELEV	Text Element	468	Spotheight Elevation text at 1:200 scale
STEPS	Polyline Element	469	Steps
STEPS_FTR	Text Element	470	Steps Feature text at 1:200 scale
STEPS_ELEV	Text Element	471	Steps Elevation text at 1:200 scale
STOPTAP	Point Element	475	Stop Tap
STOPTAP_FTR	Text Element	476	Stop Tap Feature text at 1:200 scale
STOPTAP_ELEV	Text Element	477	Stop Tap Elevation text at 1:200 scale
SURVEY_STATION	Point Element	478	Topographic Survey Station
SURVEY_STATION_FTR	Text Element	479	Topographic Survey Station Feature text at 1:200 scale
SURVEY_STATION_ELEV	Text Element	480	Topographic Survey Station Elevation text at 1:200 scale
SMART_CARD_VALIDATOR	Point Element	481	Luas Smart Card Validator
SMART_CARD_VALIDATOR_FTR	Text Element	482	Luas Smart Card Validator Feature text at 1:200 scale

CAD Layer/ Level Name	Element Type	Level No.	Level Description
SMART_CARD_VALIDATOR_ELEV	Text Element	483	Luas Smart Card Validator Elevation text at 1:200 scale
TICKET_VENDING_MACHINE	Polyline Element	489	Luas Ticket Vending Machine
TICKET_VENDING_MACHINE_FTR	Text Element	490	Luas Ticket Vending Machine Feature text at 1:200 scale
TICKET_VENDING_MACHINE_ELEV	Text Element	491	Luas Ticket Vending Machine Elevation text at 1:200 scale
TANK_STORAGE	Polyline Element	492	Storage Tanks
TANK_STORAGE_FTR	Text Element	493	Storage Tanks Feature text at 1:200 scale
TANK_STORAGE_ELEV	Text Element	494	Storage Tanks Elevation text at 1:200 scale
TECHNICAL_CUBICLE	Polyline Element	495	LUAS Technical Cubicle
TECHNICAL_CUBICLE_FTR	Text Element	496	LUAS Technical Cubicle Feature text at 1:200 scale
TECHNICAL_CUBICLE_ELEV	Text Element	497	LUAS Technical Cubicle Elevation text at 1:200 scale
TELECOM_EIRCOM	Polyline Element	498	Eircom Chamber
TELECOM_EIRCOM_FTR	Text Element	499	Eircom Chamber Feature text at 1:200 scale
TELECOM_EIRCOM_ELEV	Text Element	500	Eircom Chamber Elevation text at 1:200 scale
TELECOM_NTL	Polyline Element	501	NTL Chamber
TELECOM_NTL_FTR	Text Element	502	NTL Chamber Feature text at 1:200 scale
TELECOM_NTL_ELEV	Text Element	503	NTL Chamber Elevation text at 1:200 scale
TELECOM	Polyline Element	504	Telecom Cover
TELECOM_FTR	Text Element	505	Telecom Cover Feature text at 1:200 scale
TELECOM_ELEV	Text Element	506	Telecom Cover Elevation text at 1:200 scale
TELECOM_ESAT	Polyline Element	507	Esat Chamber
TELECOM_ESAT_FTR	Text Element	508	Esat Chamber Feature text at 1:200 scale
TELECOM_ESAT_ELEV	Text Element	509	Esat Chamber Elevation text at 1:200 scale
TELEGRAPHPOLE	Point Element	510	Telegraph pole
TELEGRAPHPOLE_FTR	Text Element	511	Telegraph pole Feature text at 1:200 scale
TELEGRAPHPOLE_ELEV	Text Element	512	Telegraph pole Elevation text at 1:200 scale
TELEPHONE_BOX	Polyline Element	513	Telephone Box
TELEPHONE_BOX_FTR	Text Element	514	Telephone Box Feature text at 1:200 scale
TELEPHONE_BOX_ELEV	Text Element	515	Telephone Box Elevation text at 1:200 scale
TEXT_1_200_Street_Names	Text Element	516	Street name text at 1:200 plot scale
TEXT_1_200_Building_Descriptions	Text Element	517	Building description text at 1:200 plot scale
TEXT_1_500_Uilities	Text Element	518	Utility text at 1:500 plot scale

CAD Layer/ Level Name	Element Type	Level No.	Level Description
TEXT_1_500_Street_Names	Text Element	519	Street name text at 1:500 plot scale
TEXT_1_500_Building_Descriptions	Text Element	520	Building description text at 1:500 plot scale
TEXT_1_500_All_elevations_except_spotheights	Text Element	521	All elevation text except spotheight text at 1:500 plot scale
TEXT_1_500_Spotheights_only	Text Element	522	Spotheight text at 1:500 plot scale
TEXT_1_500_All_features_except_utilities	Text Element	523	All features text except utility text at 1:500 plot scale
TITLEGRID	Text, Points & Line	524	Title Grid
TOILET	Polyline Element	525	Toilet Public/Private
TOILET_FTR	Text Element	526	Toilet Public/Private Feature text at 1:200 scale
TOILET_ELEV	Text Element	527	Toilet Public/Private Elevation text at 1:200 scale
TRACKBED	Polyline Element	528	LUAS trackbed
TRACKBED_FTR	Text Element	529	LUAS trackbed Feature text at 1:200 scale
TRACKBED_ELEV	Text Element	530	LUAS trackbed Elevation text at 1:200 scale
TRAFFIC_CONTROL_BOX	Polyline Element	531	Traffic Control Box
TRAFFIC_CONTROL_BOX_FTR	Text Element	532	Traffic Control Box Feature text at 1:200 scale
TRAFFIC_IC	Polyline Element	534	Traffic Inspection Cover
TRAFFIC_IC_FTR	Text Element	535	Traffic Inspection Cover Feature text at 1:200 scale
TRAFFIC_IC_ELEV	Text Element	536	Traffic Inspection Cover Elevation text at 1:200 scale
TRAFFICLIGHT	Point Element	537	Traffic light
TRAFFICLIGHT_FTR	Text Element	538	Traffic light Feature text at 1:200 scale
TRAFFICLIGHT_ELEV	Text Element	539	Traffic light Elevation text at 1:200 scale
TRAM_RAIL	Polyline Element	540	Tram Rail
TRAM_RAIL_FTR	Text Element	541	Tram Rail Feature text at 1:200 scale
TRAM_RAIL_ELEV	Text Element	542	Tram Rail Elevation text at 1:200 scale
TRAVERSE_LINE	Polyline Element	543	Traverse Route
TREE	Point Element	544	Tree
TREE_FTR	Text Element	545	Tree Feature text at 1:200 scale
TREE_ELEV	Text Element	546	Tree Elevation text at 1:200 scale
TRIALPIT	Polyline Element	547	Trial Pit
TRIALPIT_FTR	Text Element	548	Trial Pit Feature text at 1:200 scale
TRIALPIT_ELEV	Text Element	549	Trial Pit Elevation text at 1:200 scale
TRIANGULATION	Polyline Element	550	Valid Triangulation
TEMPORARY_STRUCTURE	Polyline Element	551	Temporary Structure
TEMPORARY_STRUCTURE_FTR	Text Element	552	Temporary Structure Feature text at 1:200 scale
TEMPORARY_STRUCTURE_ELEV	Text Element	553	Temporary Structure Elevation text at 1:200 scale
UTILITY_CABINET	Polyline Element	554	Utility Cabinet & Mini Pillar

CAD Layer/ Level Name	Element Type	Level No.	Level Description
UTILITY_CABINET_FTR	Text Element	555	Utility Cabinet Feature text at 1:200 scale
UTILITY_CABINET_ELEV	Text Element	556	Utility Cabinet Elevation text at 1:200 scale
VALVE	Point Element	562	Valve _ General
VALVE_FTR	Text Element	563	Valve _ General Feature Text
VALVE_ELEV	Text Element	564	Valve _ General Elevation Text
VEGETATION	Polyline Element	565	Vegetation Line
VEGETATION_FTR	Text Element	566	Vegetation Line Feature text at 1:200 scale
VEGETATION_ELEV	Text Element	567	Vegetation Line Elevation text at 1:200 scale
VERGE	Polyline Element	568	Verge Line
VERGE_FTR	Text Element	569	Verge Line Feature text at 1:200 scale
VERGE_ELEV	Text Element	570	Verge Line Elevation text at 1:200 scale
VENT	Polyline Element	571	Under Ground Car Park Vent
VENT_FTR	Text Element	572	Under Ground Car Park Vent Feature Text at 1:200
VENT_ELEV	Text Element	573	Under Ground Car Park Vent Elevation text at 1:200
WALL	Polyline Element	582	Wall
WALL_FTR	Text Element	583	Wall Feature text at 1:200 scale
WALL_ELEV	Text Element	584	Wall Elevation text at 1:200 scale
WATERMETER	Polyline Element	585	Water Meter
WATERMETER_FTR	Text Element	586	Water Meter Feature text at 1:200 scale
WATERMETER_ELEV	Text Element	587	Water Meter Elevation text at 1:200 scale
WATERVALVE	Point Element	588	Water Valve
WATERVALVE_FTR	Text Element	589	Water Valve Feature text at 1:200 scale
WATERVALVE_ELEV	Text Element	590	Water Valve Elevation text at 1:200 scale
TEXT_1_200_Street_Names_Rotated	Text Element	591	Street name text at 1:200 plot scale Rotated
TEXT_1_500_Street_Names_Rotated	Text Element	592	Street name text at 1:500 plot scale Rotated
TEXT_1_200_Building_Number	Text Element	593	Building numbers at 1:200 plot scale
TEXT_1_500_Building_Number	Text Element	594	Building numbers at 1:500 plot scale

20 APPENDIX 2 LINE TYPES AND TEXT FORMATS

Colour

All elements to be placed on COLOUR 9 (light grey)

Line Weight

All elements to be placed on WEIGHT 0 except Level 147, Building Outlines and Level 162, Building Facades, to be placed on WEIGHT 1

Font Type

All text to be on FONT (Working)

Font Size

There are four different text sizes in conjunction with two different scales for Font (Working):

Scale 1:200

1. Text on Scale 1:200, on all Levels except 516, Street Names & 517, Building Descriptions
Font height 0.4, Font width 0.4
2. Text on Scale 1:200, on Level 516, Street Names & 517, Building Descriptions
Font height 0.688, Font width 0.619

Scale 1:500

1. Text on Scale 1:500, on all Levels except 519, Street Names & 520, Building Descriptions
Font height 1.0, Font width 1.0
2. Text on Scale 1:500, on Level 519, Street Names & 520, Building Descriptions
Font height 1.719, Font width 1.547

21 APPENDIX 3 SAMPLE DRAWINGS AND TEMPLATES

Sample 1:200 3D Microstation & AutoCAD Topographical Survey Drawings (DGN & DWG files)

TII_Sample_1-200TopoSurvey_3D_CAD_Drawing

These ITM drawings (metres) shown in 3D CAD format are a sample of the drawing, which is one of the outputs required of the Survey Consultant.

Sample Station Location Diagram provided in Word and Adobe Acrobat format (DOC & PDF files)

SUR-SVW-0002 Station Description Sheet Template

These templates show a sample of the Station Description Sheet to be used when generating station description sheets for all survey control stations on this Contract, which is one of the outputs required of the Survey Consultant.

22 APPENDIX 4 SELF-CERTIFICATION CHECK LISTS

TOPOGRAPHICAL SURVEY CHECK LIST

Contract No.:	Consultant:
Location:	
Surveyor:	Checker:
Date Surveyed:	Date Checked:

The Checker has been given access to:	Yes	No	N/A
Horizontal and vertical control data/Station Schedule			
Detail survey field data/notes			
Vertical and horizontal control listings			
Client's Brief/Specification			
Mapping			
Traverse diagrams			
Calibration dates of instruments and equipment used			

Checks done on Detail Survey:	Yes	No	N/A
Checked values input into instruments including Scale Factors			
Checked R.O. readings against heights and distances derived from control listing			
Checked field data against control listing and adjacent detail survey data			
Checked instrument field checks			
Checks done on Detail Survey Deliverables:	Yes	No	NA
Checked survey meets Client's Brief/Specification for accuracy			
Checked survey meets Client's Brief/Specification for content and completeness			
Checked survey meets Client's Brief/Specification for formats			
Checked survey meets Client's Brief/Specification for layering			
Checked survey meets Client's Brief/Specification for labelling, coding and annotation			
Checked overlaps and adjacent heights and features for gross error			

Checked plots have a completed title box, north point, and legend of symbols used and key plan			
Checked content of Final Report			

Remedial Actions Undertaken:

I certify that all checks and remedial actions have been completed.	
Print Name:	Position:
Signed:	Date:

GNSS SURVEY CHECK LIST

Contract No:	Consultant:
Location:	
Surveyor:	Checker:
Date Surveyed:	Date Checked:

Model and Type of Receiver and Antenna used	
Height of Antenna Reference Point above control station	
Correction used – Antenna Reference point to Phase Centre	
Post-processing and RTK Software and Version used	
OSI Active Stations used Names Dates used	
OSI Passive Stations used References Names Co-ordinates Dates used	
Observation period	
Epoch interval	
Details of Satellite Ephemeris source and of type used	
Troposphere reduction strategy used	
Method of conversion from WGS84 to ITM Grid & current Geoid model as defined by Project control	

The following data shall be provided to the Client in digital format:

Raw GNSS observation data recorded at the station in RINEX format

RINEX data for OSI active stations used
Raw GNSS observation data recorded at OSI passive stations and/or raw GNSS observation data recorded at TII control stations in RINEX format
A Baseline Processing Report and Network Adjustment Report

Notes and Remarks:	
We certify that all the above information is complete and correct	
Surveyor:	Position:
Signed:	Date:
Checker:	Position:
Signed:	Date:

LEVELLING CHECK LIST

Contract No:	Consultant:
Level Run:	
Surveyor:	Checker:
Date Surveyed:	Date Checked:

The Checker has been given access to:	Yes	No	NA
Vertical control data/Station Schedule			
Field notes/data			
GNSS/trigonometric height data			
Client's Brief/Specification			
Mapping			
Instrument checks Calibration dates of instruments and equipment used			

Checks done on Vertical Control:	Yes	No	NA
Checked control data against data in field notes			
Checked values input into digital levels			
Checked misclosure between control stations			
Checked other loop misclosures			
Checked two peg test notes			

Checks done on Levelling Report:	Yes	No	NA
Checked Schedule of TBMs			

Checked Location Diagrams			
Checked TBM layout map			
Remedial Actions Undertaken:			

I certify that all checks and remedial actions have been completed.	
Print Name:	Position:
Signed:	Date:

TRAVERSING CHECKLIST

Contract No.:	Consultant:
Traverse:	
Surveyor:	Checker:
Date Surveyed:	Date Checked:

The Checker has been given access to:	Yes	No	NA
Horizontal control data/Station Schedule			
Field notes/data			
Vertical control schedules			
Client's Brief/Specification			
Mapping			
Traverse diagrams			
Traverse adjustment printout			
Traverse Station Schedule			
GNSS Report			
Calibration dates of instruments used			

Checks done on Horizontal Control:	Yes	No	NA
Checked control data against data in field notes and GNSS Report			
Checked values input into instruments			
Checked defaults and input in network adjustment printout			
Checked misclosures between stations and adjustment residuals			
Checked discrepancies between levelling and trigonometric heights			
Checked instrument field checks			
Checks done on Traverse Report:	Yes	No	NA
Checked co-ordinate values are quoted correctly in all documents			
Checked values in Location Diagrams and Station Schedules			

Checked traverse layout map			
Checked co-ordinate values against Clients Supplied data			

Remedial Actions Undertaken:	
I certify that all checks and remedial actions have been completed.	
Print Name:	Print Name:
Signed:	Signed:

23 APPENDIX 5 MX STRING NAMING CONVENTION

MX Label	CAD Layer/ Level Name	Element Type	Level No.	TIN Status	Feature Description
AB	ABUTMENT	Polyline Element	100	Included	Bridge Abutment
AC	AIRCON_VENT	Polyline Element	103	Included	Air Conditioning vents
PAV	AIRVALVE	Point Element	106	Included	Air Valve
U	BANKBOTTOM	Polyline Element	120	Included	Bottom of Embankment
T	BANKTOP	Polyline Element	123	Included	Top of Embankment
BM	BASEMENT_COVER	Polyline Element	126	Included	Basement Cover
PBL	BEDLEVEL	Point Element	129	Included	Bed Level
BN	BIN	Polyline Element	132	Included	BIN
PBD	BOLLARD	Point Element	135	Included	Bollard
PBH	BOREHOLE	Point Element	138	Included	Bore Hole
BD	BRIDGE	Polyline Element	141	Excluded	Bridge
BR	BRIDGE_PIER	Polyline Element	144	Included	Bridge Pier
B	BUILDING	Polyline Element	147	Included	Building Outline
PBS	BUS_STOP	Point Element	150	Included	Bus Stop
UM	BASEMENT_MANHOLE_SQUARE	Polyline Element	153	Excluded	Basement Manhole Square
UE	BASEMENT_PIPE	Polyline Element	156	Excluded	Basement Pipe
UW	BASEMENT_WALL	Polyline Element	159	Excluded	Basement Wall
BF	BUILDING_FACADE	Polyline Element	162	Excluded	Building Facade Outline
O	CANOPY	Polyline Element	164	Excluded	Canopy
C	CHANNEL	Polyline Element	167	Included	Channel Line
PCE	COALHOLE_COVER	Point Element	170	Included	Coalhole Cover
Y	CONTOUR	Polyline Element	173	Excluded	Positive Normal Contour
Z	CONTOUR_INDEX	Polyline Element	174	Excluded	Positive Index Contour
A	CROWN	Polyline Element	175	Included	Road Crown Line
CL	CYCLE_LANE	Polyline Element	178	Included	Cycle Lane
CP	CONCRETE_PAD	Polyline Element	181	Included	Concrete Pad
CT	CABLE_TV	Polyline Element	184	Included	Cable Television
D	DITCH	Polyline Element	192	Included	Ditch
DP	DAMP_PROOF_COURSE	Polyline Element	195	Excluded	Damp Proof Course
DT	DUCT	Polyline Element	198	Excluded	Duct
PEP	ELECTRICPOLE	Point Element	206	Included	Electricity Pole
EC	ESB	Polyline Element	209	Included	ESB Cover
EB	ESB_BOX	Polyline Element	212	Included	ESB Box
EY	ESB_PYLON	Polyline Element	215	Included	ESB Pylon
F	FENCE	Polyline Element	223	Included	Fence
FH	FIREHYDRANT	Polyline Element	226	Included	Fire Hydrant

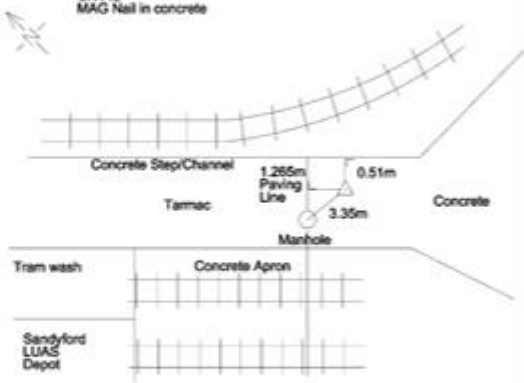
MX Label	CAD Layer/ Level Name	Element Type	Level No.	TIN Status	Feature Description
FB	FLOWERBED	Polyline Element	229	Included	Flowerbed
FP	FOOTPATH	Polyline Element	232	Included	Footpath
L	FORMLINE	Polyline Element	235	Included	Formline/Breakline
PGV	GASVALVE	Point Element	249	Included	Gas Valve
GE	GATE	Polyline Element	252	Excluded	Gate
PGP	GATEPOST	Point Element	255	Included	Gate Post
GG	GRATING	Polyline Element	258	Included	Grating in footpaths & buildings
G	GULLY	Polyline Element	261	Included	Gully
GM	GASMETER	Polyline Element	264	Included	Gas Meter
H	HEDGE	Polyline Element	275	Included	Hedge
HG	HOARDING	Polyline Element	278	Included	Hoarding
HT	HYDRANT	Polyline Element	281	Included	Hydrant
IC	INSPECTION_COVER	Polyline Element	295	Included	Inspection Cover
PIL	INVERTLEVEL	Point Element	298	Excluded	Invert Level
K	KERB	Polyline Element	312	Included	Top of kerb line
KK	KIOSK	Polyline Element	315	Included	Kiosk
PLP	LAMP_STANDARD	Point Element	329	Included	Lamp Post
LA	LANDING_AREA	Polyline Element	332	Excluded	Private Landing Area
LT	LIFT	Polyline Element	335	Included	Wheel Chair Lift
PMH	MANHOLE	Point Element	346	Included	Manhole Round
CR	METAL_COVER	Polyline Element	349	Included	Metal Cellar Cover
BL	METAL_STRIP	Polyline Element	352	Included	Property Line
TE	MONUMENT	Polyline Element	355	Included	Monument Plinth
TW	MONUMENT_WIREFRAME	Polyline Element	359	Excluded	Monument Wire Frame
SM	MANHOLE_SQUARE	Polyline Element	358	Included	Manhole Square
PCS	OHLE_POLE	Point Element	369	Included	OCS Pole
OV	OVERHEAD_CABLE	Polyline Element	372	Excluded	Overhead Cables
BP	PARAPET	Polyline Element	386	Excluded	Bridge Parapet
PMP	PARKING_METER	Point Element	389	Included	Parking Meter
S	PAVING	Polyline Element	392	Included	Paving type change
WP	PILLAR	Polyline Element	395	Included	Wall/Gate pillar
UP	PIPE	Polyline Element	398	Excluded	Pipe
FM	PLATFORM	Polyline Element	401	Included	Train/Tram Platform
BX	POSTBOX	Polyline Element	404	Included	Postbox
RA	RAIL	Polyline Element	418	Excluded	Hand Rail
RP	RAMP	Polyline Element	421	Included	Ramp
WR	RETAINING_WALL	Polyline Element	424	Included	Retaining Wall
RE	ROAD_EDGE	Polyline Element	427	Included	Edge of road
R	ROAD_MARKINGS	Polyline Element	430	Included	Broken White Line,
R	ROAD_MARKINGS	Polyline Element	430	Included	Continuous White Line,

MX Label	CAD Layer/ Level Name	Element Type	Level No.	TIN Status	Feature Description
R	ROAD_MARKINGS	Polyline Element	430	Included	Single Yellow Line,
R	ROAD_MARKINGS	Polyline Element	430	Included	Double Yellow Line,
R	ROAD_MARKINGS	Polyline Element	430	Included	Broken Yellow Line,
R	ROAD_MARKINGS	Polyline Element	430	Included	Yellow Box, etc.
RC	ROAD_SCAR	Polyline Element	433	Included	Road scar/repair line
PR	ROADSIGN	Point Element	436	Included	Road Sign
J	ROAD_SYMBOLGY	Polyline Element	439	Excluded	Painted Arrows & Text
BE	SEAT	Polyline Element	450	Included	Bench Seat
ST	SECTION_TEMPLATE	Polyline Element	453	Excluded	Section Template
SR	SHELTER	Polyline Element	454	Excluded	Shelter Bus/Tram
SN	SIGN	Polyline Element	457	Included	Sign (General)
PSV	SLUICEVALVE	Point Element	460	Included	Sluice Valve
PSF	SOFFIT	Point Element	463	Excluded	Non-DTM Elevation Point
PS	SPOTHEIGHT	Point Element	466	Included	Spotheight
N	STEPS	Polyline Element	469	Included	Steps
PST	STOPTAP	Point Element	475	Included	Stop Tap
PSS	SURVEY_STATION	Point Element	478	Included	Topographic Survey Station
PCV	SMART_CARD_VALIDATOR	Point Element	481	Included	Luas Smart Card Validator
VM	TICKET_VENDING_MACHINE	Polyline Element	489	Included	Luas Ticket Vending Machine
TS	TANK_STORAGE	Polyline Element	492	Included	Storage Tanks
TC	TECHNICAL_CUBICLE	Polyline Element	495	Included	LUAS Technical Cubicle
EM	TELECOM_EIRCOM	Polyline Element	498	Included	Eircom Chamber
NC	TELECOM_NTL	Polyline Element	501	Included	NTL Chamber
TM	TELECOM	Polyline Element	504	Included	Telecom Cover
ES	TELECOM_ESAT	Polyline Element	507	Included	Esat Chamber
PTP	TELEGRAPHPOLE	Point Element	510	Included	Telegraph pole
TX	TELEPHONE_BOX	Polyline Element	513	Included	Telephone Box
*	TEXT_1_200_Street_Names	Text Element	516	Excluded	Street name text at 1:200 plot scale
*	TEXT_1_200_Building_Descriptions	Text Element	517	Excluded	Building description text at 1:200 plot scale
*	TEXT_1_500_Uilities	Text Element	518	Excluded	Utility text at 1:500 plot scale
*	TEXT_1_500_Street_Names	Text Element	519	Excluded	Street name text at 1:500 plot scale
*	TEXT_1_500_Building_Descriptions	Text Element	520	Excluded	Building description text at 1:500 plot scale

MX Label	CAD Layer/ Level Name	Element Type	Level No.	TIN Status	Feature Description
*	TEXT_1_500_All_elevations_except_spotheights	Text Element	521	Excluded	All elevation text except spotheight text at 1:500 plot scale
*	TEXT_1_500_Spotheights_only	Text Element	522	Excluded	Spotheight text at 1:500 plot scale
*	TEXT_1_500_All_features_except_utilities	Text Element	523	Excluded	All features text except utility text at 1:500 plot scale
*	TITLEGRID	Line & Text Element	524	Excluded	Title Grid
TT	TOILET	Polyline Element	525	Included	Toilet Public/Private
TK	TRACKBED	Polyline Element	528	Included	LUAS trackbed
TB	TRAFFIC_CONTROL_BOX	Polyline Element	531	Included	Traffic Control Box
TI	TRAFFIC_IC	Polyline Element	534	Included	Traffic Inspection Cover
PTL	TRAFFICLIGHT	Point Element	537	Included	Traffic light
TR	TRAM_RAIL	Polyline Element	540	Included	Tram Rail
RS	TRAVERSE_LINE	Polyline Element	543	Excluded	Traverse Route
P3	TREE	Point Element	544	Excluded	Tree
TP	TRIALPIT	Polyline Element	547	Included	Trial Pit
TN	TRIANGULATION	Polyline Element	550	Excluded	Valid Triangulation
Q	TEMPORARY_STRUCTURE	Polyline Element	551	Included	Portacabins, etc.
I	UTILITY_CABINET	Polyline Element	554	Included	Utility Cabinet
PV	VALVE	Point Element	562	Included	Valve _ General
V	VEGETATION	Polyline Element	565	Included	Vegetation Line
E	VERGE	Polyline Element	568	Included	Verge Line
VT	VENT	Polyline Element	571	Included	Under Ground Car Park Vent
W	WALL	Polyline Element	582	Included	Wall
WM	WATERMETER	Polyline Element	585	Included	Water Meter
PWV	WATERVALVE	Point Element	588	Included	Water Valve
*	TEXT_1_200_Street_Names_Rotated	Text Element	591	Excluded	Street name text at 1:200 plot scale Rotated
*	TEXT_1_500_Street_Names_Rotated	Text Element	592	Excluded	Street name text at 1:500 plot scale Rotated
*	TEXT_1_200_Building_Number	Text Element	593	Excluded	Build numbers at 1:200 plot scale
*	TEXT_1_500_Building_Number	Text Element	594	Excluded	Build numbers at 1:500 plot scale

V1.13

24 APPENDIX 6 STATION DESCRIPTION SHEET TEMPLATE

Project Name: Green Line Capacity Enhancement		Notes:							
Revision No: Rev1									
ETRF89/WGS84 Co-ordinates	Latitude:	Longitude:		Ellipsoidal Ht:					
	N/A	N/A		N/A					
Irish Transverse Mercator (ITM) Co-ordinates	Easting (m):	Northing (m):	Orthometric Height (m): (OSGM02)		Local Scale Factor:				
	720027.145E	728582.452N	79.823		0.999984				
Positional Accuracy	StDev Easting (m):	StDev Northing (m):	StDev Height (m):	Linear Misc. (RACR ¹):	Level Misc. (n/k):	HRMS (m):	VRMS (m):		
	N/A	N/A	N/A	1: 128 000	0.5mm √1.9 km	N/A	N/A		
				LINEAGE Grid System: Irish Transverse Mercator (ITM) Reference Datum: OSGM02 Malin Head (Grid Inq. V8.6) Project Classification: Secondary Established By: - Traverse B612 & B613 to B551 & B625 - Levelling B612 & B613 to B551 Reference Benchmark: MND2 – Ortho Height: 11.762m Last Surveyed: June 2015 PGM Description: MAG Nail in concrete, Sandyford Depot grounds, South Eastern Apron.					
				GN142 MAG Nail in concrete 					
© Copyright 2007 – 2020 Transport Infrastructure Ireland (TII). This document is confidential and the copyright in it is owned by the TII. This drawing must not be either loaned, copied or otherwise reproduced in whole or in part or used for any purpose without the prior permission of the TII. © Copyright 2011 – 2019 Ordnance Survey Ireland and Government of Ireland. All O.S. data used for plans are printed under Ordnance Survey permit no. O.S. 0417. All elevations are in metres and relate to OSGM02 (OSGB3600) Mean Head as defined by existing Project Control.				Surveyed By: Name		Checked By: Name		Approved By: Name	
1. RACR = Relative Accuracy Closure Ratio (Ref. TSOCC-SVD-007.4-2002)									

25 APPENDIX 7 SAMPLE 3D STARNET INPUT FILE

(I) SAMPLE STARNET DATA (.DAT) FILE

```
#
# Reduced StarNet data file (.DAT) required by Client for 3D Link Traverse Checking and QA
# Showing the coordinates of the beginning and end fixed pairs of stations and the
# reduced forward and reverse 3D observations from each survey station on the traverse and the
# Relevant heights of instruments and heights of targets
#
# From MW14toMW16-rawobs.Traverse (see below for the associated raw observation file)
# Date Tuesday January 06 2009
#
# Co-ordinates
# Format of
# CoordinateInput_StationName_Easting_Northing_Elevation_Fixed_Fixed_Fixed
C MW13 308472.757 239830.243 72.777! ! !
C MW14 308603.341 239720.591 71.091! ! !
C MW15 307491.859 239259.613 57.376! ! !
C MW16 307357.594 239132.105 60.278! ! !
#
# Observations
# Format of file
# DataBeginning_At Stn
# DataMeasurement_To Stn_Backward Mean Angle_Mean SlopeDist_Mean ZenithAngle_HI_HT
# DataMeasurement_To Stn_Forward Mean Angle_Mean SlopeDist_Mean ZenithAngle_HI_HT
# DataEnding
#
DB MW13
DM MW14 000-00-00 170.532 090-33-24 1.588/1.621
DM RW155 234-01-17 114.224 089-47-32 1.588/1.570
DE
```

DB RW155

DM MW13 000-00-00 114.224 090-12-31 1.570/1.588

DM RW156 040-29-34 155.471 090-00-23 1.570/1.644

DE

etc...

DE

DB RW162

DM RW161 000-00-00 147.735 089-35-56 1.653/1.633

DM MW15 152-20-04 134.847 089-21-26 1.653/1.656

DE

DB MW15

DM RW162 000-00-00 134.846 090-38-40 1.656/1.653

DM MW16 118-31-35 185.196 089-05-40 1.656/1.683

DE

#

End of data file

#

(II) RAW TRAVERSE DATA FILE

Sample raw 3D traverse data file (or similar) shall be supplied by the Contractor for the purposes of quality checking by the Employer. Sample file below shows individual raw 3D observations for Face Left and Face Right reading which shall be reduced for StarNet entry.

Date: Tuesday January 06 2009

Averaging face 1 & face 2

Set-up 1, at MW13 BackSight to MW14
Ha 130 01 13, Va 090 33 28, Dist 170.532
Ha 310 01 16, Va 269 26 36, Dist 170.532
Mean Ha 130 01 14, Mean Va 090 33 26, Mean Dist 170.532

Set-up 1, at MW13 ForeSight to RW155
Ha 004 02 30, Va 089 47 34, Dist 114.224
Ha 184 02 30, Va 270 12 29, Dist 114.223
Mean Ha 004 02 30, Mean Va 089 47 32, Mean Dist 114.224
etc....

Set-up 11, at MW15 BackSight to MW16
Ha 226 28 45, Va 089 05 43, Dist 185.196
Ha 046 28 48, Va 270 54 22, Dist 185.196
Mean Ha 226 28 47, Mean Va 089 05 40, Mean Dist 185.196

Set-up 11, at MW15 ForeSight to RW162
Ha 107 57 09, Va 090 38 41, Dist 134.847
Ha 287 57 13, Va 269 21 23, Dist 134.846
Mean Ha 107 57 11, Mean Va 090 38 39, Mean Dist 134.846
etc...

(III) REDUCED TRAVERSE DATA

Sample file below shows multiple traverse rounds reduced to a mean horizontal direction, vertical angle and slope distance.

Setup at Stn to Stn Mean FMA Mean Va Mean SD
1 MW13 MW14 000 00 00.00 090 33 24.41 170.532

Forward	MeanAngle	Va	SDist	Diff. FMA	Diff. Va	Diff. SDist
000 00 00.00	090 33 26.00	170.532	000 00 00.00	000 00 01.58	0.000	
000 00 00.00	090 33 26.00	170.532	000 00 00.00	000 00 01.58	0.000	
000 00 00.00	090 33 23.50	170.532	000 00 00.00	000 00 00.9	0.000	
000 00 00.00	090 33 23.50	170.532	000 00 00.00	000 00 00.9	0.000	
000 00 00.00	090 33 23.50	170.532	000 00 00.00	000 00 00.9	0.000	

Setup At Stn To Stn Mean FMA Mean Va Mean SD
1 MW13 RW155 234 01 17.50 089 47 32.30 114.224

Forward	MeanAngle	Va	SDist	Diff. FMA	Diff. Va	Diff. SDist
234 01 17.00	089 47 32.50	114.224	-000 00 00.5	000 00 00.2	0.000	
234 01 18.00	089 47 32.50	114.224	000 00 00.5	000 00 00.2	0.000	
234 01 17.00	089 47 32.50	114.224	-000 00 00.5	000 00 00.2	0.000	
234 01 17.00	089 47 31.50	114.224	-000 00 00.5	000 00 00.8	0.000	
234 01 18.50	089 47 32.50	114.224	000 00 01.0	000 00 00.2	0.000	

etc..



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Sráid Gheata na Páirce
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D08 DK10



Transport Infrastructure Ireland
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Appendix B

CKG-ARP-PMG-P3-DR-001



Notes

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Cork National Roads Office



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Job Title

Cork to Kinsale Greenway

Scale

NTS

Role

Alignment Design

Date

July 2026

Drawing Title

Topographic, Hydrographic and Structures
Survey Contract Drawings
Keyplan

Suitability

S2 - Suitable for Information

Job No

297194

Figure ID

Rev.

P01

Drawing No

CKG-ARP-PMG-P3-DR-100-KeyPlan



FOR INFORMATION

Legend:

Area of Topographical Survey

Area of Hydrographic Survey

THS-01
Structures to be surveyed as part of Topographic and Hydrographic Surveys

STS-01
Structures to be surveyed as part of Structures Surveys

Notes

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Job Title

Cork to Kinsale Greenway

Scale	NTS
Role	Alignment Design
Date	July 2026

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Issue	Date	By	Chkd	Appd

Drawing Title

Topographic, Hydrographic and Structures
Survey Contract Drawings
Sheet 1 of 9

Suitability

S2 - Suitable for Information

Job No	Figure ID	Rev.
297194		P01

Drawing No

CKG-ARP-PMG-P3-DR-001



FOR INFORMATION

Legend:

Area of Topographical Survey

Area of Hydrographic Survey

THS-01
Structures to be surveyed as part of Topographic and Hydrographic Surveys

STS-01
Structures to be surveyed as part of Structures Surveys

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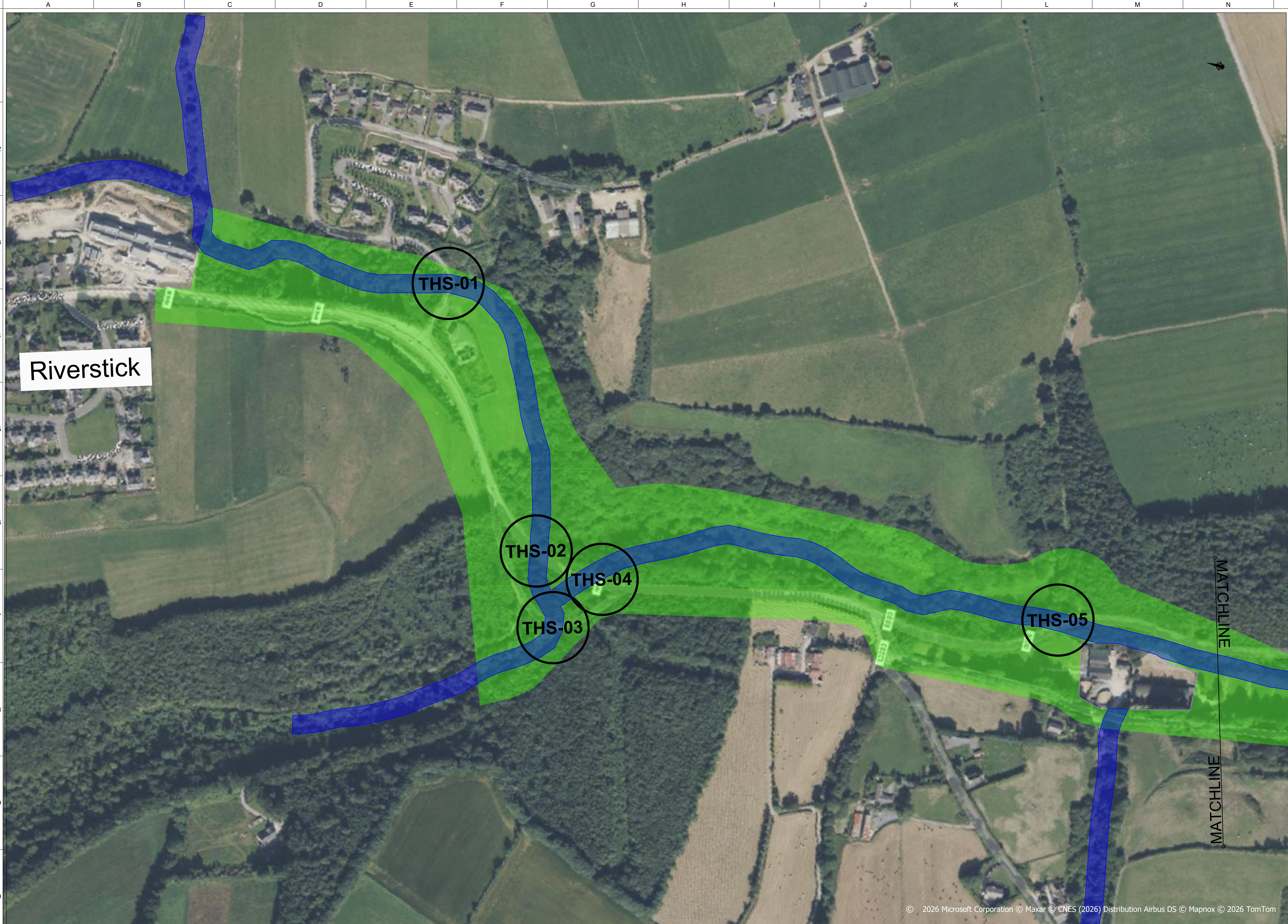
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Issued For Information (Status S2)				
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Drawing Title
Topographic, Hydrographic and Structures
Survey Contract Drawings
Sheet 2 of 9

Suitability
S2 - Suitable for Information

Job No. 297194	Figure ID	Rev. P01
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Drawing No
CKG-ARP-PMG-P3-DR-002



FOR INFORMATION

Legend:

Area of Topographical Survey

Area of Hydrographic Survey

THS-01
Structures to be surveyed as part of Topographic and Hydrographic Surveys

STS-01
Structures to be surveyed as part of Structures Surveys

Riverstick

THS-02

THS-04

THS-03

THS-05

MATCHLINE

MATCHLINE

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Drawing Title
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Sheet 3 of 9

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Job No 297194	Figure ID	Rev. P01

Drawing No
CKG-ARP-PMG-P3-DR-003



FOR INFORMATION

Legend:

Area of Topographical Survey

Area of Hydrographic Survey

THS-01

Structures to be surveyed as part of Topographic and Hydrographic Surveys

STS-01

Structures to be surveyed as part of Structures Surveys

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Comhairle Cathrach Chorcaí
Cork City Council

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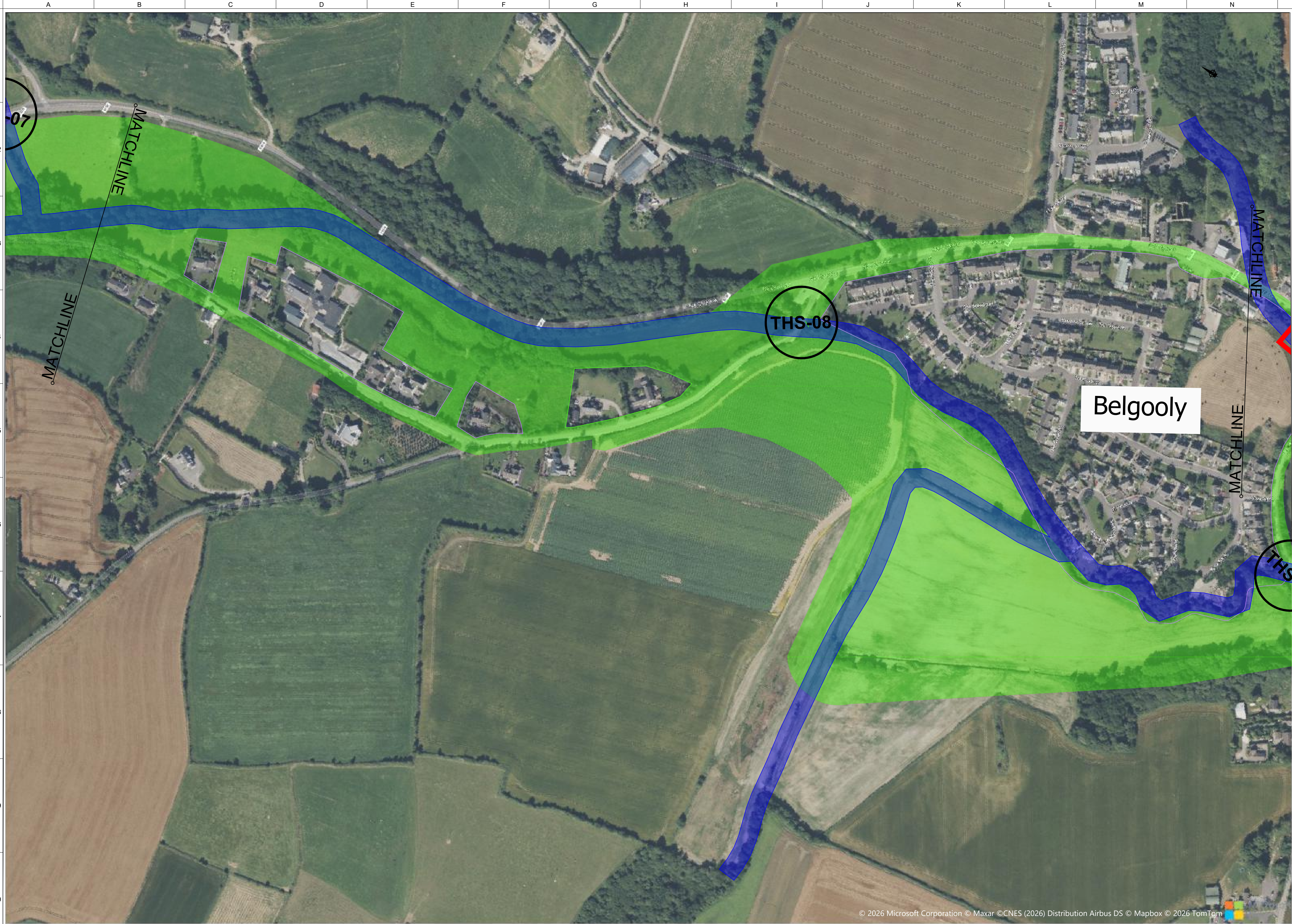
Topographic, Hydrographic and Structures Survey Contract Drawings
Sheet 4 of 9

Suitability

S2 - Suitable for Information

Job No	Figure ID	Rev.
297194		P01

Drawing No
CKG-ARP-PMG-P3-DR-004



FOR INFORMATION

Legend:

Area of Topographical Survey

Area of Hydrographic Survey

THS-01

Structures to be surveyed as part of Topographic and Hydrographic Surveys

STS-01

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Topographic, Hydrographic and Structures Survey Contract Drawings
Sheet 5 of 9

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297194		P01

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CKG-ARP-PMG-P3-DR-005

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Legend:

Area of Topographical Survey

Area of Hydrographic Survey

THS-01

Structures to be surveyed as part of Topographic and Hydrographic Surveys

STS-01

Structures to be surveyed as part of Structures Surveys

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Job Title

Cork to Kinsale Greenway

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Role

Alignment Design

Date

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Topographic, Hydrographic and Structures Survey Contract Drawings
Sheet 6 of 9

Suitability

S2 - Suitable for Information

Job No

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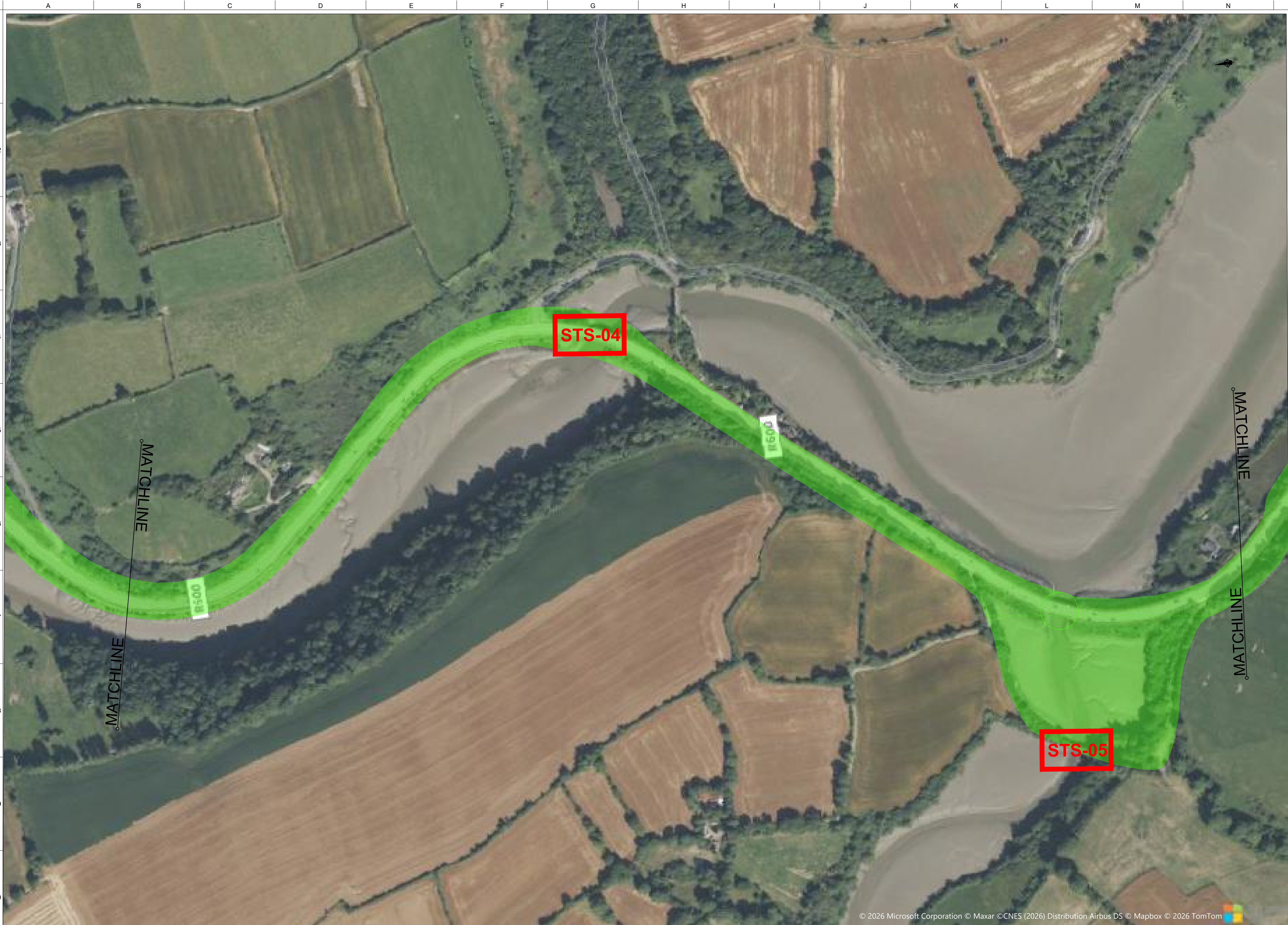
Figure ID

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P01

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CKG-ARP-PMG-P3-DR-006



FOR INFORMATION

Legend:

Area of Topographical Survey

Area of Hydrographic Survey

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Sheet 7 of 9

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Job No 297194	Figure ID	Rev. P01
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Drawing No
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Legend:

Area of Topographical Survey

Area of Hydrographic Survey

THS-01
Structures to be surveyed as part of Topographic and Hydrographic Surveys

STS-01
Structures to be surveyed as part of Structures Surveys

- Notes
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Topographic, Hydrographic and Structures
Survey Contract Drawings
Sheet 8 of 9

Suitability
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Job No	Figure ID	Rev.
297194		P01

Drawing No
CKG-ARP-PMG-P3-DR-008



FOR INFORMATION

Legend:

Area of Topographical Survey

Area of Hydrographic Survey

THS-01
Structures to be surveyed as part of Topographic and Hydrographic Surveys

STS-01
Structures to be surveyed as part of Structures Surveys

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Scale	NTS
Role	Alignment Design
Date	July 2026

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Topographic, Hydrographic and Structures
Survey Contract Drawings
Sheet 9 of 9

Suitability
S2 - Suitable for Information

Job No 297194	Figure ID	Rev. P01
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Drawing No
CKG-ARP-PMG-P3-DR-009

Appendix C

Photogrammetry Specification

C.1 Photogrammetry Specification

C.1.1 Aerial Photogrammetry General

The purpose of this document is to define the specifications that shall be followed while performing aerial surveys, photogrammetry, and geospatial data processing.

Aerial photogrammetry is the science of deducing the physical dimensions of objects on or above the surface of the Earth from measurements on aerial photographs of the objects. The end result produces the coordinate (X, Y, and Z) position of a particular point, a planimetric feature, and a graphic representation of the terrain from a DTM.

Aerial photogrammetry is often used for the following:

- Highway reconnaissance
- Environmental
- Preliminary design
- Structure Condition Visual Assessment
- Geographic Information System (GIS)
- Asset management models

The information produced from aerial photographs of the existing terrain allows both designers and environmental personnel to explore alternate routes without having to collect additional field information. The photographs can be used to layout possible alignments for a more detailed study.

Photogrammetry has evolved into a limited substitution for topographic ground surveying. It can relieve survey crews of the most tedious time-consuming tasks required to produce topographic maps and DTMs. The ground surveys will remain an indispensable part of aerial surveys as a basis for accuracy refinement, quality control and a source of supplemental information unavailable to aerial data acquisition.

C.1.2 Photogrammetric Advantages / Disadvantages

Surveys collected by aerial photogrammetry methods have both advantages and disadvantages when compared with ground survey methods as follows:

C.1.2.1 Advantages:

- Photos provide a permanent record of the existing terrain conditions at the time the photograph was taken.
- Photos can be used to convey information to the general public and other agencies.
- Photos can be used for multiple purposes such as reconnaissance, preliminary design, environmental.
- Large area mapping and digital terrain models can be accomplished quicker and at a lower cost when compared to ground survey methods.
- Photogrammetry can be used in locations that are difficult or impossible to access from the ground.
- If information must be re-surveyed or re-evaluated, it is not necessary to perform expensive field work. The photogrammetry model can be re-loaded, and measurements verified and/or additional information compiled in a timely manner

C.1.2.2 Disadvantages:

- Overall accuracy is relative to camera quality and flying height. Elevations derived from photogrammetry are less accurate than ground surveys (when compared to conventional or GPS ground survey methods using appropriate elevation procedures).
- Underground utilities cannot be located, measured, or identified.
- Seasonal weather patterns that produce increased wind and cloud cover may hamper the ability to perform the mission.
- Solar conditions such as sun angles less than 30° above the horizon will cast long shadows. Sun angles greater than 45° will produce sunspots on the image.
- It may be difficult or impossible to collect measurements in areas with dark shadows, dense vegetation, snow, water, or overhanging features.

C.2 Photogrammetry Requirements

C.2.1 General

Aerial survey data must be referenced to ground control points in order to maximize the absolute accuracy achievable for the aerial data. This is achieved by survey crews establishing photo ground control within the project area. Targets are placed over ground control so that the location of the point is easily identified on the imagery. The field measurement of the horizontal and vertical elevation (X, Y and Z) of the control points will be used in the downstream processes of photogrammetry and/or point cloud calibration to register the data sets to field survey values. Elevations, (Z), must be provided at surface grade.

C.2.2 Ground Control Targeting Requirements

Ground control requirements for aerial mapping will be predicated upon flying height, terrain, equipment, accuracy requirements and technology applied for data acquisition.

C.2.3 Ground Sampling Distance (GSD) and expected images precision.

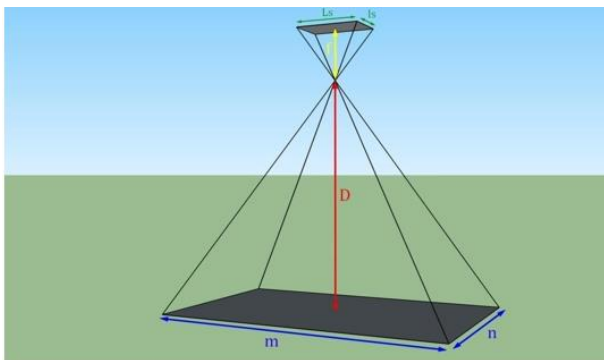
GSD (ground sampling distance) depends on the camera model, the lens, and the distance from the scene. The expected precision will be specified to meet requirements of the photogrammetry model.

$$R = \frac{L_s * D}{f * L}$$

R	ground sampling distance (GSD)
D	distance to the scene
f	focal length
L _s	sensor size
L	image size in pixel

Expected precision

$$P = 2 \times R$$



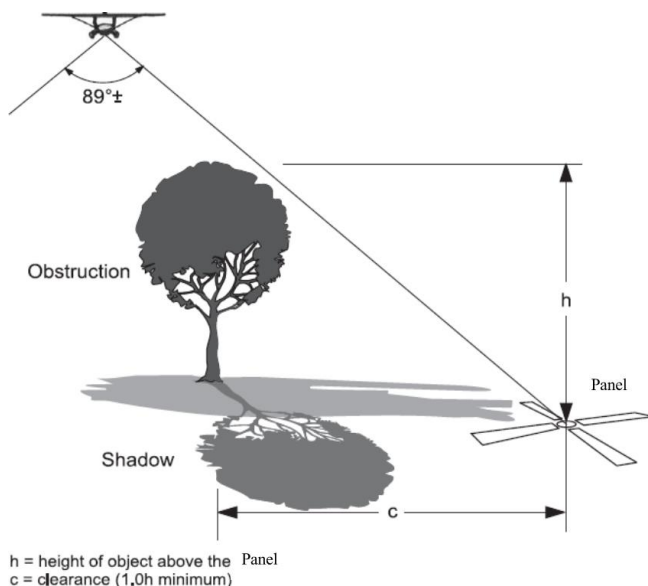
C.3 Photogrammetry background

The control points must be visible from a minimum of two overlapping photographs. To apply the basic principle of photogrammetry, at least three photo ground control points are needed for any single stereo model, (one overlapping pair of photographs) or block of adjoining stereo models. This establishes the spatial relationship between the ground and the model coordinates. One or more additional points are required to determine the accuracy of the model based residual error and to identify any data entry errors. When controlling multiple models or blocks of photography, aerial triangulation is applied serving to bridge control across multiple stereo models by combining their relative orientations with the ground control measurements. The following diagram illustrates the aerial triangulation concept for a small block of photographs.

The photo coordinates of identifiable points on the ground (i.e., photo ground control points) are measured on multiple photographs, (at least two), along with other image locations, or tie points, common to multiple photographs to begin the aerial triangulation process. From these measurements and the camera calibration data, a trigonometric calculation determines the camera (focal point) location and sensor attitude for each exposure. Finally, a least squares adjustment is applied to the entire block, refining relative orientations of each image, and registering the block to ground control for absolute orientation.

Most of aerial survey acquisitions apply GPS or a combination of GPS and RTK technology. This is supported by collection of data at static ground base stations during the aerial survey. GPS provides additional control to aerial photography by establishing a coordinate value for each photo centre embedded in images metadata (EXIF). For photogrammetry, the direct geo-referencing provides additional input to aerial triangulation process, facilitating more automation. Modern aerial triangulation software automates the selection of photogrammetry tie points. This allows a much larger number of tie points to be incorporated into the aerial triangulation solution improving overall results.

For photogrammetric measurement made during the aerial triangulation process, the target must be clearly visible on multiple images. A minimum of two adjacent images allows measurement but accuracy increases with the number of images the target can be seen from. Ideally, targets should be visible from aerial view between 90 and 60 degrees above horizon in all directions. Trees or structures may obscure view of the target. See below.

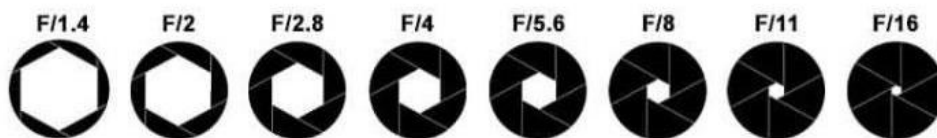


Ideally, the targets should be placed on the ground just prior to the aerial survey and should be maintained until the aerial mission has been flown and the data has been accepted. This reduces the risk of the targets being disturbed prior to the aerial survey.

C.3.1 Camera Setup – Aperture

The aperture will affect the amount of light that is captured by the sensor for a given shutter speed. A small aperture number (f/1.8) means a wide opened diaphragm letting in more light.

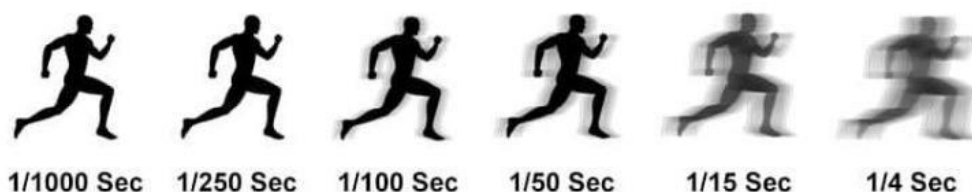
The aperture directly affects the depth of field. A bigger aperture number (f/22) means a smaller diaphragm diameter, letting in less light but with a deeper depth of field, meaning more of the scene in focus.



Where possible, stop-down the lens to a small aperture (e.g., f/11 or f/16) to optimize focus via an increased depth of field.

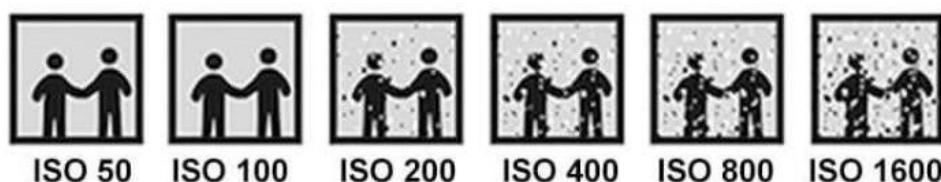
C.3.2 Camera Setup – Shutter speed

Shutter speed is the most important factor to consider avoiding blurry photos. Minimize image blur by ensuring the camera / drone is steady when each image is captured. Faster shutter speed will help. Shutter speed 1/100sec and slower should be avoided as it may require re-flights.



C.3.3 Camera Setup – ISO

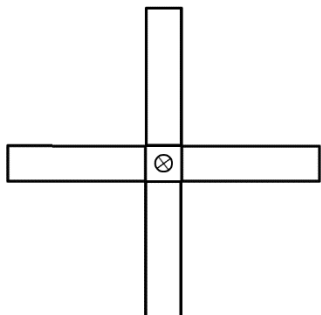
The ISO value represent the sensibility of your sensor. With a high ISO value (high sensibility), sensor will need less light for the same pixel brightness. However, a high ISO value will produce more noise/grain in your photos.



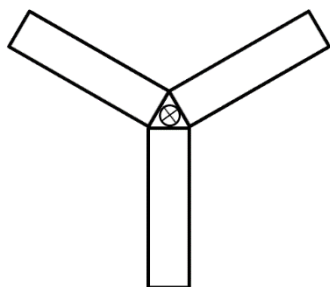
Underexposing the photography by 1 to 2 stops often enhances the contrast between code ‘marks’ and their background, thus making automatic image scanning faster and more accurate. Where possible, a maximum ISO 100 shall be used.

C.3.4 Aerial Control Target Design & Material

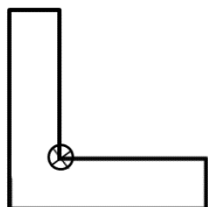
The target design shall be symmetrical and centred on the aerial control point. There are three designs commonly applied for aerial surveys. These include four-legged “X” targets, three-legged “Y” targets), and two-legged “L” targets. More than one type can be used for a project if there is a need to distinguish between different types of control, such as wing and centre control point targets. The length and width of the target legs will depend on the specifications of the flight mission. The principal drivers will be flying height or GSD of the resulting data.



“X” Type Target



“Y” Type Target



“L” Type Target

If paint is used to target aerial control point locations, it must be of a type that is biodegradable and washes away within six months

Natural target features, also known as Photo ID points or PID's may be used in lieu of artificial targets provided that a reasonably large angle of intersection exists to positively identify a point. Examples include sidewalk intersections, corner of concrete slabs, corners of existing paint markings on asphalt, or other clearly visible feature from which a precise location can be interpreted. The elevation should be measured at the hard element at the point location.

C.3.5 Removal of Aerial Control Target Material

To maintain proper public relations all man-made target material placed over aerial control points shall be removed and the site cleaned up within seven days of confirmation that aerial survey was successfully acquired, and no re-flights are necessary.

C.3.6 Aerial Control Horizontal Survey Datum

All aerial control horizontal surveys shall be referenced and tied into the Irish primary control survey. All aerial control horizontal surveys shall be referenced to and tied into the Irish Transverse Mercator ITM geographic coordinate system (EPSG Code: 2157) as defined by Ordnance Survey Ireland (OSi) and the Ordnance Survey of Northern Ireland (OSNI).

C.4 Aerial Control Vertical Survey

C.4.1 Photo Control Vertical Survey Geoid Model and Height Datum

All aerial control vertical surveys shall be referenced and tied to OSGM15 geoid model, Malin Head datum in Ireland.

GPS altitude type (Sea level or WGS 84 ellipsoid) should be confirmed by Survey Contractor.

C.4.2 Absolute Accuracy

The absolute accuracy is specified in the main body of the survey specification and is depends on the survey purpose.

C.5 Aerial Surveys and Photogrammetry Specifications

C.5.1 Project Location and Limits

The location and limits of the aerial survey project is indicated in the project provisions.

Location and limits of the aerial survey project need to be clearly defined to ensure complete coverage is acquired. There are several alternative methods to define the location and limits such as on hard copy maps or electronic maps such as Google Earth or Bing Maps. (Please note that web-based maps should only be used for planning and general illustration purposes since their spatial accuracy is limited and inconsistent.) Further clarification of the aerial survey location and limits may be provided with some text descriptions.

The location and limits of the aerial survey should specify the following:

- Beginning and end sections
- Required width
- Minimum distance on either side of the existing transportation corridor
- Aerial Photography shall extend one full photograph beyond the end of the aerial survey location and limits.

C.5.2 Image's Precision / Scale

The relative scale of the image can be calculated in different manners depending upon the requirements. The following equation can be used for scale calculation

$$\frac{\text{FOCAL LENGTH}}{\text{ALTITUDE (AGL)}} = \frac{152 \text{ mm}}{7600 \text{ m}} = \frac{152 \text{ mm}}{7600000 \text{ mm}} = \frac{1}{50000} \quad \text{SCALE: 1/50 000}$$

Image Precision P = 2 x GSD, is a relative resolution of an image in mm of distance on ground per pixel.

Flight Height [m]	Precision P [mm/pixel]	Image scale	Recommendation / Purpose
100	50	1:10000	Aerial models
50	25	1:5000	Aerial models
25	12.5	1:2500	Assessments
20	10	1:2000	Assessments
15	8	1:1500	Assessments
10	5	1:1000	Assessments

The following steps shall be used to determine if the scale is correct and within specifications for the project. Actual scale shall not deviate from the specified scale by more than 5 percent high or low.

- Each flight line shall be inspected visually for proper scale.
- When the scale is incorrect or does not meet specifications, the client shall be notified, and a determination shall be made to accept or reject the photography. If the photography is rejected, the location shall be re-flown.

C.5.3 Flight Plan

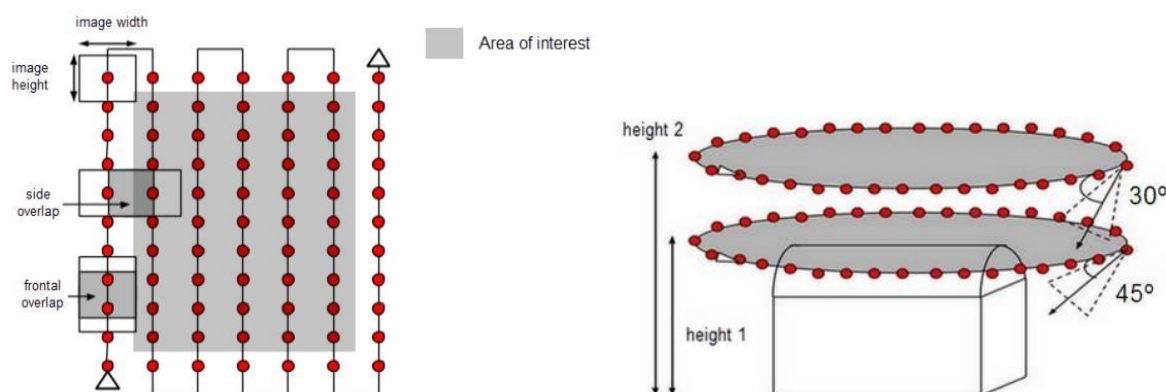
Prior to any aerial survey the Survey Contractor shall submit a flight plan showing the proposed flight lines on a topographic map of the project area or in a digital file that can be geo-referenced with existing mapping or a web-based GIS application.

Grid flight plan is optimal for urban and built-up areas with direction of camera 10-35° from the vertical

Corridor flight plan (roads, railways) recommends round-trip route (dual pass) with a vertical or oblique views or one-way route (single pass), but then with 90% overlap

Circular or spiral routes for vertical objects

Various combination of mentioned plans



The flight plan shall at a minimum include the following:

The Survey Contractor is responsible for ensuring that the proposed plan assures adequate aerial survey coverage to produce the results required for all the deliverable products. The final flight plan should include.

Flight lines labelled to show flight height or nominal Ground Sample Distance (GSD).

Camera calibration report and calibration file as appropriate to sensor(s) planned.

Manufacturer's Specification sheets for digital cameras.

C.5.4 Aerial Data Acquisition

The planning and aerial data acquisition shall meet or exceed the following:

Flight height, determined by the desired precision of mm per pixel

Forward and side overlap, typically 75% forward and 60% side for photography

Nominal Ground Sampling Distance GSD for digital photography

Sensor manufacturer's estimate of accuracy at planned flying height

The photos acquisitions using GPS with RTK to reduce ground control targeting

Homogeneous resolution: same distance to objects within a sequence

Capture more details, where possible get closer and add transition photos

Circle flight around the scene at different level to reveal any masked areas

C.5.5 Point Cloud

The calibrated point cloud for the project scope to be delivered in LAS format unless otherwise specified in the scope of work.

C.5.6 Re-flights

Unacceptable photography / aerial data coverage shall be corrected at the Survey Contractor expense. Re-flights shall be flown parallel to the original flight line. Re-flight aerial photography coverage shall overlap accepted coverage by two stereo models and shall meet the end and side lap requirements specified. The same camera used on the original flights shall be used on re-flight.

C.6 Photogrammetry Deliverables

C.6.1 General

The following is a list of potential deliverables. Some or all of these may be requested based on project needs. Specific file formats and detailed specifications for all deliverables should be clearly specified in the project scope and reviewed at the Pre-survey Meeting.

- Original Photographic Images
- Aerial Survey Report

C.6.2 Aerial Survey Report

The Aerial Survey Report is intended to summarize the key elements of the aerial mission and should include the following details at a minimum:

- Spatial Reference System
- Vertical and Horizontal Datum

- Units
- Coordinate system
- Geoid applied to ellipsoid elevations
- Project Accuracy Specifications
- List of Aerial Ground Control Points, with their coordinates and plan layout showing location of targets to enable identification on aerial photographs
- Flight Plan – Flight line diagram and description of aircraft & aerial system deployed
- Flying height
- For aerial photography: Nominal GSD
- Summary Report
- Copies of flight logs / trajectories
- Camera Calibration Reports

C.7 References

- Survey Manual, Aerial Surveys, Colorado DoT, December 30, 2015
- OSGM15 and OSTN15 – Updated transformations for UK and Ireland, <https://osi.ie/wp-content/uploads/2016/08/OSGM15-and-OSTN15-Updated-transformations-for-UK-and-Ireland.pdf>
- Context Capture, Bentley, Photogrammetry modelling guide

Appendix D

Key Inspection and Testing Requirements

D.1 Inspection Requirements

The information required to be captured and collected for each structure as part of the inspection for assessment shall be as per the standards noted in Section 4.1.6. This appendix provides a summary of the key parameters to be obtained; however, the contractor shall undertake their own review of the applicable standards to ensure all relevant information is captured.

For each structure requiring structural inspection, the contractor shall verify the form of structure through site visit prior to the assessment being carried out.

D.2 Inspection Data

D.2.1 General Structural Requirements

- The Contractor shall record and document a complete geometric inventory of the structure including details on span arrangement, bridge width and length, parapet height and thickness, skew and curvature, pier geometry and heights and abutment geometry and heights
- For existing road bridges, the clear width of carriageway, position of lane markings, and horizontal alignment (when curved on the structure) shall be recorded
- As per AM-STR-06026 Section 2, the structure shall be inspected to record all the parameters needed to determine the strength of members and elements, including possible deficiencies, e.g. including but not limited to cracks, corrosion, settlement, defective materials, damage, etc.

D.2.2 Structure Specific Requirements - Masonry Arch Bridge

This section is applicable to Masonry Arch Bridges (STS-02, STS-03, THS-09).

Specific information to be obtained and recorded as part of the inspection includes:

Geometry and Materials

- Measurement and documentation of key dimensions as per AM-STR-06002 Section 3.5 and AM-STR-06056 Section 2.1
- Record and documentation of key information as per AM-STR-06002 Section 3.6-3.9, AM-STR-06026 Section 2.10-2.13 and AM-STR-06056 Section 2.1
- Measurements shall be supported by detailed sketches and/or drawings showing clear measurement location. A comprehensive photographic record shall be provided, clearly illustrating each measured feature and corresponding dimensions.

Material Testing

- Core samples and testing should be taken to determine the compressive strength of masonry as per AM-STR-06002 Section 4.8. The contractor shall allow for:
 - STS-02: a minimum of 3 core samples (one per arch). All testing shall be carried out in accordance with IS EN 1052
- Sample locations shall be documented with photographs and marked on sketches / drawings

Arch Thickness and Properties

- Core sampling shall be undertaken to determine arch barrel thickness and identify materials used in construction. Coring should be undertaken as per AM-STR-06056 Section 3.1 and AM-STR-06057 Section 3.6. The contractor should allow for:

- A minimum of 2 cores should be retrieved from each arch span. Cores shall be taken from the arch barrel close to the crown and at the quarter point. Core voids shall be reinstated using appropriate materials and finished with a mortared section of stone from the core.
- The following should be recorded from the core: total barrel thickness, presence of arch rings (number and thickness), evidence of voiding, presence of backing material, masonry type and mortar condition
- For STS-02, undertake slit trench excavations adjacent to the abutments to expose the arch barrel and confirm the presence, extent, depth, and composition of backing material. Record the backing type, condition, layering, moisture conditions, and any evidence of voiding, loss of material, or deterioration. Reinstatement all excavations on completion.
- Sample and trench locations shall be documented with photographs and marked on sketches / drawings

Depth of Fill and Properties

- Hand dug trial holes over the crown of the arch shall be undertaken to determine depth of fill over the arch barrel as per AM-STR-06056 Section 3.1 and AM-STR-06057 Section 3.6. The contractor should allow for:
 - A minimum of 3 trial pits per arch span (two over the crown of the arch and one over the pier / abutment)
 - The fill depth, material properties and condition of fill should be recorded
- Trial hole locations shall be documented with photographs and marked on sketches / drawings

Scour Screening

- Undertake a tactile inspection of accessible masonry below and adjacent to water level to identify evidence of scour, undermining, voiding, loose or displaced stones, mortar loss, foundation exposure, erosion, or other signs of instability. Record the extent of inspection and any areas inaccessible due to water depth, flow conditions, or access constraints.

Specific Defects

- Record and document key defects in general and as per AM-STR-06002 Section 3.15, 3.19, 3.21, 3.22
- Defect mapping with associated photos and sketches / drawings shall be included
- Specific to STS-02, the contractor shall ensure vegetation clearing is undertaken prior to inspection works to ensure full inspection of the masonry is possible

D.2.3 Structure Specific Requirements – Concrete Bridge STS-04

Specific information to be obtained and recorded as part of the inspection includes:

- Specific requirements for inspection considering where no records exist as per AM-STR-06056 Section 2.3
- Site investigation to determine the size, type and spacing of transverse reinforcement in deck slabs as per AM-STR-06056 Section 3.4
- If there is evidence of corrosion or damage in reinforcement, the cross-sectional areas of the corroded bars shall be recorded as per AM-STR-06026 Section 7.9
- Detailed visual inspection should include photographs and measurement of defects and extent of deterioration that may affect safety or condition. Recording should include the following:
 - signs of movement;
 - rust staining, cracks and/or spalling of concrete;
 - hollow or delaminated concrete surfaces;

- evidence of corrosion of reinforcing steel;
- leakage through joints in beams and decks
- The extent and nature of spalling, corrosion of reinforcement, rust staining, crazing or soft or friable concrete should be recorded with photographic evidence. Where cracking is present, details of position (including orientation), extent and widths should be obtained including:
 - significant or unusual cracks;
 - cracks showing evidence of rust staining;
 - all cracks in excess of 0.2 mm wide;
 - all cracks in pretensioned or post-tensioned concrete elements.

D.2.4 Structure Specific Requirements – STS-01

Specific information to be obtained and recorded as part of the inspection includes:

General

- Undertake a close visual and tactile inspection of all accessible structural steelwork to identify evidence of corrosion, deformation, damage, loose fixings, fatigue cracking, and other defects.

Defect Identification

- Record and documentation of key defects, in general and as per AM-STR-06026 Section 7.6, with photographic evidence. Key defects include, but is not limited to:
 - Distortions such as bowing, buckling, local impact damage and bolt/rivet distortions
 - Fractures and cracks in members and connections
 - Corrosion mapping
 - Missing connections or members with detailed mapping
 - Failed CHS ties with detailed mapping
 - Defects in cast iron and welds such as porosity
- Vegetation clearing at the top of the piers is required to capture any deterioration in members at support zones, as well as any evidence of movement or restraint at the bearing location of the arch to pier connection.

Paint Sampling

- Paint sampling and laboratory testing shall be undertaken to determine the presence and concentration of lead and other hazardous constituents within the coating system.
- The contractor shall allow for a minimum of ten paint sampling locations. Samples shall be distributed across different spans, different member types, different elevations and any areas exhibiting differing coating condition, colour or paint build-up.
- Sampling locations shall be documented with photographs and marked on drawings.

Member Measurements and Thickness Verification

- Site measurements shall be undertaken to verify dimensions and thicknesses of the key structural members (Figures D1) against the geometric survey. The contractor shall allow for detailed dimensional verification of a minimum of one representative span.
- For cast iron arches:
 - Measurements (plate thickness, flange width and depth) should be taken at intervals along their length to detect both intended variations or casting errors. At a minimum, four locations should be taken per arch including the springing point, splice location, quarter point and crown

- Measurements should be determined from physical means (i.e. calipers). The use of UTG on cast iron is not recommended. The web thickness can be determined from measurement of the outer and inner flange widths.
- For spandrel wall:
 - Measurements (plate thickness and widths) should be taken at representative locations length to detect both intended variations and casting errors. At a minimum, five locations should be taken along the span.
- Complete replacement of the lateral bracing members (cast iron bracing and wrought iron CHS ties) is required for rehabilitation works of the structure, therefore no measurements are required of these existing members.

Connections

- Close visual inspection shall be undertaken to the assess condition of all connections along the structure, including the bearing region. Loose or missing bolts or rivets, rivets with corroded heads, crack initiation at connected members and any rust staining of any connections should be recorded.
 - A fastener head shall be classified as severely corroded when full bearing contact between the head and the connected plate is no longer maintained, or when corrosion visibly compromises the fastener's structural integrity.
- Site measurements shall be undertaken to confirm dimensions and arrangement of typical structural connections. The contractor shall allow for a minimum of:
 - Bolted splice connection between arch segments. Allow for site measurement of plate thickness and bolt diameter of all bolted splice connections across the arch (3 No.) in a typical span.
 - Bolted connection of spandrel wall to cast iron arch. Allow for site measurement of bolt diameter of at least 5 representative locations across span. The number of locations may depend on any variability observed on site.
 - Bolted connection of spandrel wall segments together. Allow for site measurement of bolt diameter of at least 5 representative locations across span. The number of locations may depend on any variability observed on site.
- Measurement locations shall be documented with photographs and marked on drawings.

Corrosion Assessment and Thickness Measurement

- Plate thickness measurements shall be taken at all members along all spans where corrosion has caused a visible loss of section after corrosion products are removed.
 - Local coating removal shall be undertaken where required to facilitate steel thickness measurements and assessment of corrosion-induced section loss in accordance with AM-STR-06056 Section 3.6.
 - The resulting section loss from corrosion shall be quantified. Mechanical tools (pit gauges / depth micrometres / calipers) shall be used. The use of UTG is not recommended on cast iron.
- The contractor shall allow for inspection of all spans for evidence of corrosion. The contractor shall allow for a minimum number of ultrasonic thickness measurements as specified in Table D1.

Table D-1 Minimum Requirement for UTG testing

Structure ID	Minimum Number of Locations for corrosion measurement
STS-01	One location per cast iron arch, (16 total) where corrosion is most notable Fifteen locations per critical member type (CHS Tie, bracing, spandrel wall) where corrosion is most notable

- The contractor shall provide a lump sum rate including the minimum number of measurement locations as per Table D1, and a schedule rate per additional location to allow for the number of sample locations to be adjusted as required during the investigation based on the observed level of corrosion
- Thickness data shall be recorded in tabular form together with member identification, chainage/span reference, photographs and estimated percentage section loss.
- For local coating removal, the contractor should ensure appropriate safety protections are in place in the case of presence of hazardous constituents in the paint.

Scour Screening

- Undertake a tactile inspection at the base of the pier below and adjacent to water level to identify evidence of scour, undermining, voiding, loose or displaced stones, mortar loss, foundation exposure, erosion, or other signs of instability.



Figure D1. Key Members for STS-01

D.2.5 Structure Specific Requirements – STS-05

Specific information to be obtained and recorded as part of the inspection includes:

General

- Undertake a close visual and tactile inspection of all accessible structural steelwork to identify evidence of corrosion, deformation, damage, loose fixings, fatigue cracking, and other defects.

Defect Identification

- Record and documentation of key defects, in general and as per AM-STR-06026 Section 7.6, with photographic evidence. Key defects include, but is not limited to:
 - Distortions such as bowing, buckling, local impact damage and bolt/rivet distortions
 - Fractures and cracks in members and connections
 - Corrosion mapping
 - Missing connections or members
 - Defects in cast iron and welds such as porosity

Paint Sampling

- Paint sampling and laboratory testing shall be undertaken to determine the presence and concentration of lead and other hazardous constituents within the coating system.
- The contractor shall allow for a minimum of ten paint sampling locations. Samples shall be distributed across different spans, different member types, different elevations and any areas exhibiting differing coating condition, colour or paint build-up.

- Sampling locations shall be documented with photographs and marked on drawings.

Member Measurements and Thickness Verification

- Site measurements shall be undertaken to verify dimensions and thicknesses of the key structural members (Figure D2) against the geometric survey.
 - For longitudinal beams, measurements should be taken at intervals along their length to detect both intended variations or casting errors. At a minimum, three locations should be taken per beam (at abutment, at pier column and midspan).
 - For pier columns, lateral bracing, transverse beams: a minimum of five representative locations per element type shall be recorded.
- Measurements should be determined from physical / mechanical means (i.e. calipers). The use of UTG on cast iron is not recommended. For I beams, the web thickness can be determined from measurement of the outer and inner flange widths.
- Measurement locations shall be documented with photographs and marked on drawings.

Connections

- Close visual inspection shall be undertaken to assess condition of all connections along the structure, including the bearing region. Loose or missing bolts or rivets, rivets with severely corroded heads, crack initiation at connected members and any rust staining of any connections should be recorded.
 - A fastener head shall be classified as severely corroded when full bearing contact between the head and the connected plate is no longer maintained, or when corrosion visibly compromises the fastener's structural integrity.
- Site measurements shall be undertaken to confirm dimensions and arrangement of typical structural connections. The contractor shall allow for a minimum of:
 - 5 No. representative connections for each connection type (bracing to pier column, pier column to longitudinal beam, transverse beam to longitudinal beam).
 - The required site measurements are to be confirmed with the assessment engineer (Arup) once the connection type is confirmed through the initial site visit prior to the inspection works.
- Measurement locations shall be documented with photographs and marked on drawings.

Corrosion Assessment and Thickness Measurement

- Plate thickness measurements shall be taken at all members along all spans where corrosion has caused a visible loss of section after corrosion products are removed.
 - Local coating removal shall be undertaken where required to facilitate steel thickness measurements and assessment of corrosion-induced section loss in accordance with AM-STR-06056 Section 3.6.
 - The resulting section loss from corrosion shall be quantified. Mechanical tools (pit gauges / depth micrometres / calipers) shall be used. The use of UTG is not recommended on cast iron.
- The contractor shall allow for inspection of all spans for evidence of corrosion. As a minimum, the contractor shall allow for a minimum number of ultrasonic thickness measurements as specified in Table D2.

Table D-2 Minimum Requirement for UTG testing

Structure ID	Minimum Number of Locations for UTG
STS-05	Five locations per critical member type (longitudinal beam, pier column, transverse bracing, transverse beam) where corrosion is most notable

- The contractor shall provide a lump sum rate including the minimum number of measurement locations of Table D2, and a schedule rate per additional location to allow for the number of sample locations to be adjusted during the investigation.
- Thickness data shall be recorded in tabular form together with member identification, chainage/span reference, photographs and estimated percentage section loss.
- The contractor shall inspect the cast iron pier columns below the water mark for evidence of corrosion.
- For local coating removal, the contractor should ensure appropriate safety protections are in place in the case of presence of hazardous constituents in the paint.

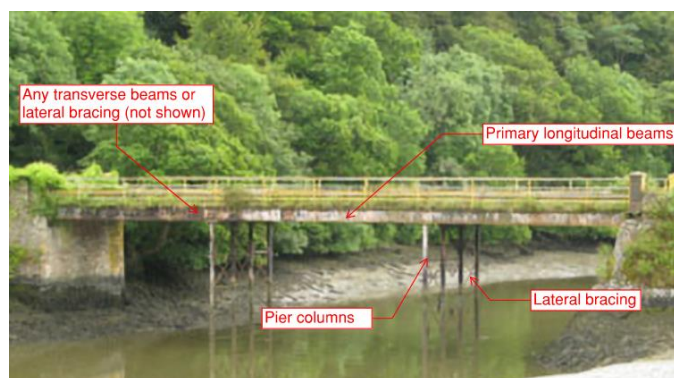


Figure D2. Key Members for STS-05

D.2.6 Structure Specific Requirements – Sub structures

This section is applicable to the abutment and piers of all structures.

Specific information to be obtained and recorded as part of the inspection includes:

- Measurement and documentation of structural dimensions of piers and abutments as per AM-STR-06002 Section 6.2 – 6.3. Measurements shall be supported by detailed sketches and/or drawings, in addition to photographic records, showing clear measurement location.
- The existence and condition of the bearings should be documented, with supplementary photographic records.
- Movement of abutment and piers should be recorded and measures as per AM-STR-06002 Section 6.5 and AM-STR-06026 Section 2.17
- All accessible parts of the sub-structures, foundations and wing walls shall be examined and any defects, including extent, and possible causes recorded with photographic evidence. Key defects, in general and as per AM-STR-06026 Section 2.16-2.19, include but are not limited to:
 - Tilting and rotation, in any direction
 - rocking;
 - cracking, splitting and spalling;
 - erosion beneath water level;

- weathering and other material deterioration, including lack of pointing for masonry and brickwork;
 - vegetation intrusion;
 - lack of effective drainage;
 - internal scour and leaking of fill;
 - settlement of structure;
 - settlement of fill.
- For sub-structures founded in water, underwater inspection of the submerged sub-structure and foundations are required to determine their condition.