



THE HIGHWAYS AGENCY



THE SCOTTISH OFFICE DEVELOPMENT DEPARTMENT



**THE WELSH OFFICE
Y SWYDDFA GYMREIG**



**THE DEPARTMENT OF THE ENVIRONMENT FOR
NORTHERN IRELAND**

Specification for Geodetic Surveying Services

Summary: This Specification for Geodetic Surveys sets out the requirements for Geodetic Surveying Services on trunk road schemes, including motorway schemes.

REGISTRATION OF AMENDMENTS

Amend No	Page No	Signature & Date of incorporation of amendments	Amend No	Page No	Signature & Date of incorporation of amendments

Registration of Amendments

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VOLUME 5 CONTRACT DOCUMENTS FOR SPECIALIST ACTIVITIES
SECTION 1 GEODETIC SURVEYS

PART 2

SPECIFICATION FOR GEODETIC SURVEYING SERVICES

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1. INTRODUCTION

1.1 General

1.1.1 This specification is for the use of survey firms engaged in work for the Department and for Design Organisation responsible for the administration of geodetic survey services.

1.2 European Mutual Recognition

1.2.1 Except where the specified standard implements or is technically equivalent to a Harmonised European Standard or to a European Standard adopted for use within the European Communities after 31 December 1985, any requirement for products or materials to comply with a British Standard shall be satisfied by compliance with

- (i) a relevant standard or code of practice of a national standards institution or equivalent body of any states of the European Economic Area.
- or (ii) a relevant international standard recognised in any states of the European Economic Area.
- or (iii) a relevant specification acknowledged for use as a standard by a public authority of any states of the European Economic Area.
- or (iv) traditional procedures of manufacture of any states of the European Economic Area where these are the subject of a written technical description sufficiently detailed to permit assessment of the goods or materials for the use specified
- or (v) a European Technical Approval (ETA) issued in accordance with the Construction Products Directive 89/0106/EEC (or, until procedures are available for the issue of ETAs, a specification sufficiently detailed to permit assessment) for goods or materials of an innovative nature or subject to innovative processes of manufacture and which fulfill the purpose provided for by the specified standard.

provided that the proposed standard, code of practice, specification, technical description or European Technical Approval provides in use levels of safety, suitability and fitness for purpose equivalent to those required by the specified standard in so far as they are not inconsistent with the Essential Requirements of the Construction Products Directive (89/106/EEC).

1.3 Changes and Amendments to the Specification

1.3.1 This Specification is a reproduction of that contained in Volume 5 Section 1 Part 2 of the Manual of Contract Documents For Highway Works modified by the Substitute, Additional, Cancelled or Amended Clauses or Figures, listed in Clauses 1.3.5, 1.3.6, 1.3.7 and 1.3.8 respectively.

1.3.2 Insofar as any Substitute, Additional or Amended Clause or Figure may conflict or be inconsistent with any provisions of the Specification, the Substitute, Additional or Amended Clause or Figure shall always prevail.

1.3.3 Any reference in the Contract to a Clause or Figure Number shall refer to any Substituted, Additional or Amended version of that Clause or Figure within the Contract. A list of Substituted, Additional or Amended Clauses or Figures will be found in Sections 1.3.5 - 1.3.8.

1.3.4 Where the Specification requires options to be deleted or details to be added, these shall be explicitly identified. This shall be performed by drawing a line through the options to be deleted and inserting in manuscript items to be inserted, in both cases using black ink. Deletions and insertions shall not be made by editing the text using a word processor or similar device.

1.3.5 List of Substitute Clauses or Figure Numbers

1.3.6 List of Additional Clauses or Figure Numbers

1.3.7 List of Cancelled Clauses or Figure Numbers

1.3.8 List of Amended Clauses or Figure Numbers

1.4 The Survey Contractor

1.4.1 Organisations considered for contracts under this Specification.

1.5 The Survey Advisor

1.5.1 The Survey Advisor is the Design Organisation's representative for Geodetic surveys.

1.5.2 For each commission, a Survey Advisor shall be appointed who shall be a qualified and experienced Land Surveyor and who may be an employee of the Design Organisation or an employee of a survey contractor not invited to tender. The Survey Advisor shall assist the Design Organisation from the inception of the planning process by preparation of the detailed project survey specification. He shall also be responsible for providing advice during the assessment of the tenders, providing support to the Design Organisation during the contract period and ensuring that the requirements of the Specification are properly met in time and tolerance.

2. PURPOSE AND SCOPE

2.1 Location

Road Number(s)

Area of survey.....

.....

.....

Town

County(ies)

2.2 Aim of the Project for which the Survey is Required

.....

.....

.....

2.3 Aim of the Survey

To carry out a Topographical Survey of the area shown on the Drawings to include the following:

Establish, locating and survey a framework of Permanent Ground Markers.

Prepare plans atscales, with/ without contours.

Prepare String Digital Models and/ or other digital information as detailed in the specification, Clause

Photograph the area in black and white to a scale of 1: for a photographic mosaic.

2.4 Brief Description of Survey Area

Survey area :

Approx. Lengthkm x Average Widht.....m

Terrain conditions for area of survey

.....

.....

.....

Areas of special significance.....

.....

.....

.....

2.5 Use of the Survey Information

The survey information will be used for the following purposes:

Feasibility study for: alignment/ earthworks/ landscape/ environmental/ other

.....

Outline engineering and/ or landscaping plans
.....

Compulsory purchase order, Highways Act /Roads (Scotland) Act and/ or land reference
plans

Base plans required for public display/ design/ other

To provide information on noise calculations/ ground investigation

To provide geometric information on existing structures

3. GENERAL REQUIREMENTS

3.1 Health and Safety at Work etc Act 1974

3.1.1 All activities performed during the course of work undertaken by the Survey Contractor on this Contract shall be in accordance with the requirements of the Health and Safety at Work etc Act 1974. The Survey Advisor shall inform the Survey Contractor of any operations or areas which involve safety considerations over and above those normally required during survey activities.

3.2 Landowners, Occupiers and Entry

3.2.1 Unless otherwise stated in Appendix A, owners and occupiers of all the land covered by the survey will have been notified in writing of the period during which entry is likely to be required and their permission for entry obtained by the Design Organisation or the Survey Advisor. Notwithstanding the above, the Survey Contractor shall also notify in writing all occupiers before gaining entry and agree with them all routes and means of access. Where access to the Survey Contractor is refused, the Survey Contractor shall immediately notify the Survey Advisor.

3.3 Control

3.3.1 A horizontal and vertical control framework shall be established by the Survey Contractor and submitted to the Survey Advisor for approval. Control points shall be marked in such a manner that their location shall allow effective future use. 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.

3.3.2 Connection to the Ordnance Survey National Grid, where required, shall be specified by the Survey Advisor before the start of the Survey, together with details of any Local Grid system required.

3.3.3 A Control Report shall be produced in accordance with Clause 5, Project Control.

3.3.4 All survey control stations shall be referenced to surrounding detail and a location plan prepared by the Survey Contractor showing these references to permit their later re-establishment.

3.3.5 The accuracy and density of the control shall be as defined in the appropriate Clause of this Specification.

3.4 Detail to be Surveyed

3.4.1 The nature and type of features to be surveyed will depend upon the scale of the survey and the purpose for which the survey information is required. Lists of features, which the Survey Advisor shall mark to show those required for this survey, are contained in the appropriate Clause of this Specification.

3.4.2 Where features cannot be surveyed to the specified accuracy without extensive clearing of vegetation or obstructions the instructions of the Survey Advisor shall be obtained.

3.4.3 Features shall be represented in accordance with the feature symbol tables in Appendix B.

3.4.4 The line or point to be surveyed on a feature shall be at the feature's intersection with the ground surface unless otherwise required in the appropriate Clause of this Specification or in Appendix B.

3.4.5 Identification of all objects shall be based upon their nature and surroundings. Where exact identification is not possible, a general purpose description shall be used.

3.4.6 Any building or surface which is in a state of change at the time of the survey shall be annotated to this effect, with the boundary of the area of change indicated. The Survey Advisor shall specify any areas where the degree of change is such that either limited, or no, survey information is required within the area.

3.4.7 The ground surface shall be surveyed such that any point interpreted from this information shall be within the tolerance specified of the actual ground surface location for the area and type of surface involved. These tolerances are given in the appropriate Clause of this Specification.

3.5 Presentation

3.5.1 All survey information shall be presented in a format and manner which allows for easy use and which permits additional copies to be made as necessary, excepting any limitations which may be imposed in respect of the copyright of data from third parties.

3.5.2 All final products from the source data shall be supplied on stable media. All products supplied shall be intelligible and usable for the purpose specified.

3.5.3 Within two weeks of award of the Contract, the Survey Contractor shall supply samples of the output, for approval by the Design Organisation within 10 working days of the date of receipt.

3.5.4 On completion of the Survey, the Survey Contractor shall deliver to the Survey Advisor a detailed survey report, covering those items specified in the appropriate Clauses of this Specification. The Contract shall be considered to have been completed upon acceptance of the suitability of this report and of all the survey data delivered and accepted.

3.6 General

3.6.1 Within two weeks of award of the Contract, the Survey Contractor shall provide the Survey Advisor with a detailed programme and method statement of the activities the Survey Contractor intends to carry out, in order to meet the Contract timetable and the Specification. The method statement shall include copies of calibration certificates for the survey equipment.

3.6.2 The Survey Contractor shall conform with all requirements of any private or public utility service company involved as far as access to their facilities is concerned. The Survey Advisor shall identify those facilities which can be inspected by the Survey Contractor and those which can only be inspected by the statutory undertaker concerned.

3.6.3 The Survey Contractor shall ensure that written permission is obtained from the Survey Advisor for any works which in the opinion of the Survey Contractor are likely to cause damage to property.

3.6.4 The Survey Contractor shall make provision to carry out any traffic safety and management requirements necessary to undertake the Survey on public roads in accordance with all relevant statutory regulations. Details of these requirements shall be included in Appendix C.

3.6.5 All source survey information shall be safely held by the Survey Contractor for a period of three years from the date of completion of the Survey Contract. After this period it may then be destroyed without reference to the Design Organisation or Survey Advisor unless otherwise instructed in Clause 14.3.3.

4. PROJECT INFORMATION

4.1 Client

4.1.1 Project Promoted by:-.....
Address:-
.....
.....
.....

4.2 Design Organisation

4.2.1 Project Administered by:-.....
Principal Contact for the Survey:-
Address:-
.....
.....
.....
Position:-
Telephone No:- Fax No:-

4.3 Survey Advisor

4.3.1 Project Survey Advisor:-
Name:-
Organisation:-
Address:-
.....
.....
.....
Telephone No:- Fax No:-

4.4 Existing Mapping

4.4.1 Existing mapping available for inspection:-
Brief description and source:-
.....
.....
Scale:-(Digital/Non Digital)
Available from:-
Times:-

4.5 Existing Aerial Photographs

4.5.1 Existing aerial photographs available for inspection:-
Brief description:-
.....
Scale:-(Colour/Monochrome)
Available from:-
Times:-

4.6 Landowners and Occupiers

4.6.1 Landowners/occupiers have been notified of the following:-

- a. Purpose and scope of survey(Yes/No)
- b. Expected period of survey and commencement date(Yes/No)
- c. Arrangements for survey marker way leaves(Yes/No)

4.6.2 Land owner/occupier information:-

- a. Schedule of owners/occupiers - See Appendix A.
- b. Information to be obtained by the Survey Contractor and made available to the Design Organisation/ Survey Advisor(Yes/No)
- c. Other arrangements

4.7 Access

4.7.1 Details of special access requirements in survey area - See Appendix D.

4.8 Restrictions

4.8.1 Details of restrictions to the survey programme - See Appendix E.

4.9 Contacts

4.9.1 Details of contacts in the Highway and Police Authorities, private and public utility service companies and other Statutory Authorities in the area including British Rail - See Appendix F.

4.10 Traffic Safety and Management

4.10.1 Details of requirements for traffic safety and management - See Appendix C.

4.11 Services

4.11.1 Details of any known information on location of Public/Private services and supplies - See Appendix G.

4.12 Contract Drawings

4.12.1 Schedule of Contract Drawings - See Appendix H.

5. PROJECT CONTROL

5.1 Project Control Requirements

5.1.1 Horizontal and vertical control frameworks shall be established to satisfy the following specified survey requirements:

- a. Revision and/or upgrading of existing mapping as specified in Clause 6.
- b. Production of new mapping as specified in Clause 7.
- c. Survey of key points as specified in Clause 7.2.11.1 and shown on the Contract Drawings in Appendix H.
- d. Survey of existing structures as specified in Clause 11.
- e. Setting-out during construction.
- f. Structural monitoring.

5.2 Planimetric Control

5.2.1 Framework

5.2.1.1 Planimetric control shall be made up of a framework to provide a suitable foundation for the production of a reliable survey. The framework shall comprise of all of the following elements:

- a. Primary points connected by direct measurement and located at a nominal distance 1000 m or m apart and not less than 500 m or m apart.
- b. Secondary points tied into the primary points and located at a nominal distance of 250 m or m apart and generally not less than 100 m or m apart.
- c. Minor control points as required for mapping at the specified scale.

5.2.2 Location of Permanent Ground Markers

5.2.2.1 The primary and secondary control points

shall be defined by permanent ground markers. Prior to installation the approximate locations of the permanent ground markers shall be defined in one of the following ways:

- a. Marked on a set of plans by the Survey Contractor and submitted together with a diagram of the proposed control framework to the Survey Advisor for approval.
- b. Marked on the Contract Drawings scheduled in Appendix H.

5.2.2.2 Final positions of permanent ground markers shall be determined by terrain and intervisibility constraints. Any position which differs substantially from that defined in Clause 5.2.2.1 shall be subject to approval by the Survey Advisor.

5.2.2.3 Minor control points shall not be permanently marked.

5.2.3 Construction of Permanent Ground Markers

5.2.3.1 Permanent Ground Markers shall be stable for a period of 5/..... years and shall be of a construction which conforms to the types illustrated in Appendix J.

5.2.4 Survey Grid

5.2.4.1 The planimetric control shall be related to one of the following:

- a. A plane rectangular grid with an origin defined by the nearest National Grid 10 km intersection to the south-west of the survey area and with the same orientation as the National Grid.

The origin of the plane grid shall bem E andm N.

The origin values selected shall ensure that all survey grid co-ordinates are positive.

- b. An existing grid
- c. An arbitrary plane local grid

5.2.4.2 A description of the grid system used shall be defined on one of the following:

- a. A key plan or data file
- b. Each survey plan or data file

5.2.5 Accuracy Acceptance Criteria

5.2.5.1 The acceptance criteria specified below are in terms of internal rather than absolute accuracies and are given as permitted deviations for distances, angles and levels. Internal accuracies are more critical to the construction process than the absolute accuracy of points in a higher co-ordinate system.

5.2.5.2 The relation between the permitted deviation (PD) and root mean square error (rmse) is:
 $PD = 2.5 \times \text{rmse}$.

5.2.5.3 Where the control system forms a network, it shall be observed by measuring sufficient distances and angles to obtain a redundant number of observations, which shall then be adjusted by a least squares method.

5.2.5.4 When comparing measured distances and angles with those derived from the adjusted co-ordinates the differences shall not exceed the following permitted deviations:

a. Primary Points

Distances: either $\pm 0.5\sqrt{L}$ mm or $\pm \dots \sqrt{L}$ mm
 Angles: either $\pm \frac{0.035}{\sqrt{L}}$ degrees or $\pm \dots \frac{\dots}{\sqrt{L}}$ degrees
 As an offset: either $\pm 0.61\sqrt{L}$ mm or $\pm \dots \sqrt{L}$ mm

b. Secondary Points

Distances: either $\pm 0.75\sqrt{L}$ mm or $\pm \dots \sqrt{L}$ mm
 Angles: either $\pm \frac{0.045}{\sqrt{L}}$ degrees or $\pm \dots \frac{\dots}{\sqrt{L}}$ degrees
 As an offset: either $\pm 0.75\sqrt{L}$ mm or $\pm \dots \sqrt{L}$ mm

c. Minor Control

Distances: either $\pm 1.0\sqrt{L}$ mm or $\pm \dots \sqrt{L}$ mm
 Angles: either $\pm \frac{0.09}{\sqrt{L}}$ degrees or $\pm \dots \frac{\dots}{\sqrt{L}}$ degrees
 As an offset: either $\pm 1.5\sqrt{L}$ mm or $\pm \dots \sqrt{L}$ mm
 where L is the distance in metres between the points concerned. In the case of angles, the shorter of the two distances defining the angle shall be used.

5.2.6 Schedule of Permanent Control Stations

5.2.6.1 A schedule shall be prepared giving the following information:

- a. Station designation
- b. Plan co-ordinates
- c. Level value (where available)
- d. Description
- e. Ordnance Survey triangulation stations (if used)

5.2.7 Location Diagrams

5.2.7.1 A location diagram shall be prepared for each permanent ground marker on a standard form, an example of which is shown in Appendix K.

5.2.8 Control Framework Diagram

5.2.8.1 A simple plan shall be prepared of the planimetric control framework showing the surveyed connections between the permanent ground markers.

5.3 Vertical Control

5.3.1 Framework

5.3.1.1 Permanent ground markers and permanent bench marks (if required) shall be connected by levelling and adjusted to the datum bench marks.

5.3.2 Location

5.3.2.1 The vertical control framework shall be defined by the permanent ground markers of the planimetric network and the permanent bench marks in the locations shown on the Contract Drawings scheduled in Appendix H.

5.3.3 Construction

5.3.3.1 Permanent bench marks shall be stable for a period of either 5/ years and their construction shall conform to the illustration given in Appendix L.

5.3.4 Datum

5.3.4.1 All levels shall be related to one of the following:

- a. Ordnance Datum - Newlyn/Liverpool.
- b. Other datum

connections between the bench marks.

5.4 Control Report

5.3.4.2 The value of the datum bench mark to which the survey is related shall be confirmed by check levelling to other existing bench marks.

5.4.1 On completion of the fieldwork and adjustment, a comprehensive control report shall be prepared detailing the methods used and checks applied, any problems encountered and demonstrating that the results achieved are in compliance with this Specification.

5.3.4.3 The location, description and value of each datum bench mark used shall be quoted on one of the following:

- a. A key plan or data file
- b. Every survey plan or data file

5.4.2 An advance copy of the report, together with copies of the horizontal and vertical control framework diagrams, schedules of stations and bench marks, and station and bench mark location diagrams, shall be submitted to the Survey Advisor for his approval. On approval, this shall form part of the final report.

5.3.5 Accuracy Acceptance Criteria

5.3.5.1 When comparing measured height differences with those derived from the adjusted reduced levels, the differences shall not exceed the following permitted deviations:

- a. Between bench marks, primary stations and other closed loops in the framework: either $\pm 12\sqrt{K}$ mm or $\pm \dots \sqrt{K}$ mm, where K is the distance levelled in km
- b. Between adjacent secondary stations or minor control points less than 300 m or m apart: either ± 5 mm or $\pm \dots$ mm

5.3.6 Schedule of Bench Marks

5.3.6.1 A schedule shall be prepared giving the following information:

- a. Bench mark designation
- b. Level value
- c. Description
- d. Ordnance Survey bench marks (if used)

5.3.7 Location Diagrams

5.3.7.1 A location diagram shall be prepared for each datum bench mark and for each other permanent bench mark on a standard form, an example of which is shown in Appendix M.

5.3.8 Level Framework Diagram

5.3.8.1 A simple plan shall be prepared of the vertical control framework showing the levelled

6. REVISION OR UPGRADING OF EXISTING MAPPING

6.1 Scale

6.1.1 Revision mapping is required at the following scale(s):

- a. 1:1250
- b. 1:2500
- c. 1:10,000
- d. Other

6.2 Area to be Surveyed

6.2.1 The areas to be surveyed at each scale shall be shown on the Contract Drawings scheduled in Appendix H.

6.3 Base Mapping

6.3.1 The base mapping shall be as follows:

- a. National Grid series Ordnance Survey maps
- b. Other

6.4 Source of Base Mapping

6.4.1 The source of the base mapping shall be as follows:

- a. Supplied by the Design Organisation
- b. To be purchased/supplied by the Survey Contractor
- c. Other

6.5 Base Mapping Source Medium

6.5.1 Drawings

6.5.1.1 The medium of the base mapping source shall be as follows:

- a. Transparency
- b. Positive film
- c. Negative film
- d. Sepia
- e. Published paper plans
- f. Other

6.5.2 Digital

6.5.2.1 The medium of the base mapping source shall be as follows:

- a. Magnetic tape - 1/4", for use on tape streamer.
- b. DOS disk - 3 1/2", 5 1/4", High Density, Double Density.
- c. Other.....

6.6 Planimetric Detail to be Revised or Upgraded

6.6.1 The planimetric detail to be revised or upgraded shall conform to that currently adopted by the Ordnance Survey with additions and deletions in respect of 1:1250 and 1:2500 scale mapping as detailed in Clauses 6.7 and 6.8 respectively.

6.7 Additional Details

6.7.1 The additional details required at 1:1250 and 1:2500 scale shall be as specified below:

6.8 Detail Not Requiring Revision

6.8.1 The following details shall **not** be revised unless specifically required in Clause 6.7.:

- a. Parcel numbers and sizes
- b. County and administrative boundaries of any kind
- c. Changes or additions to house names and numbers
- d. Minor detail within residential property, parks and ornamental gardens
- e. Individual trees
- f. Small details which are not relevant to these scales such as guide posts, mile stones, boundary stones, troughs, etc
- g. High and low water marks
- h. Antiquities

- i.** Non-statutory footpaths and bridleways
- j.** Isolated buildings of less than 2 mm² at map scale
- k.** Building divisions in built up areas which cannot be identified externally
- l.** Detail obscured or not clearly definable
- m.** Other.....

6.9 Planimetric Accuracy

6.9.1 The accuracy of the revision shall be the same as that of the base maps used.

6.10 Height Information

6.10.1 Contours

6.10.1.1 Contours shall be required at the following vertical intervals:

Map Scale	Contour Interval
1:1250	either 1 m or m
1:2500	either 2 m or m
1:10,000	either 5 m or m
Other m

6.10.2 Spot Heights

6.10.2.1 Spot levels shall be required on the maps at the following locations:

- a.** At salient points such as hilltops, bottoms of depressions and saddles
- b.** Along the centre of all roads and public accesses at ...m intervals, road intersections and significant changes of gradient.
- c.** Along the centres of sets of railways at m intervals

- d.** At water level at the time of survey or of photography, along rivers, streams and major watercourses at m intervals
- e.** At any other positions indicated on the Contract Drawings scheduled in Appendix H
- f.** Other

6.11 Height Information Accuracy

6.11.1 Contours

6.11.1.1 Contours shall be accurate to half the vertical interval specified or to m.

6.11.2 Spot Heights

6.11.2.1 Spot heights shall be accurate to the following tolerances:

Map Scale	Hard Surfaces	Other Surfaces
1:1250	± 0.2 m or ± m	± 0.3 m or ± m
1:2500	± 0.3 m or ± m	± 0.5 m or ± m
1:10000	± 1.0 m or ± m	± 1.6 m or ± m

7. NEW MAPPING

7.1 Scale

7.1.1 A survey shall be performed to produce new mapping at the following scales:

- a. 1:1250
- b. 1:1000
- c. 1:500
- d. 1:200
- e. 1:100
- f. 1:50
- g. Other.....

7.1.2 The areas to be surveyed at each scale shall be as shown on the Contract Drawings scheduled in Appendix H.

7.2 Features/Detail to be Surveyed

7.2.1 Control Points

7.2.1.1 The following features and details shall be surveyed:

- a. Ordnance Survey trigonometrical stations
- b. Permanent survey stations
- c. Ordnance Survey bench marks used in the survey
- d. Permanent bench marks
- f. Other.....

7.2.2 Building/Structures

7.2.2.1 The following features and details shall be surveyed:

- a. The plinth (or roof) line of all permanent buildings
- b. Open sides of buildings
- c. Pre-fabricated houses
- d. Hutments, camps
- e. Outbuildings
- f. Garden sheds
- g. Glasshouses
- 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. Names and numbers of all buildings, trade premises or plots
- l. Buildings under construction
- m. Bridges
- n. Overhangs and canopies
- o. Other.....
.....
.....

7.2.3 Boundary Features

7.2.3.1 The following features and details shall be surveyed:

- a. Fences (showing type and height)
- b. Gates
- c. Stiles
- d. Hedges - showing type, height and width
- e. Walls - showing type, height and width
- f. Boundary markers
- g. Other
.....

7.2.4 Roads, Tracks and Footpaths

7.2.4.1 The following features and details shall be surveyed:

- a. Kerb line or edge of surfacing to carriageways
- b. Tracks and bridle paths
- c. Rides and drives
- d. Footways
- e. Pedestrian crossings
- f. Steps
- g. Traffic islands
- h. Paths in public grounds
- i. Paths in private grounds
- j. Tunnels and/or underpasses
- k. Changes of paved surface materials
- l. Bridges and subways
- m. Other.....
.....
.....

7.2.5 Street Furniture and Visible Service Features

7.2.5.1 The following features and details shall be surveyed:

- a. Call boxes - type identified, eg police, RAC, AA, etc

- b.** 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
- 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.....
.....
.....

7.2.6 Railways

7.2.6.1 The following features and details shall be surveyed:

- a.** Gauge faces of railway running rails
- b.** Points and cross-overs
- c.** Level crossings
- d.** Buffers
- e.** Platforms
- 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.....
.....

7.2.7 Water, Drainage and Coastal Features

7.2.7.1 The following features and details shall be surveyed:

- a.** Lakes
- b.** Ponds
- c.** Reservoirs
- d.** Rivers
- e.** Streams
- f.** Water courses
- g.** Ditches
- h.** Canals and towpaths
- i.** Wells
- j.** Springs
- k.** Marshes
- l.** Locks
- m.** Aqueducts
- n.** Water towers
- o.** Culverts
- p.** Millraces
- q.** Syphons
- r.** Sluice gates
- s.** Weirs
- t.** Waterfalls
- u.** Fords
- v.** Mooring posts
- w.** Pumps
- x.** Troughs
- y.** Tanks
- z.** Fountains
- A.** Sewer outfalls
- B.** Piers, jetties and landing stages
- C.** Harbour walls and breakwaters
- D.** Groynes and sea defences
- E.** Tunnels
- F.** Hydraulic rams
- G.** The direction of flow of all rivers, streams and cater courses
- H.** Other.....
.....

7.2.8 Slopes and Earthworks

7.2.8.1 The following features and details shall be surveyed:

- a.** Cuttings and embankments
- b.** Terraced slopes
- c.** Retaining walls
- d.** Mounds
- e.** Open pits
- f.** Quarries

- g.** Rock outcrops
- h.** Tips
- i.** Adits and mineshafts
- j.** Other

- j.** Gas storage vessels and pipes
- k.** Other

7.2.9 Woods, Trees and Recreation Areas

7.2.9.1 The following features and details shall be surveyed:

- a.** Playgrounds and sports facilities
- b.** Parks and open spaces
- c.** Trees and Woods
 - (i) Details of species, girths/diameter (measured 1 m above the ground), height and spread (drawn) of all trees greater thanm girth shall be supplied and plotted to scale.
 - (ii) Isolated trees above m trunk diameter
 - (iii) Individual trees abovem trunk diameter in wooded areas.
 - (iv) Tree count with average girth, height and spread in wooded areas.
 - (v) Canopy line to be plotted.
 - (vi) Staked saplings - individual and/or areas thereof to be plotted.
 - (vii) Schedule of trees.
- d.** Ornamental garden features.....
- e.** Other.....

7.2.10 Industrial

7.2.10.1 The following features and details shall be surveyed:

- a.** Tanks
- b.** Conduits and pipes
- c.** Valve chambers
- d.** Filter beds
- e.** Transformers (boundary fences only)
- f.** Electricity sub-stations and switch boxes boundary fences only)
- g.** Pylon bases and reference numbers
- h.** Overhead lines and cables
- i.** Flagstaffs and masts

7.2.11 Key Points

7.2.11.1 The planimetric co-ordinates of the key points shown on the Contract Drawings scheduled in Appendix H shall be surveyed to the accuracy specified in the appropriate Clause of this Specification.

7.2.12 Spot Levels

7.2.12.1 The spot levels of the following features shall be surveyed:

- a.** Pavements, kerbs, channels and centre-line of roads at m intervals between cross-sections
- b.** Steps and ramps (top and bottom)
- c.** Corners of buildings and other structures
- d.** Floor levels of buildings (or, when inaccessible, threshold levels which shall be clearly annotated)
- e.** Railway lines (highest rail/both rails at m intervals)
- f.** Centre of railways at sleeper level at m intervals
- g.** Hilltops, depressions and saddles
- h.** Top and bottom of embankments at m intervals
- i.** Ditches, outfalls, stream, culverts and drains including bank and bed/invert levels at m intervals
- j.** Water levels (with date of survey) of rivers, streams, water courses, canals, ponds, lakes and reservoirs, and where applicable, flood water levels
- k.** Storm water gullies, manholes, inspection covers, ducts and conduits
- l.** Heights of overhead cables (specify).....
- m.** At additional locations indicated on the Contract Drawings scheduled in Appendix H
- n.** Other

7.3 Accuracy

7.3.1 The planimetric co-ordinates of directly surveyed points shall be correct to \pm m rmse on carriageways and hard surfaces, and \pm m rmse on other surfaces, when checked from the nearest control point.

7.3.2 The levels of directly surveyed points shall be correct to within \pm m rmse on carriageways and hard surfaces, and to within \pm m rmse on other surfaces, (except on ploughed or otherwise broken surfaces), when checked from the nearest control point.

7.3.3 Features which cannot be surveyed to the specified accuracy without extensive clearing shall be treated in one of the following methods:

- a. Surveyed approximately and annotated/labelled accordingly.
- b. Cleared by, or with the authority of, the Survey Advisor or Design Agent.

7.3.4 The co-ordinates of key points as defined in Clause 7.2.11 shall be accurate to within \pm m rmse when checked from the nearest control point.

7.4 Definition

7.4.1 The spacing of points on planimetric features shall be such that interpolated points are correct to within \pm m on hard or well-defined features, and to within \pm m on other features.

ALTERNATIVELY

The spacing of points on planimetric features shall be such that the straight line joining any two adjacent points on a feature shall not deviate from the true position of that feature by more than \pm m on hard or well-defined features, and by more than \pm m on other features.

ALTERNATIVELY IN EITHER OF THE ABOVE, could be replaced by more than twice the accuracy specified in Clause 7.3.1.

7.4.2 The spacing of levels shall be such that the ground configuration, including all discontinuities, is correctly represented except for minor features such as

small banks and ditches which are insignificant in terms of earthworks quantities.

7.4.3 The spacing of levels shall be such that interpolated points shall not deviate from the true ground surface by more than \pm m on hard or well-defined surfaces, and by more than \pm m on other surfaces.

7.5 Presentation

7.5.1 The presentation of surveyed information shall be as defined in Clause 12.7.

8. AERIAL PHOTOGRAPHY

8.1 Purpose of Photography

8.1.1 The photography shall be of an image and geometric quality suitable for the following purposes:

- a. Photogrammetric mapping
- b. Photomosaics
- c. Orthophoto mapping
- d. General interpretation
- e. Other

8.2 Type of Photographic Coverage

8.2.1 The type of photographic coverage shall be as follows:

- a. Stereoscopic
- b. Mono
- c. Oblique
- d. Other

8.3 Area

8.3.1 The areas to be surveyed at each scale shall be as shown on the Contract Drawings scheduled in Appendix H.

8.4 Scale

8.4.1 The nominal scale of the photography shall not be smaller than the following:

- 1:..... for 1:..... scale mapping
- 1:..... for 1:..... scale mapping
- 1:..... for 1:..... scale mapping
- 1:..... for 1:..... scale mapping
- 1:..... for 1:..... scale mapping

8.5 Direction of Flight Lines

8.5.1 The direction of flight lines shall be as defined in one of the following:

- a. Selected by the Survey Contractor and a copy of the flight plan supplied to the Design Organisation.

b. Conform within normal flying standards to the flight plan detailed in Appendix N

c. Other

8.6 Type of Aerial Film

8.6.1 The film used shall be as follows:

- a. Monochrome
- b. Colour
- c. Monochrome infra-red
- d. False colour infra-red
- e. Other

8.7 Film Identification

8.7.1 Photographic products shall contain a block showing the following information:

- a. Reference number or title of project
- b. Date and time of photography
- c. Altitude above sea level
- d. Number of optical unit
- e. Negative number
- f. Mean photographic scale
- g. Focal length

8.8 Paper Prints

8.8.1 Contact prints or proofs shall be made of good quality materials and comply with one of the following:

- a. Materials on which ink and pencil can be used on both sides, samples of which shall have been approved by the Survey Advisor
- b. Other

8.9 Diapositives

8.9.1 Diapositives or transparencies shall be produced on a stable base film, or as specified below:

- a.

8.10 Duplicate Negatives

8.10.1 Duplicate negatives shall be supplied and be produced in one of the following methods:

- a. With a wrong reading image when viewed emulsion up
- b. With a right reading image when viewed emulsion up

8.10.2The duplicate negatives shall be produced on a stable base film with tone reproduction (density distribution) to the same quality as the original negatives.

8.11 Camera

8.11.1The camera used shall be appropriate for the purposes defined in Clause 8.1. The focal length of the camera shall be agreed with the Survey Advisor, prior to photography being undertaken.

8.11.2Where photography is to be used for mapping, a metric survey camera should be used, fitted with a lens that is designed to give a residual radial distortion not greater than 15 mm within 100 mm of the principal point. The film should be held in the intended image plane during exposure, to maintain sharp focus and hold image distortion so that the original negative or contract diapositives produced from them does not contain residual y-parallaxes after relative orientation in excess of 20 mm anywhere in the model. The focal length of the camera should be agreed with the Survey Advisor.

8.12 Filters

8.12.1The Survey Contractor shall select filters to provide suitable tone reproduction, except where the filters to be used are specified below:

- a.

8.13 Flying Conditions

8.13.1Photography shall be taken at a solar altitude such that detail in shadow is acceptable.

8.13.2Where photography is an end product, it shall be flown in conditions when the visibility does not significantly impair the tone reproduction in the negative. Relevant detail shall not be lost as a result of atmospheric haze or dust. The extent of lost coverage shall comply with one of the following:

- a. Photography shall be substantially free from

cloud or smoke. Isolated areas of cloud or smoke shall not be cause for rejection of the photography provided the intended use is not impaired

- b. Photography shall be completely free of cloud or smoke
- c. Other

8.13.3Special conditions related to timing or season for photography shall be as specified below:

- a.

8.14 Materials to be Delivered

8.14.1 Film Negatives

8.14.1.1 All films exposed on the Survey Contract shall be dealt with as follows:

- a. Delivered to the Survey Advisor
- b. Delivered to the Design Organisation
- c. Stored by the Survey Contractor

8.14.2 Other Materials to be Delivered

8.14.2.1 The following materials shall be delivered:

- a. An index plot at 1:..... scale supplied in the form of:
 - (i) sets of transparencies
 - (ii) sets of negatives
 - (iii) sets of paper prints
 - (iv) Other
- b. sets of contact prints or proofs
- c. sets of duplicate negatives
- d. One copy of all film reports
- e. Other

9. SURVEYS FOR NOISE EVALUATION

9.1 Area to be Surveyed

9.1.1 The areas to be surveyed shall be as shown on the Contract Drawings scheduled in Appendix H.

9.2 Building Levels

9.2.1 Individual buildings and groups of buildings to be surveyed shall be represented by simplified blocks on the Contract Drawings. Levels shall be taken at the following points relative to these blocks and their positions recorded on the Survey Drawings.

- a. Ground levels at each of the block corners
- b. Ground levels at intermediate distances of m along the block faces
- c. Ground levels at other locations along the block faces as shown on the Contract Drawings scheduled in Appendix H
- d. The eaves and highest roof (ridge/parapet) level at each end of the block and at the positions specified in b. and c. above

9.3 Roof Types

9.3.1 Types of roofs shall be identified by the Survey Contractor as typical of the simplified block (pitched, gable end, hipped end, flat roof etc) and recorded on the Survey Drawings.

9.4 Representative Ground Levels

9.4.1 Representative ground levels, shall be taken as near as possible to the locations shown on the Contract Drawings scheduled in Appendix H. Final positions of these ground levels shall be recorded on the Survey Drawings.

9.5 Accuracy

9.5.1 Levels shall be accurate to ± 0.15 m rmse or \pm m.

9.6 Presentation

9.6.1 The results of the spot height level survey for noise evaluations shall be presented in the manner detailed in Clause 12.8.

10. UNDERGROUND SERVICES

10.1 Area of Investigation

10.1.1 The area to be investigated shall be one of the following:

- a. The whole of the area covered by the Survey Contract
- b. The specific areas shown on the Contract Drawings scheduled in Appendix H

10.2 Investigation Requirements

10.2.1 The investigation shall be carried out using one of the options given in Clause 10.3. All investigations shall be confined to mains services, except for the following:

- a.

10.3 Types of Survey

10.3.1 From Service Records

10.3.1.1 This shall comprise the addition of utility services record information and local authority drainage, relating information where possible to common detail, services 'furniture', trench scars and overhead lines.

10.3.2 From Service Records and On-Site Visual Investigation

10.3.2.1 This shall include the requirements of Clause 10.3.1, together with the lifting, where permissible, of all services covers except where damage to cover or frame would result, and identifying the contents of chambers. Service runs shall be assumed to be straight. Additional requirements shall be as follows:

a. Drainage

- (i) Measure all invert and backdrop depths
- (ii) Show all pipe sizes and direction of flow
- (iii) Link manholes by proving connection

- (iv) Show all connections at manholes

b. Other services

- (i) Relate chamber contents to record information
- (ii) Relate record information as in a. above

10.3.3 From Service Records, On-Site Visual Investigation and Route Tracing

10.3.3.1 This shall include the requirements of Clauses 10.3.1 and 10.3.2, together with the following:

a. Drainage

- (i) Determine outlets to manholes
- (ii) Electronically trace the actual route
- (iii) Locate concealed manhole positions
- (iv) Electronically trace pumping main and show depths at m intervals

b. Water and Gas (including LPG)

- (i) Electronically trace all detectable water and gas mains
- (ii) Show depths at m intervals on mains
- (iii) Provide sizes from
 - (i) records
 - (ii) visual site investigation
 - (iii) excavation

c. Electricity

- (i) Electronically trace all high medium and low voltage cables, street lighting, control cables, etc
- (ii) Provide depths of cables at m intervals

- d. Telephones**
 - (i) By arrangement with the relevant utility company, electronically trace all cable routes
 - (ii) Show depth to top of ducts at joint boxes and the number of ducts
- e. Other services or structures**
 - (i) Electronically trace route of
.....
 - (ii) Show depth at m intervals of
.....

c. Jetting of sewers required prior to survey.

10.5.2 The following results shall be provided:

a.

10.6 Presentation

10.6.1 For presentation, services shall be grouped as indicated in Clause 12.6.1 and shown as indicated in Table in Clause 12.7.1.

10.6.2 The conventions, abbreviations, line types and other representational features to be used shall be those given in Appendix P.

10.4 Schedules and Reports

10.4.1 Where information is based on records, a schedule shall be compiled showing the service, the contact address, telephone and fax numbers, and the title, reference number, scale and date of the source data. This shall be contained in Appendix G.

10.4.2 All information obtained from records shall be annotated (R) on the final services drawings and digital data files.

10.4.3 A report shall be prepared on the investigation of the services. This shall include details of any particular difficulties encountered during the Survey and any qualification regarding the accuracy of the information shown. A cautionary note shall be provided on all final services drawings and digital data files detailing any limitations in the information provided concerning completeness and accuracy.

10.5 CCTV Surveys

10.5.1 A CCTV survey shall be carried out on the following services using colour/black and white photography:

- a.** All foul and storm water sewers in excess of mm diameter
- b.** Those sewers indicated on the plan provided with the Contract Drawings scheduled in Appendix H

11. EXISTING STRUCTURES

11.1 Location

11.1.1 The structures to be surveyed shall be shown on the Contract Drawings scheduled in Appendix H. The brief names and descriptions of the structures are as follows:

11.2 Detail to be Surveyed

11.2.1 The existing structures shall be surveyed for the following:

- a. Plans at scale
- b. Sections at scale
- c. Elevations at scale.

11.2.2 The following features and defects shall be surveyed:

- a. Features
- b. Defects

11.3 Dimensions

11.3.1 The following items shall be dimensioned.

- a. Spans
- b. Headrooms
- c. Clearances

11.3.2 Dimensions shall be correct to \pm mm.

11.4 Spot Levels

11.4.1 Spot levels shall be surveyed at those points indicated on the Contract Drawings scheduled in Appendix H. The location of control points shall be agreed with the Survey Advisor. The accuracy of spot levels shall be \pm mm on hard or well-defined surfaces and \pm mm on other surfaces.

11.5 Key Features

11.5.1 Key features to be surveyed shall be specified by the Survey Advisor. The co-ordinates of key features shall be accurate to \pm mm, when checked relative to the control points agreed in Clause 11.4.

11.6 Presentation

11.6.1 The presentation of survey information shall be as defined in Clause 12.9.

12. PRESENTATION OF DRAWINGS

12.1 General

12.1.1 The final drawings shall show all the surveyed details specified.

12.1.2 Where digital data is specified the final drawings shall be produced by one of the following:

- a. Entirely from the digital data file
- b. Other

12.2 Drawing Format

12.2.1 The layout of the survey drawings shall be as shown on the Contract Drawings scheduled in Appendix H.

12.2.2 The Survey Advisor shall provide a sample of the title block and general arrangement to be used for all drawings.

12.2.3 Adjoining drawings shall conform to one of the following:

- a. Butt jointed
- b. Overlapped by mm with detail drawn to a cut line
- c. Overlapped by mm with all common detail shown on both drawings
- d. As shown in 12.2.1, where drawings do not form a straight line

12.2.4 Final drawings shall be drawn at the scale(s) and on the sheet size(s) specified in Appendix R.

12.3 Grid

12.3.1 The grid shall be shown on all drawings at mm intervals by one of the following:

- a. Continuous lines
- b. Symmetrical crosses at grid intersections with ticks at the sheet edges

12.3.2 The grid values shall be shown at the sheet edges.

12.4 Revision/Upgrading of Existing Mapping

12.4.1 Revised planimetric detail, additions and height information as specified in Clauses 6.6, 6.7 and 6.8 respectively shall be treated in one of the following ways:

- a. Shown on the base mapping source medium specified in Clause 6.5.
- b. Recompiled and shown as a strip survey of the area specified in the Contract Drawings scheduled in Appendix H. The strip shall be plotted in the top half of an size sheet and orientated such that the proposed centre line is generally parallel to the sheet edge
- c. Other

12.4.2 Contours shall be plotted at mm vertical intervals with everym contour shown as a double thickness line. The value of the contours shall be shown at distances along the contour of not more than mm. Where contours are very close together, values shall only be shown on thickened contours.

12.4.3 In flat areas where the distance between contours is likely to exceed mm additional spot heights shall be shown at the following locations:

- a. As indicated by the Survey Advisor on the Contract Drawings scheduled in Appendix H
- b. Other

12.5 New Mapping

12.5.1 All surveyed detail specified in Clause 7 shall be represented as specified in Clause 12.7.

12.5.2 Contours shall be plotted at mm vertical intervals with everym contour shown as a double thickness line. The value of the contours shall be shown at distances along the contour of not more than mm. Where contours are very close together, values shall only be shown on thickened contours.

12.5.3 In flat areas where the distance between contours is likely to exceed mm additional spot heights shall be shown at the following locations:

- a. As indicated by the Survey Advisor on the Contract Drawings scheduled in Appendix H
- b. Other

12.6 Underground Services

12.6.1 Where drawings of underground services are required they shall be grouped as follows:

- a. Each service shown on a separate sheet
- b. All services shown on the same sheet
- c. Building and Civil Engineering (B and CE) services (foul and storm water sewers, water) shown on the same sheet
- d. Mechanical and Electrical (M and E) services (gas, electricity, telecommunication, etc) shown on the same sheet
- e. Other

12.7 Plan Presentation

12.7.1 Levels, contours and underground services information shall be shown as follows:

Feature	On detail sheet	As separate drawing	In full tone on half tone detail sheet	As overlay
Levels				
Contours				
Services				
.....				

12.8 Noise Evaluation

12.8.1 Levels for noise evaluation shall be added to unmarked copies of the Contract Drawings specified in Clause 4.12 at the positions stated in Clauses 9.2 and 9.4.

12.8.2 For clarity, levels shall be prefixed GL, EL or RL for ground level, eaves level and ridge (or roof) level respectively.

12.9 Existing Structures

12.9.1 The plan position of the structure and any floor plans required shall show the features specified in Clause 11.2.2.

12.9.2 Elevations shall show the features and defects specified in Clause 11.2.2. They shall be clearly annotated to describe the elevation.

12.9.3 Sections shall be compiled from the plans and elevations. They shall be designated as Section A-A' etc and the line of the section shall be clearly indicated on the plan.

12.9.4 Dimensions, levels and coordinates of key features shall be shown on the plan survey and elevations as specified by the Survey Advisor.

13. PRESENTATION OF DIGITAL DATA

13.1 Introduction

13.1.1 The supply of digital data can be relatively straightforward, or potentially complex. This Clause assumes the Design Organisation is obtaining data for an established modelling / CAD system, and that major facets of the design and implementation are therefore explicitly defined. Completion of the options in this Clause and in Appendix S which gives feature descriptions shall satisfy this requirement. Where the Design Organisation has developed its own system, or is not using a pre-defined system, guidance is given on areas of relevance. Definitions used in this Clause are defined in Appendix T.

13.2 Purpose of Data and Basic Data Structure

13.2.1 When digital data is the end product of a geodetic survey, the general requirement is for one or more of three purposes: a digital terrain model, a cartographic model, or a geographic model. While there is information common between the three models, it is often impractical to contain all information in one data set. The model(s) required for this Project are as follows:

.....
.....
.....

13.3 Data Classification

13.3.1 Data Modelling

13.3.1.1 If the classification is not pre-defined by the modelling / CAD system in use by the Design Organisation, and selected for the supply of data, it will be necessary to establish a data model. The basic requirements of such a model and the associated record definition are described in Appendix T.

13.3.2 Data Set Grouping

13.3.2.1 Subject to the physical constraints noted in Clause 14.2, the transfer set shall be one of the following:

- a. A single logical data set containing all features

- b. Supplied in data set(s), the grouping of data for each set being as identified in the Feature Code Table in Appendix S.

13.4 Data Structure

13.4.1 Data Format

13.4.1.1 The data shall be compatible with one of the following:

- a. Modelling / CADsystem
Version
- b. Transfer / exchange format
Level
- Version

13.4.2 Geometric Definition

13.4.2.1 If features are not described by Clause 13.4, it will be necessary to supply a data model and record definition, the general requirements for which are described in Appendix T. This shall include the following:

- a. Coordinates in metres to the accuracy defined in Clause 3, GENERAL REQUIREMENTS.
- b. Unique junction points
- c. Crossing, or 'T' unique junction points between similar features
- d. A permitted level of data redundancy not exceeding %
- e. A distance between two adjacent points on the same feature of not less than metres, except where the points, such as short returns, are essential to accurately define the shape.
- f. A default text alignment either parallel to the general alignment of the survey or East-West.

13.4.2.2 Height information which is not required as discrete surveyed points (spot heights), or is not a height value of planimetric data, shall be defined as follows:

- a. Digital contours (continuous 2-D feature with height attribute)
- b. A digital terrain model with points at metre spacing, normal to the nominal grid, with height supplied in metres to decimal places

13.5 Presentation

13.5.1 Data Representation

13.5.1.1 If presentation drawings are required, the product shall be defined in Clause 12, PRESENTATION OF DRAWINGS.

13.5.2 Symbols

13.5.2.1 The symbol references shall be as defined in the feature code table given in Appendix S.

13.5.3 Coverage

13.5.3.1 Each data set shall be one of the following:

- a. A single logical data file, the limits of which cover the survey area
- b. A series of files with geographical boundaries as defined in Appendix R.

13.6 Proofs

13.6.1 Any proofs required in this Clause are concerned with completeness of the digital data and are only to examine content, coding, etc.

13.6.2 Proof drawings or prints, which have not been retouched, shall be made from each data set(s), in the groups defined in the feature code table in Appendix S. Proofs shall be supplied on paper or other suitable media.

13.6.3 The Survey Advisor may require colours or extra plots to be produced to discriminate between the main features of each grouping. The data proofs may be either to any convenient sheet size or as defined in Appendix Q.

13.6.4 Overlaps and border information are not required. The project grid shall be plotted, and where relevant shall be aligned to the National Grid. If several proof plots are supplied, a simple index diagram shall be included.

13.7 Data Integrity

13.7.1 There are three elements to data integrity; physical, logical and data validity. Many modelling / CAD systems validate some, or all of these elements on reading data into the system.

13.7.2 Where this is not the case, the Design Organisation may find it appropriate to consider the use of validation software. Areas to be considered, if such an option is adopted, are identified in Appendix U.

14. PRODUCTS TO BE DELIVERED

14.1 Drawings

14.1.1 All transparencies, unless otherwise agreed by the Survey Advisor, shall be supplied with the image printed in a positive form on dimensionally stable material with matt surfaces. They shall be produced either by digital methods or by acceptable flat bed processes.

14.1.2 Master transparencies shall be forward reading and plotted on material not less than mm thick. Duplicate transparencies shall be reverse reading and plotted on material not less than mm thick.

14.1.3 The number of copies of drawings required shall be as specified in the following table:

	Preliminary drawings	Final drawings
Advance transparencies		
Master transparencies		
Duplicate transparencies		
Paper plots		
Dyeline copies		

14.1.4 Two sets of proof plots of the final drawings shall be sent to the Survey Advisor, who shall return one set within working days with any amendments required to be incorporated in the final drawings.

14.1.5 The approved Final Drawings shall be retained by the Contractor for a period of one year from the issue of the final certificate (Clause 31 Conditions of Contract), during which time they shall be made available to the Survey Advisor on request. At the end of the one year period the Final Drawings shall be delivered to the Employer unless otherwise directed.

14.2.2 Coverage

14.2.2.1 When writing data sets to the medium, the files shall comply with the following:

- a. Span several volumes with the media sequentially numbered
- b. Not span the media volumes, the data files being split as necessary with each containing correct headers and terminators

14.2 Digital Data

14.2.1 Media Type

14.2.1.1 Data shall be supplied on the following:

- a. Medium
- b. Size
- c. Capacity
- d. Compatible with operating system
- e. Version / revision

14.2.3 Annotation

14.2.3.1 Where multiple media and/or multiple data sets are supplied, the Survey Contractor shall supply a list of all media, stating individual contents.

14.2.3.2 Each media item shall be individually labelled with the Project title, reference number, and date. In addition each item shall be uniquely referenced in the form 'Item 1 of 9'.

14.3 Final Report and Schedules

14.3.1 The final report shall be typed and bound. It shall describe the methods, techniques and equipment used in the survey, the parameters used in the transformation from the National Grid and the closing errors in both the plan and level nets and in the

connections to Ordnance Survey control. Where the Ordnance Survey control is proved to be out of tolerance the course of action agreed with the Survey Advisor shall be stated.

14.3.2 The report shall also include the following:

- a.** A schedule of PGMs showing reference number, National and local grid coordinate and level related to project datum
- b.** A schedule of PBMs showing reference number, level related to project datum and coordinate to the nearest metre
- c.** Station descriptions of all PGMs and TBMs showing the type of marker, a location sketch with reference to permanent points of detail, coordinate and level
- d.** A diagram of the plan control showing all connections within the net and to Ordnance Survey control (if used) with an indication of the accuracy of closures
- e.** A diagram of level control showing all connections between PGMs, TBMs and Ordnance Survey Bench Marks (if used) with misclosures
- f.** Copies of Ordnance Survey Triangulation Station descriptions for all stations used in the survey
- g.** Copies of Ordnance Survey Bench Mark lists showing Bench Marks used, missing, damaged or out of tolerance

14.3.3 All source survey information shall be safely retained by the survey contractor for a period of three/ years from the date of completion of the contract.

15. REFERENCES

1. Health & Safety at Work etc Act 1974.
2. Construction Products Directive. (89/106/EEC).
3. **BS EN 471 : 1994** - **British Standards Institution**
Specification for high visibility warning clothing.
4. Traffic Safety and Control (Traffic Safety) Measures - Chapter 8 of the Traffic Signs Manual.

BIBLIOGRAPHY

1. National Joint Utilities Group (NJUG) - Quality Control Procedures for Large Scale Ordnance Survey Maps digitised to 1988. NJUG Publication No13

APPENDIX A






























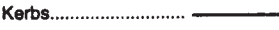















SCHEDULE OF LANDOWNERS AND OCCUPIERS

Reference Drawing Numbers






Plot number	Name, address and telephone number	Status	Permission to enter land given to/date

TABLE OF FEATURE SYMBOLS

Conventional Feature Symbols to be used for 1:500 Scale mapping.

Building..... 	Street Furniture	Public House..... PH
Building (open sided)..... 	Inspection Cover.....  IC	Flag Staff..... • FS
Glasshouse..... 	Manhole..... ◦ MH	Mile Post or Stone..... • MP, MS
Foundations..... 	B.T. Inspection Cover.....  BT	Drain..... = Dr
Ruin..... 	Gully..... G	Basement Light.....  BL
Passage..... 	Kerb outlet..... KO	Footbridge.....  F Br
Sloping Masonry..... 	Grating..... Gr	Signal Post..... • SP
Walls (under 200mm Wide).....  Wall	Hydrant..... • Hyd	Overhead Lines (with description)  Power Line
Walls 200mm and over..... 	Coal Chute..... = CC	 Gantry
Retaining Wall.....  R / W	Road Sign..... • RS	Public Utility Prefixes
Fences (with description)..... 	Guide Post..... • GP	Electricity EI
Chestnut Paling..... C/P	Sign..... • Sign	Gas G
Close Boarded..... C/B	Street Name Plate..... — NP	Water W
Corrugated Iron..... C/I	Bollard..... • B	Hedge..... 
Interwoven..... Iwn	Pedestrian Crossing...  PC	Gate..... 
Iron Railings..... I/R	Lamp Post..... • LP	Stile..... 
Paling..... Pal	Letter Box..... • LB	Stump..... • S
Post & Chain..... P/C	Traffic Signal..... • TS	Individual Tree..... 
Post & Rail..... P/R	Vehicle Detector Pad...  VDP	Slopes with height Greater than 1m 
Post & Wire Mesh Fence... P/W	Telephone Call Box.....  TCB	Cliff Face..... 
Post & Barbed Wire..... B/W	Police Call Box.....  PCB	Erosion..... 
Roads	Police Telephone Pillar.... PTP	Marsh..... 
Kerbs..... 	Electricity Sub Station...  EI Sub Sta	
Edge of Surfacing..... 	Electricity Pylon.....  EI Pylon	
Footpath.....  FP	Electricity Pole..... • EP	
Track.....  Track	Electricity Pole..... • TP	
Water Features	Post..... • P	
Canal.....  Canal	Trough.....  Tr	
Stream..... 	Chimney.....  Chy	
Ditch..... 	Vent Pipe..... • VP	
Sluice.....  Sl	Stop Tap..... • SP	
Weir.....  Weir	Stop Valve..... • SV	
Culvert.....  Cul	Gas Valve..... • GV	
Grip (Land Drain)..... 	Water Meter..... • WM	
Spring..... • Spr	Marker..... • Mkr	
Well..... OW	Bus Stop..... • BS	
	Reflector Post..... • RP	
	Belisha Beacon..... • BB	
	British Telecom or.....  Box	
	Electricity Box (Pillar)	

Survey Information Signs

* Ground Control Point.....	
Permanent Ground Marker.....	
Permanent Bench Mark.....	
O.S. Trig. Station.....	
O.S. Bench Mark.....	 BM 176.91
Standard Spot Height.....	+ 278.51
Higher Precision Spot Height..	+ 278.516
* When Ground Control Points are coincident with PGM's the symbol used shall be agreed with the Survey Advisor	

Conventional Feature Symbols to be used for 1:1000, 1:1250, 1:2500 & 1:10 000 Scale mapping.
Detail Signs to be used for 1:1000 Scale mapping

Building.....	
Building (open sided).....	
Glasshouse.....	
Foundations.....	
Ruin.....	
Passage.....	
Sloping Masonry.....	
Wall.....	
Fence.....	
Roads	
Kerbs.....	
Edge of Surfacing.....	
Footpath.....	
Track.....	
Water Features	
Canal.....	
Stream.....	
Sluice.....	
Weir.....	
Spring.....	
Well.....	
Ditch.....	
Culvert.....	
Street Furniture	
Manhole.....	
Gully or kerb outlet.....	
Hydrant.....	
Road Sign.....	
Guide Post.....	
Sign.....	
Pedestrian Crossing.....	
Lamp Post.....	
Letter Box.....	
Traffic Signal.....	

Vehicle Detector Pad.....	
Call Box.....	
Electricity Sub Station.....	
Electricity Pylon.....	
Electricity Pole.....	
Telegraph Pole.....	
Trough.....	
Chimney.....	
Vent Pipe.....	
Bus Stop.....	
Br. Telecom or Electr. Box.....	
(Pillar)	
Basement Light.....	
Footbridge.....	
Overhead Lines.....	
(with description)	
Hedge.....	
Gate.....	
Stile.....	
Individual Tree.....	
(Woods and Clumps of Trees to follow OS convention)	
Slopes with height Greater than 1m.....	
Cliff Face.....	
Erosion.....	
Marsh.....	

Survey Information Signs

* Ground Control Point.....	
Permanent Ground Marker.....	
Permanent Bench Mark.....	
O.S. Trig. Station.....	
O.S. Bench Mark.....	BM 176.91
Standard Spot Height.....	+ 88.16
Higher Precision Spot Height.....	+ 101.628

* When Ground Control Points are coincident with PGM's the symbol used shall be agreed with the Survey Advisor

REQUIREMENTS FOR TRAFFIC SAFETY AND MANAGEMENT

Traffic Safety and Control (Traffic Safety) Measures

“When surveying work is being carried out on or close to an existing highway, the Contractor shall display suitable warning signs in accordance with Chapter 8 of the Traffic Signs Manual”.

“Where work is carried out on or adjacent to a highway open to vehicles the Contractor shall ensure that the work force and site supervisory staff at all times wear high visibility warning clothing as specified in BS EN 471 : 1994.

Road name and reference number	Special requirements	Required by

ACCESS REQUIREMENTS

Reference Drawing Numbers

Plot number	Details of access requirements

RESTRICTIONS TO THE SURVEY PROGRAMME

Reference Drawing Numbers

Plot number	Details of known restrictions to the survey programme	Restriction required by

SCHEDULE OF CONTACTS

Organisation	Address, telephone and fax numbers	Name and position or rank of individual contacts

SCHEDULE OF EXISTING INFORMATION ON UNDERGROUND SERVICES

SERVICE	AUTHORITY & ADDRESS	DRAWING NUMBERS & REMARKS

NOTES:

Information obtained from records should be treated with caution and further investigation is advised.

In the absence of evidence to the contrary the routes of confirmed connections between manholes are assumed to be direct.

Underground services plotted from existing records are clearly identified on the plan. The sources of the information are listed above.

SCHEDULE OF CONTRACT DRAWINGS

Drawing number	Title of drawing

CONSTRUCTION OF PERMANENT GROUND MARKERS

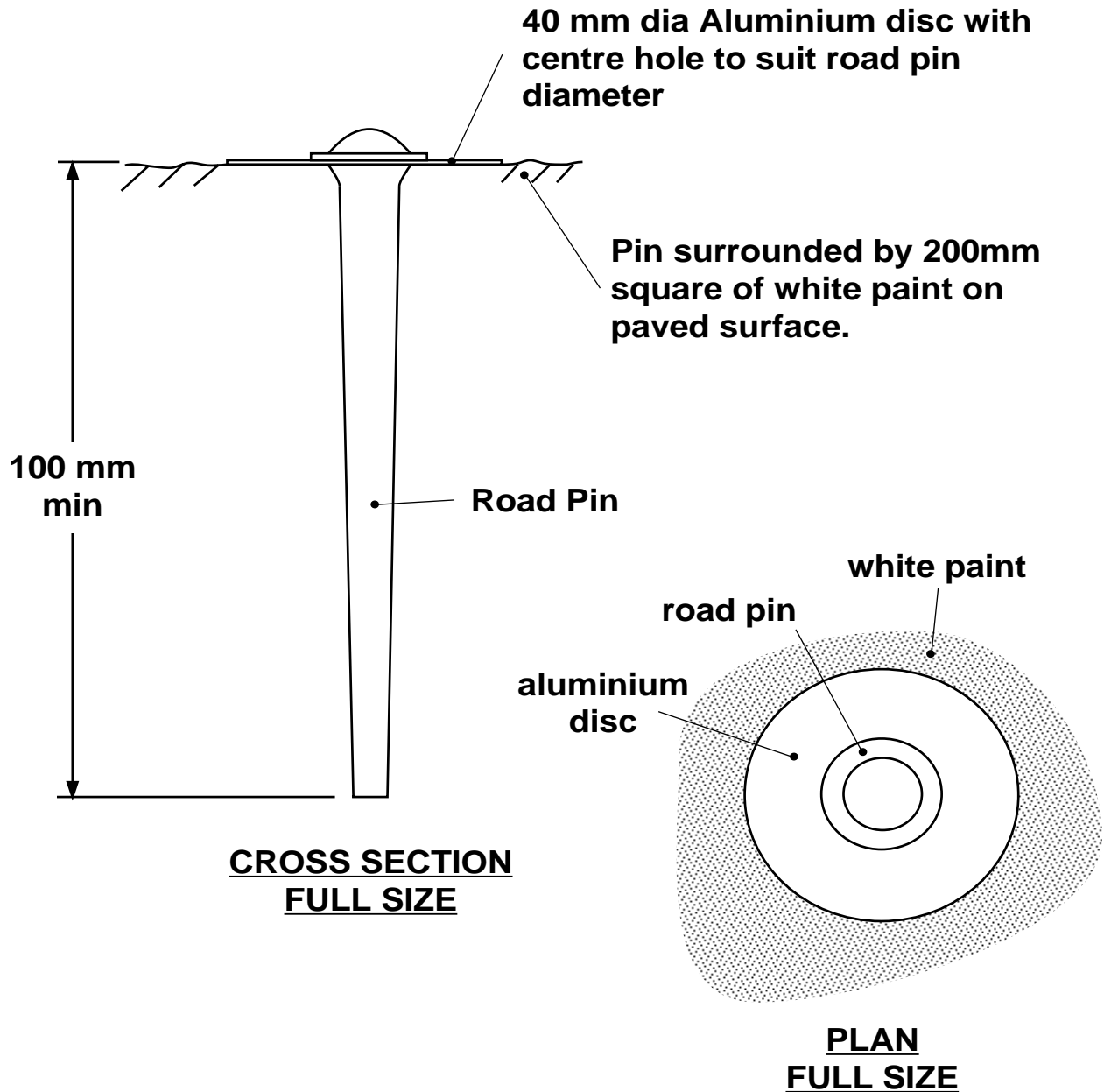


Fig. 1

PERMANENT GROUND MARKER TYPE 1
(FOR DENSE, VERY STABLE PAVED SURFACES)

CONSTRUCTION OF PERMANENT GROUND MARKERS

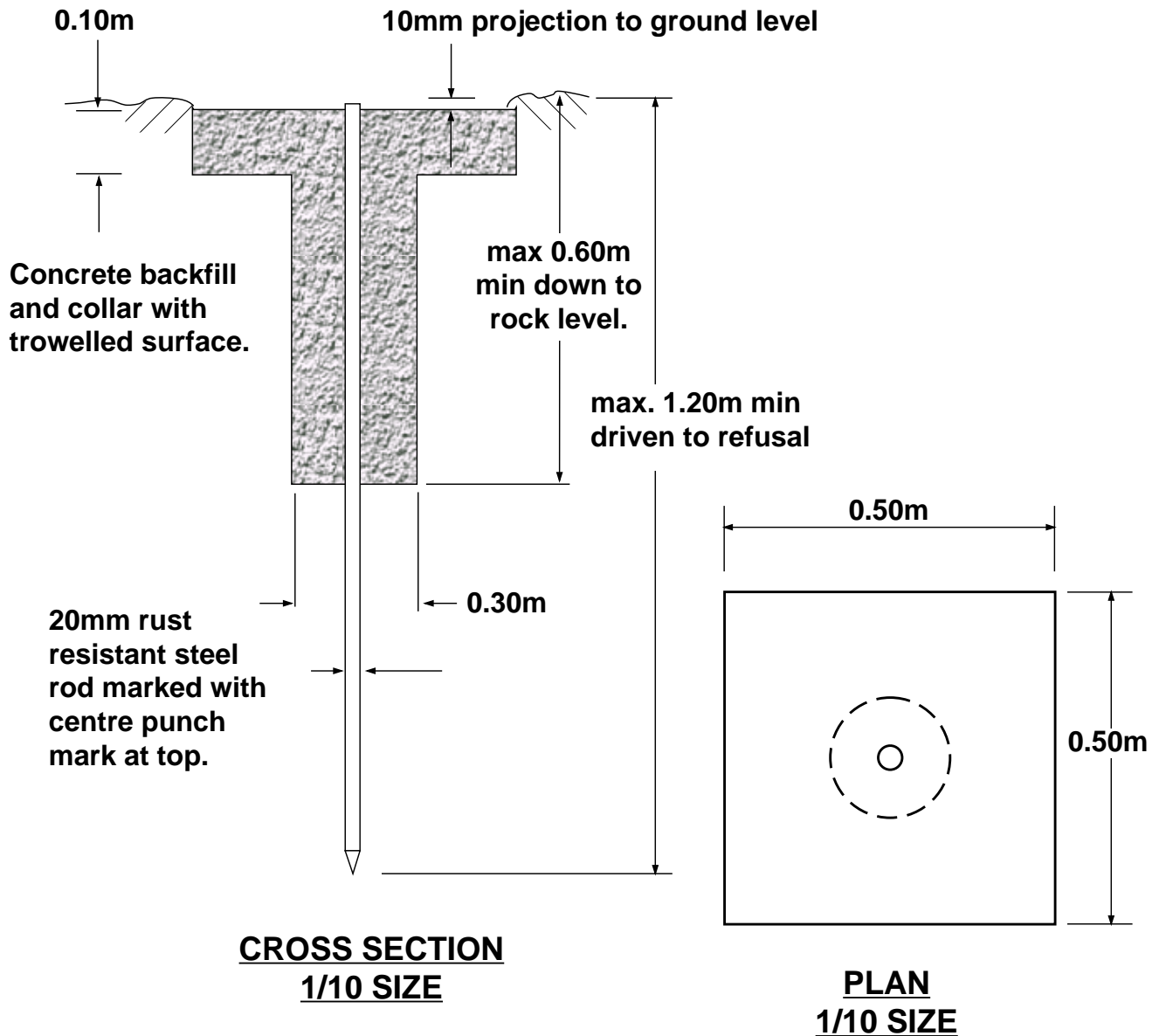


Fig. 2

PERMANENT GROUND MARKER TYPE 2
(FOR NON AGRICULTURAL SITES AND UNPAVED SURFACES)

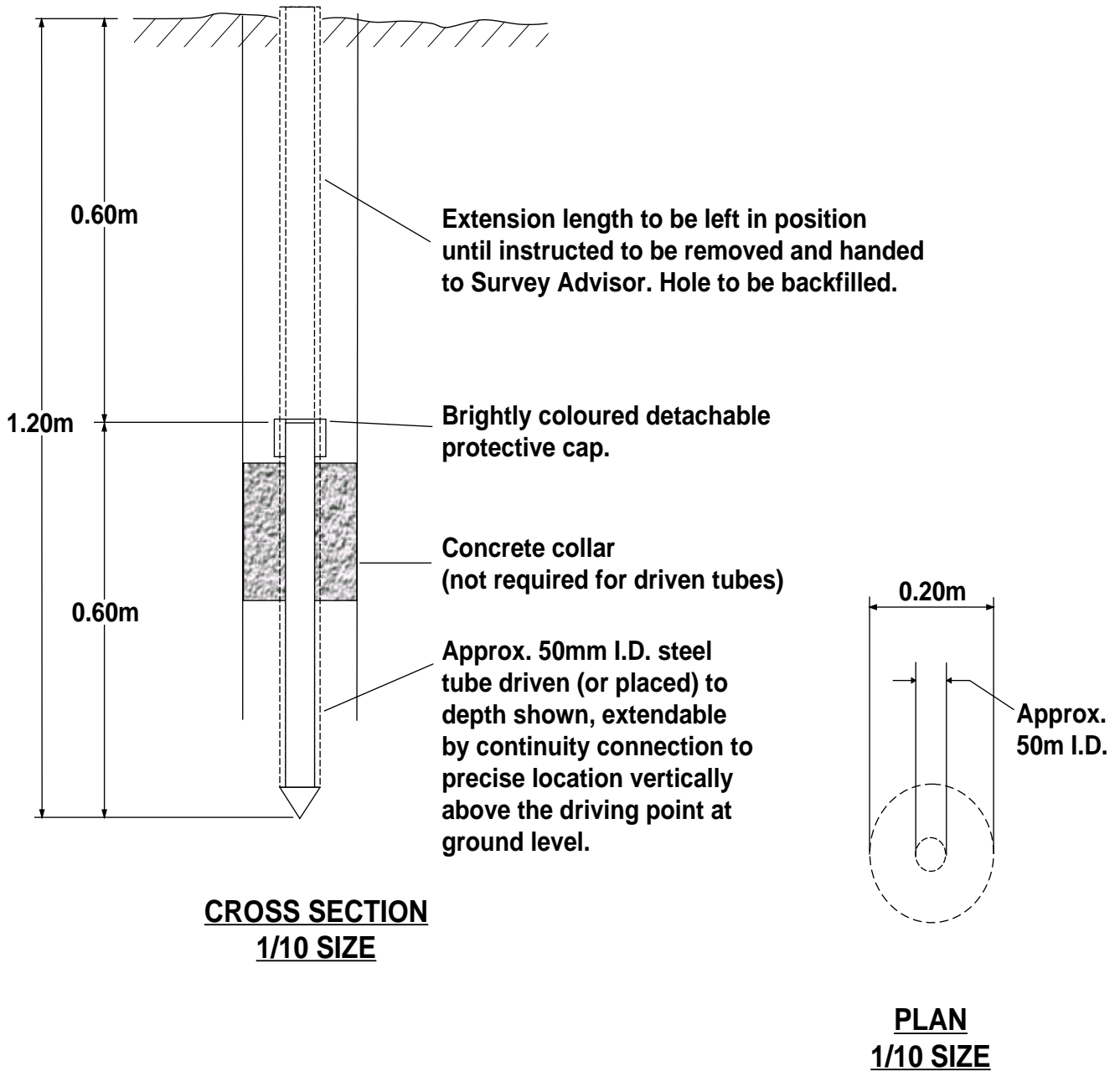
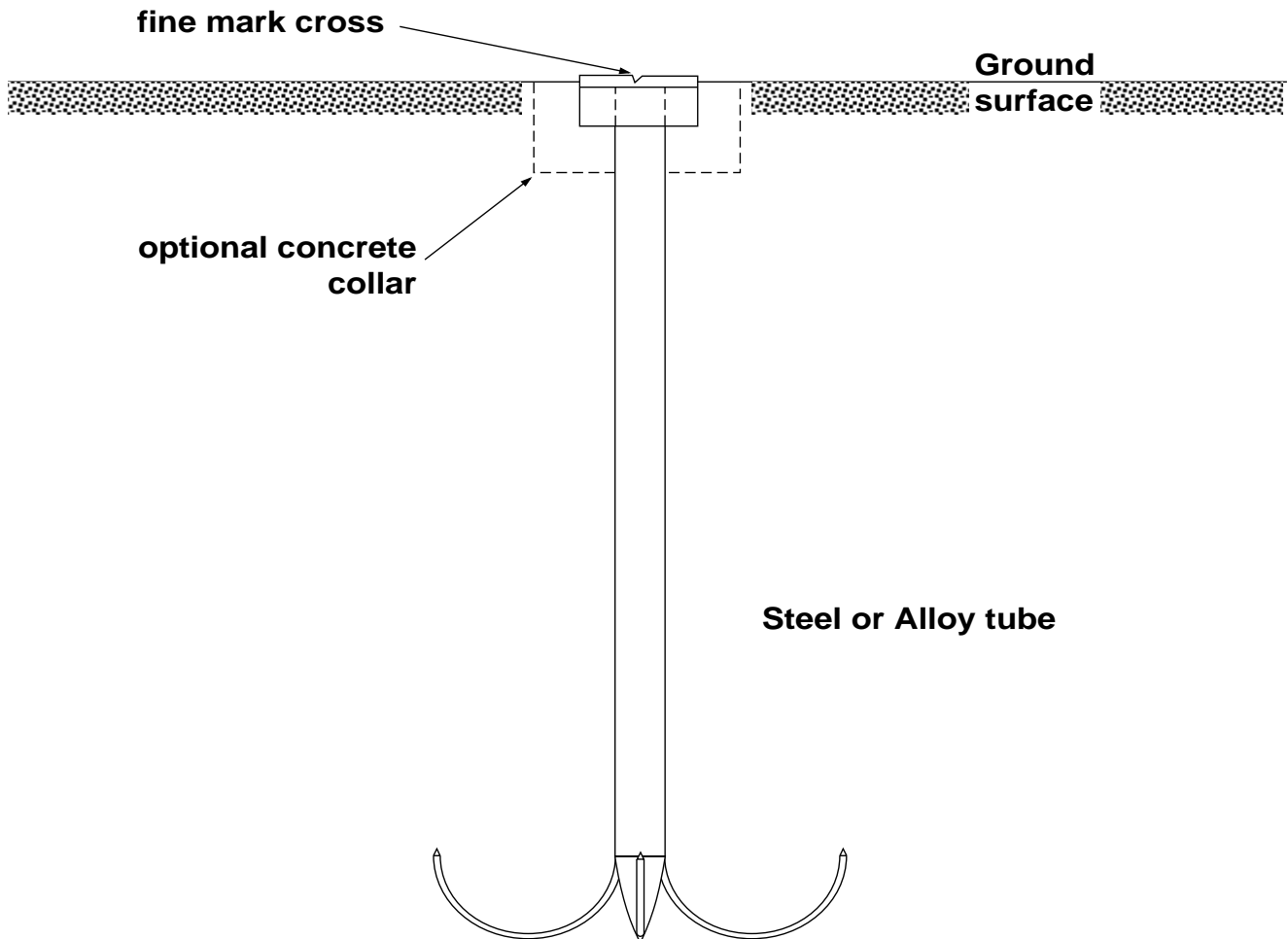


Fig. 3

PERMANENT GROUND MARKER TYPE 3
(FOR AGRICULTURAL SITES)



The illustration shown is diagrammatic only and is not intended to refer to any particular proprietary type.

Fig. 4
PERMANENT GROUND MARKER TYPE 4
(FOR SOFT SURFACES)

LOCATION OF PERMANENT GROUND MARKERS

PERMANENT GROUND MARKER RECORD SHEET			Page of
Location:			Contract No:
PGM No./ Name			
Description of PGM			
Arbitrary/ N.G. Coords	E	N	Ht
Detailed Location Diagram			
Marker Established by.....		Date.....	
Record Prepared by		Date.....	
Revisited by		Date.....	
Remarks			

CONSTRUCTION OF PERMANENT BENCH MARKS

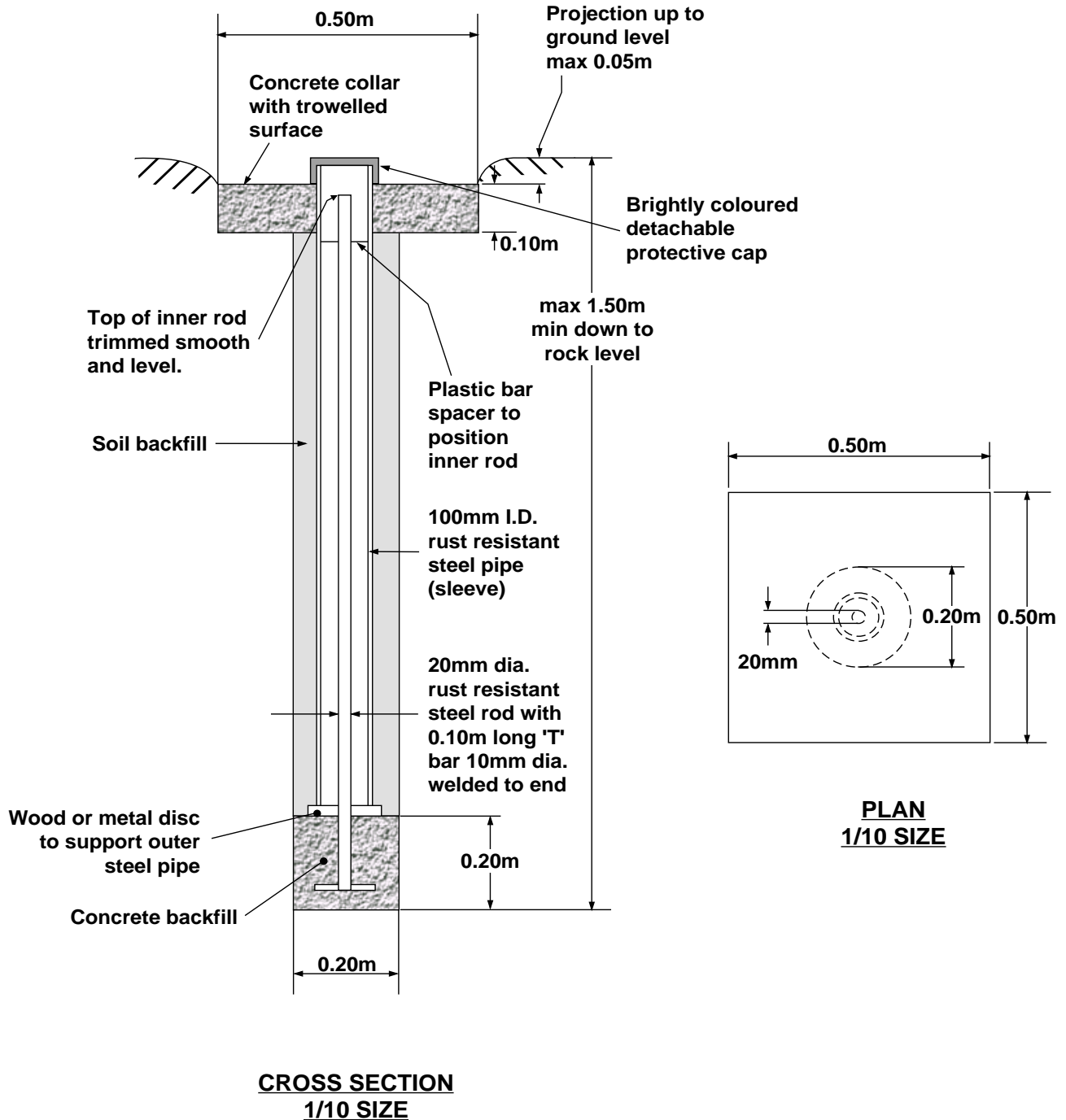


Fig. 5

PERMANENT BENCH MARK TYPE 1
(FOR MARLS, SILTS AND GRANULAR SUBSOILS)

CONSTRUCTION OF PERMANENT BENCH MARKS

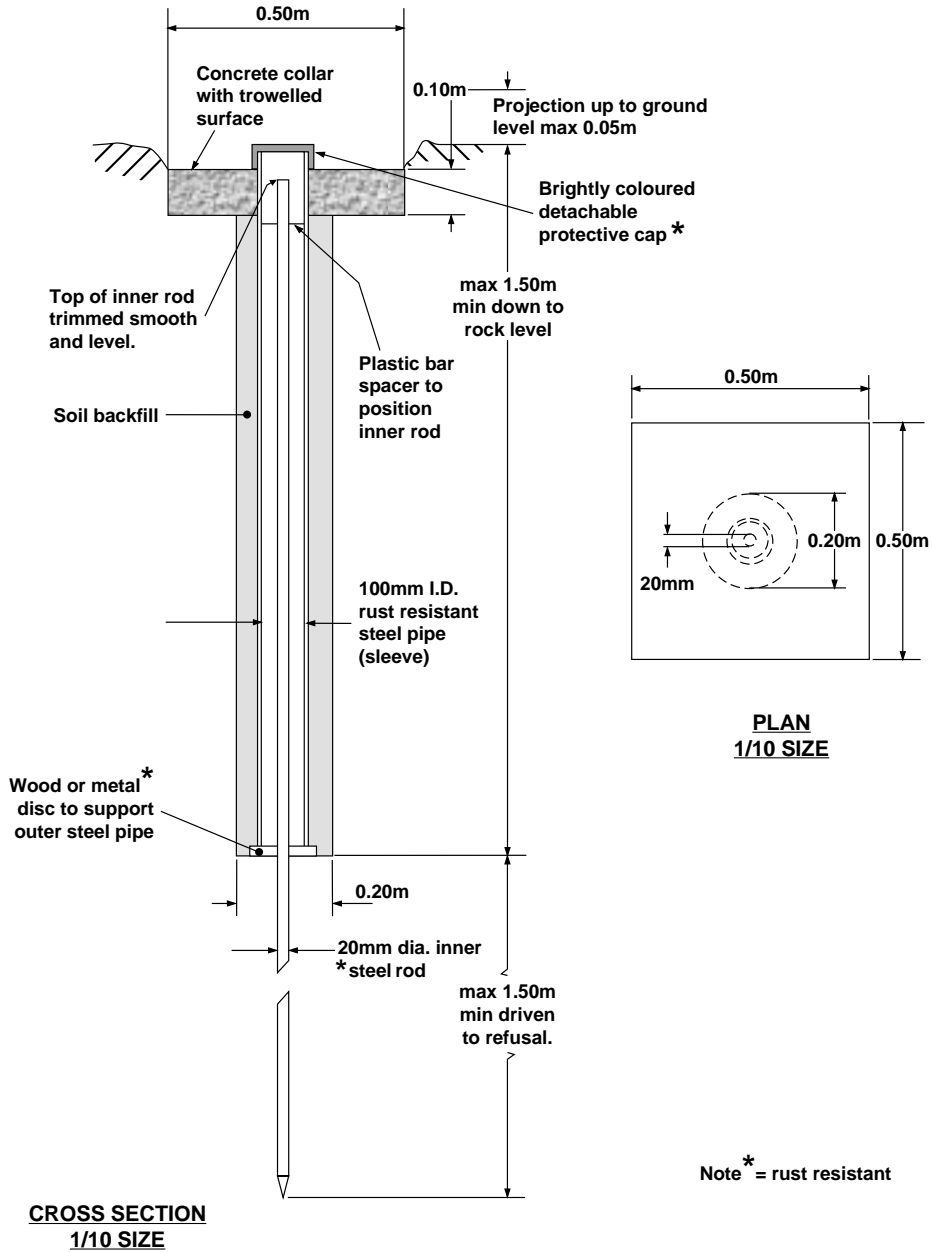


Fig. 6
PERMANENT BENCH MARK TYPE 2
(FOR HEAVY CLAY SUBSOILS)

LOCATION OF PERMANENT BENCH MARKS

PERMANENT BENCH MARK RECORD SHEET			Page of
Location:			Contract No:
PGM No./ Name			
Description of PGM			
Arbitrary/ N.G. Coords	E	N	Ht
Detailed Location Diagram			
Marker Established by.....		Date.....	
Record Prepared by		Date.....	
Revisited by		Date.....	
Remarks			

FLIGHT PLAN FOR AERIAL PHOTOGRAPHY

REPRESENTATION OF UNDERGROUND SERVICES

CONVENTIONS

Where the Design Organisation or Survey Advisor is responsible for compiling the schedule of underground services, the linestyles and abbreviations shall be depicted in the following manner:-

Drainage (Foul)		_____ > _____
Drainage (Storm)		_____ > _____
Water Main (Fresh)	O/H	_____ _____
Water Main (Fresh)	U/G	_____ _____
Water Main (Salt)	O/H	_____ SW _____
Water Main (Salt)	U/G	_____ SW _____
Central Heating	O/H	_____ CH _____
Central Heating	U/G	_____ CH _____
Hydraulic Main	O/H	_____ H _____
Hydraulic Main	U/G	_____ H _____
Gas Main	O/H	_____ G _____
Gas Main	U/G	_____ G _____
Compressed Air	O/H	_____ CA _____
Compressed Air	U/G	_____ CA _____
Fuel Pipe	O/H	_____ FP _____
Fuel Pipe	U/G	_____ FP _____
Steam Pipe	O/H	_____ S _____
Steam Pipe	U/G	_____ S _____
British Telecom	O/H	_____ T _____
British Telecom	U/G	_____ T _____
Electricity Cable	O/H	_____ √ _____
Electricity Cable	U/G	_____ √ _____

ABBREVIATIONS

AAV	Automatic air valve	CR	Cable riser
Abnd	Abandoned	Cul	Culvert
(AC)	Assumed connection	CV	Control valve
AC	Asbestos cement	CWS	Cold water service
a/g	Above ground	d	Approx depth of service
AG	Air grating	D	Diesel
AGL	Airfield ground lighting	DFL	Duct floor level
ALK	Alkathene	DH	Divisional hydrant
(AR)	Assumed route but proved connection	DI	Ductile iron
AV	Air valve	dis	Disused
B	Bollard	DL	Duct level
B&CE	Building & civil engineering	DLB	Disused light base
BB	Belisha beacon	DM	Domestic main
Bd	Backdrop	DP	Downpipe
BIG	Back inlet gully	DrC	Drainage channel
BL	Bed level	DSS	Distribution sub- station
BT	British Telecom	DT	Disconnection trap
CA	Compressed air	ECM	Electric cable marker
CC	Control cable	ECP	Electric cable pit
CCTV	Closed circuit television	ECR	Electric cable riser
CE	Cleaning eye	EDB	Electric distribution board
CH	Central heating	EH	Escape hatch
CI	Cast iron	EHV	Extra high voltage
CJ	Cable joint	EL	Effluent level
CL	Cover level	EM	Electricity meter
CM	Cable marker (low Cable on wall)	EP	Electric pole
CP	Catch pit	EPT	Earthing point
CPP	Cathodic protection point	ER	Earthing rod

ABBREVIATIONS (Cont'd)

ET	Electronically traced	HL	High level
EWS	Emergency water supply	HP	Heating pipe
FA	From above	ht	Height
FA	Fire alarm	HV	High voltage
FAI	Fresh air inlet	HW	Head wall
Fb	From below	HWS	Hot water service
FD	French drain	IC	Inspection chamber
FFP	Fuel fill point	IL	Invert level
FH	Fire hydrant	IT	Interceptor trap
FHO	Fuel hydrant outlet	K	Kerosene
FHPM	Fuel high point marker	KO	Kerb outlet
FL	Floor level	L	Light
FLt	Flood light	LB	Link box
FLM	Fuel line marker	LD	Land drain
FLPM	Fuel low point marker	LDU	Link disconnecting unit
FM	Fire main	LH	Lamp hole
FP	Feeder pillar	LHP	London hydraulic power
FPR	Fuel Pipe riser	LL	Low level
F&R	Flow & return	LP	Lamp post
G	Gully	LPG	Liquid petroleum gas
GC	Gas cock	LV	Low voltage
GM	Gas meter	MC	Mercury Communications
GP	Gully pot	M&EE	Mechanical & Elect Eng
GPP	Gas protection point	MH	Manhole
GPR	Gas pipe riser	Mkr	Marker
GS	Gas syphon	NFI	No further information
GT	Grease trap	NIC	Not in commission
GV	Gas valve	o/h	Overhead
HB	Hand basin	OL	Obstruction light
HBL	Hatch box level	OT	Oil trap
HD	Heating duct		

Appendix P

ABBREVIATIONS (Cont'd)

Pd	Depth to top of pipe	SWG	Switchgear
PDC	Power distribution console	Ta	To above
Pe	Polyethylene	Tb	To below
PE	Pot end	Tc	Depth to top of cables
POL	Petrol oil lubricants	TCR	Telephone cable riser
PP	Pressure point	Td	Depth to top of duct
PR	Pipe riser	TL	Traffic light
PRV	Pressure reducing valve	TP	Telephone pole
PVC	Polyvinyl chloride	Trans	Transformer
(r)	From records	u/c	under construction
Rad	Radiator	u/g	underground
RE	Rodding eye	UPVC	Unplasticised PVC
RG	Road gully	(UTL)	Unable to lift without damage
RMU	Ring main unit	(UTT)	Unable to trace
RWP	Rain water pipe	V	Vent
RWS	Rain water shoe	(VI)	Verbal information
RV	Reflux valve (non return)	VP	Vent pipe
SA	Soakaway	WD	Way duct
SC	Stop cock	WL	Water level
SD	Sump depth	WM	Water meter
SE	Side entry	WO	Wash out
SI	Spun iron	WP	Waste pipe
SL	Sump level	WPR	Water pipe riser
Sof.D	Soffit depth	WTK	Water tank
Sof.L	Soffit level		
SP	Stand pipe		
Spr	Sprinkler		
ST	Stop tap		
StB	Strobe beacon		
StL	Strobe light		
SV	Sluice valve		

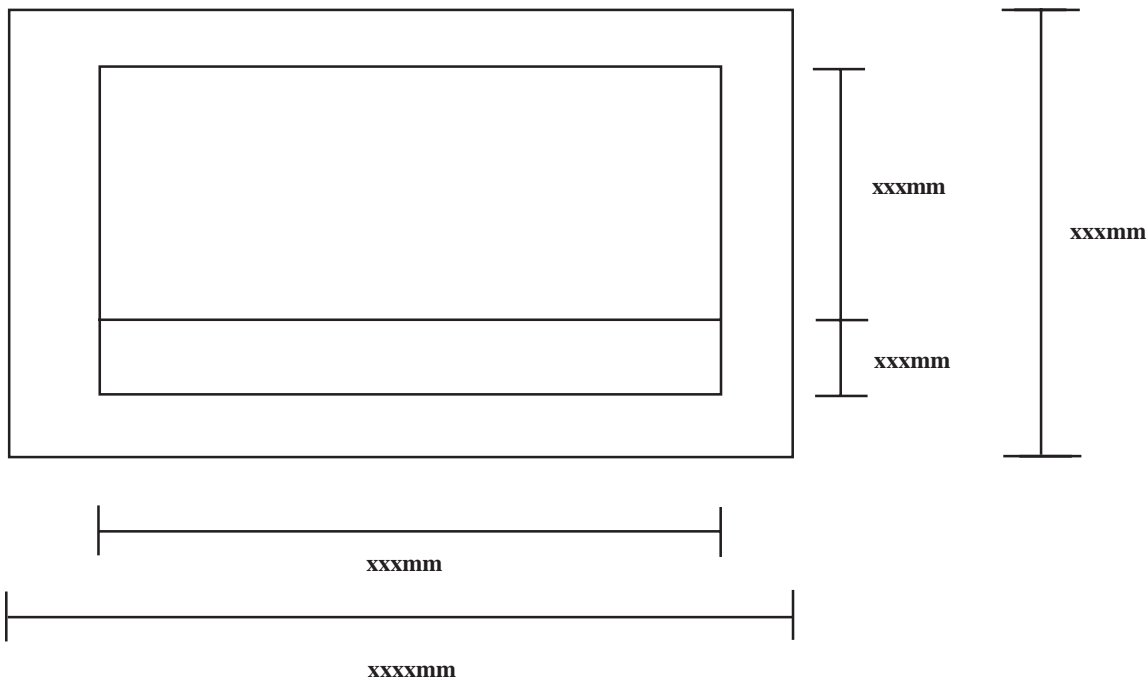
SCHEDULE OF FINAL DRAWINGS

Schedule of Drawings, Scales & Sheet Sizes

SCALE	SHEET SIZE	REMARKS
1/xxxx	Ax (xxxxmm.xxxxmm)	

OR

Sheet Size:-



DEFINITIONS FOR DIGITAL DATA

This Appendix concerns the transfer of digital data from the Survey Contractors system. To avoid ambiguity, the following definitions shall apply.

Attribute

Characteristics and/or descriptions attached to a feature. A feature may have none, or many attributes.

Cartographic Model

A data set, the primary requirement of which is to produce a graphic output. Coding is often limited to information for drafting purposes, such as line or symbol type, and often includes data such as grid and border, titles etc.

Clean Data

A data set with unique junction points.

Data Set

A part of a transfer set which may be homogeneous (ie a noise survey data set), or a geographical subset.

Digital Ground or Terrain Model (DGM or DTM)

A data set usually representing the ground surface (ie 'bare earth', excluding buildings). The model is most often defined by a regular grid of 'posts', each of which has a height. Additional data may include break lines to record heights for definite changes of slope.

Feature

A point or line defined by two or three dimensional coordinates. By definition, a point has no dimensions but may require an orientation and/or scale attribute for output as a symbol. Curves are features defined by a series of straight lines, or a series of points with a regular or complex curve attribute.

Field

A field is a unique unit of data, eg a height coordinate field.

Geographic Model

A data set which explicitly includes the relationships (topology) associated with the geometry. It will sometimes include attributes which are not spatial (ie ownership). This form of model is most suitable for analysis in a geographical information system.

Appendix R

Headers and Terminators

The first and last records of a data set. They usually contain information to explicitly identify the start and finish of a data set.

Null Height

A height entry which is interpreted as no value. Usually an impossible value such as -999 m.

Record

A logical group of fields which is written with a terminator character.

Symbol

A graphic representation of a feature (usually a point). Not usually inherent in the data themselves, but a result of interpretation by the processing software and/or definition by the user.

Transfer Set

The complete data for the project, including supporting information.

Unique Junction Points

Clean data occur when any junction point has only one set of coordinates (2 or 3-D as appropriate): ie in graphic terms there are no under- or over-shoots. Normally, points will only be added to create a 'crossing' or 'T' junction where one would sensibly occur to complete a polygon (such as a fence and wall etc). A junction would be illogical between a river and fence, or an overhead line and road.

Volume

A physical item of media. A transfer set may be written to several volumes.

FEATURE CODING SCHEME FOR GEODETIC SURVEYS

The column of default codes may be amended to those preferred by the Survey Advisor, who may wish to consider alpha or numeric codes, or both. Sample 'default codes' and 'line / symbol definitions' have been inserted for a few examples only. The Survey Advisor should insert those codes he requires. The column of line / symbol reference will also require setting to preferred options.

Notes for Completion

Columns 1, 2, 4, 5, and 6 shall apply unless explicitly amended.

If Groups (column 7) are not identified, all features will fall in Group 1, and will be supplied as a single logical data set.

Comments may be added in column 8.

The listing of a Feature description does not imply the data will be surveyed. Survey Contractors must examine Clauses 6 and 7 to determine the requirements for a particular survey.

Column 1	2	3	4	5	6	7	8
Feature Description	Default Code	Structure	Default Attributes	Other Attributes	Line/ Symbol	Group ref	Comments

CONTROL POINTS

Ordnance Survey trigonometrical stations	OSTS	point	RN
Permanent survey stations	PSST	point	RN
Ordnance Survey bench marks used	OSBM	point	RN
Site bench marks	BM	point	RN
Control line, other than above	CL	line	
Control point, other than above	CP	point	
Control text	CTXT	text	NS

Appendix S (Contd)

Column 1	2	3	4	5	6	7	8
Feature Description	Default Code	Structure	Default Attributes	Other Attributes	Line/ Symbol	Group	Comments ref
BUILDINGS AND STRUCTURES							
The plinth line of buildings	BLDG	line		WI,HT			
Open sides of buildings	OBLD	line		WI,HT			
Ruins	RUIN	line					
Foundations	FNDN	line					
Glass houses and glass roofed extensions	GLAS	line		HT			
Passageways	PASS	line					
Building division	BDIV	line					
Overhangs, roof line		line		NS(CL)			
Bridges		line		NS(CL)			
Headwalls and retaining walls		line		HT			
Tunnels and subways		line					
NS(CL)							
Airshafts		line					
Building/structure line, other than above		line					
Building/structure point, other than above		point					
Building/structure text		text					
BOUNDARY FEATURES							
Fences		line		HT,TY			
Gates		line,2		pointHT,TY			
Stiles		line,2		point			
Hedge centre line		line		WI,HT,TY			
Line Hedge extent, (hedge to right)		line		HT,TY			
Wall centre line		line		WI,HT,TY			
Wall face		line		HT,TY			
Boundary marker		point					
Boundary line		line					
Boundary feature line, other than above		line					
Boundary feature point, other than above		point					
Boundary feature text		text					
Kerb line to carriageway		line					
Edge of hard surface to carriageway		line					
Change of surface		line					
Edge of track or unsurfaced footpath		line					
Edge of hard surface to footway		line					
Highway centre line		line					
Road markings		line					
Road/track/footpath line, other than above		line					
Road/track/footpath point, other than above		point					
Roads, tracks and footpaths text		text					

Column 1	2	3	4	5	6	7	8
Feature Description	Default Code	Structure	Default Attributes	Other Attributes	Line/ Symbol	Group	Comments ref
STREET FURNITURE AND VISIBLE SERVICE FEATURES							
Call box		line					
Letter box		line					
Bus stop		point					
Lamp post		point					
Telecommunications pole		point					
Electricity pole		point					
Ventpipe		point					
Road sign		line,2 points	TX				
Road and street name boards		line,2 points	TX				
Hoardings		line					
Notice boards		line					
Traffic signals		point					
Utility cabinets		line					
Vehicle detector pads		line					
Drains and gullies		line					
Fire hydrant		point					
Stop valve and stop cock covers		line					
Manhole and inspection covers		line					
Covers or lights to cellars		line					
Parking meters		point					
Barriers		line					
Bollards		line					
Marker posts		point					
Street furniture lines, other than above		line					
Street furniture points, other than above		point					
Street furniture text		text					
RAILWAYS							
Gauge faces of railway running lines		line		GA			
Buffers		line					
Platforms		line					
Signals		line					
Telephone points		point					
Loading gauge		line					
Overhead electrification gantries		line		CL			
Warning signs		line					
Cable troughs and runs		line					
Point/signal operating rods/wires		line					
Mile posts		point					
Railway feature lines, other than above		line					
Railway feature points, other than above		point					
Railway text		text					

Appendix S (Contd)

Column 1	2	3	4	5	6	7	8
Feature Description	Default Code	Structure	Default Attributes	Other Attributes	Line/ Group Symbol	Group	Comments ref
WATER DRAINAGE AND COASTAL FEATURES							
Edge of lake, loch, pond or reservoir			line				
Edge of river			line				
Edge of stream, ditch			line				
Edge of watercourse			line				
Edge of canal			line				
Well			line				
Spring			point				
Edge of marsh			line				
Culverts			line				
Syphons			line				
Sluice gates or lock gates			line				
Weirs			line				
Fords			line				
Mooring posts			line				
Pumps			line				
Trough			line				
Tanks			line				
Fountains			line				
Groynes and sea defences			line				
Water feature lines, other than above			line				
Water feature points, other than above			point				
Water feature text			text				
SLOPES, EARTHWORKS, SURFACE MODEL							
Top and bottom of cuttings and embankments			line				
Ground break lines (defining ground form)			line				
Edge of rock outcrop			line				
Top and bottom of cliffs			line				
Contours			line				
Surface triangulation side			line, 2	point			
Spot levels			point				
Slope/earthwork feature line, other than above			line				
Slope/earthwork feature point, other than above			point				
Slope and earthwork feature text			text				
WOOD, TREES AND RECREATION AREAS							
Tree trunk			line	GH,SP,HT			
Tree and wood canopy			line				
Flowerbeds			line				
Pitch marking			line				
Other wood/tree/recreation feature line			line				
Other wood/tree/recreation feature point			point				
Wood/tree/recreation feature text			text				
INDUSTRIAL FEATURES							
Tanks			line				
Pipes, above ground			line				
Valve chambers			line				
Pylon bases			line				
Overhead telecom cable			line				
Overhead electricity cable			line				
Industrial feature lines, other than above			line				
Industrial feature points, other than above			line				
Industrial feature text			line				

Column 1	2	3	4	5	6	7	8
Feature Description	Default Code	Structure	Default Attributes	Other Attributes	Line/ Symbol	Group	Comments ref
CARTOGRAPHIC							
Flow arrows (downstream)			line,	2 point			
Marsh symbols			line,	2 point			
Gradient tadpoles (uphill)			line,	2 point			
Cliff face symbol			line,	2 point			
Level mark			point				
Tree symbol			point				
TRANSPARENT FEATURES							
Area seeds			point				
Virtual segments			line				
Survey extent			line				
FEATURE CODES FOR MEASURED BUILDING SURVEY							
BUILDINGS AND STRUCTURES							
Beams			line				
Columns			line				
Wall faces, structural			line				
Wall faces, non structural			line				
Doorways			line				
Windows			line				
Parapets			line				
Step risers			line				
Building or structure line, other than above			line				
Building or Structure point, other than above			point				
Building or Structure text			text				
SERVICES							
Electrical cable runs			line				
Electrical sockets			point				
Electric light switches			point				
Electric light point			point				
Electric light line			line				
Telephone cable runs			line				
Telephone points			point				
Computer cable runs			line				
Computer points			point				
Gas pipe runs			line				
Gas points			point				
Water pipes runs			line				
Tap points			point				
Basins, sinks, baths and toilets			line				
Heating pipe runs			line				
Radiators			line				
Fire Hydrant pipe runs			line				
Fire Hydrant points			point				
Services line, other than above			line				
Services point, other than above			point				
Services text			text				

Appendix S (Contd)

Column 1	2	3	4	5	6	7	8
Feature Description	Default Code	Structure	Default Attributes	Other Attributes	Line/ Symbol	Group	Comments ref
FURNITURE							
Desks and Tables		line					
Filing Cabinets		line					
Shelves		line					
Furniture line, other than above		line					
Furniture point, other than above		point					
Furniture text		text					
FEATURE CODES FOR UNDERGROUND SERVICES SURVEY							
UNDERGROUND SERVICES							
Electricity main or service		line					
Gas pipe		line					
Water main pipe		line					
Sewerage/drainage pipe		line					
Telecommunications cable/duct		line					
Surface apparatus - general		point					
Manhole/inspection cover		point					
Area of special sensitivity		line					
Limits of underground chamber		line					
Thrust block		point					
PUSWA road description		line					
Improvement line		line					
Observed plant position		point					
Supports		point					

NOTE: This feature coding scheme conforms with the standard system published by the National Joint Utilities Group.

ATTRIBUTE MNEMONICS

The following attribute mnemonics are to be used if attribute data are required.

- GA Gauge
- HT Height
- WI Width
- DI Diameter
- TY Type
- TX Text
- CL Clearance
- DP Depth
- GH Girth
- SP Spread
- CL Cover level
- IL Invert level
- NS Non surface (specify separation)
- RN Reference number
- FC Feature code

SYMBOL DEFINITIONS FOR OUTPUT

This Appendix defines the symbols referenced in the feature code table in Appendix S. These symbols shall be used for output from digital data, if drawings are specified in Clause 12.

SYMBOL

DEFINITION

1. Triangulation Station

RN Attribute

Origin
size

Comment:- Base parallel to grid.
Ref.No. positioned preferred parallel to grid/line of survey.

2. Bench Mark

-----Origin

RN Attribute

Comment:- Ref.No. positioned to right preferred parallel to grid/line of survey

3. Pylon

-----Origin

WI

Comment:- Positioned to correct orientation and scale unless below ...metres WI
Then symbolised to WI at correct orientation.

Data Model and Record Definition - a brief introduction

If the data model is not defined by the modelling / CAD system in use by the Client, it will be necessary to define one, and define the various records in use by the model.

There are four generic data models for geodetic data.

Raster - All data is defined in two dimensions only by a succession of pixels. No features, attributes, or relationships are identified, nor can they be.

Coded Strings - The data defines the geometry by a succession of coordinate pairs or triplets. Point and line relationships as simple as a solid line, or as complex as attributes allow can be defined. This is the most commonplace data model and is the basis of most modelling / CAD systems.

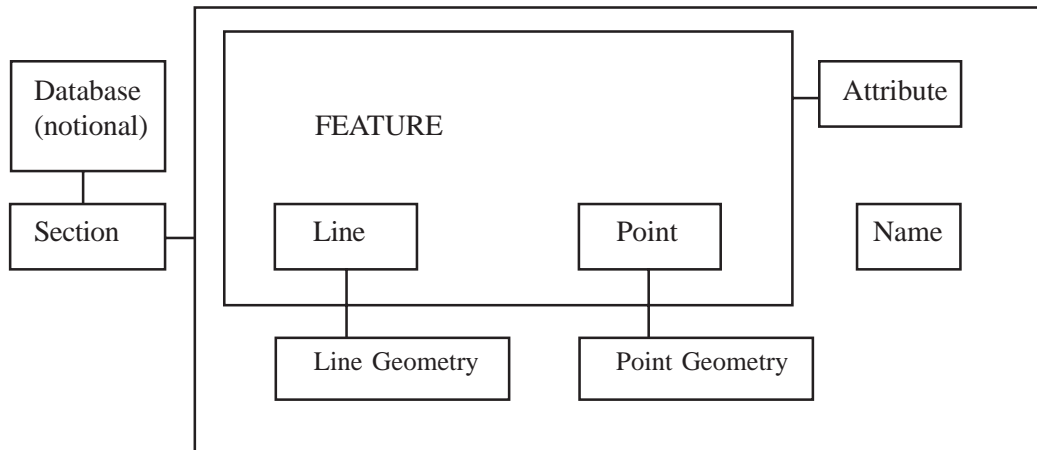
Link and Node - A series of segments (links) connected only at terminals (nodes). Link and node data have relationships (topology) which are no longer dependent just on position, but can be represented in a logical data model such that the data can be mathematically manipulated. The classic illustration is the road network model. The nodes are junction points, the links represent possible routes, which may not be in their geometric position.

Structured Data (Object Related) - The term structured is often used, but this is misleading as all data - even raster - have some structure albeit very simple.

The term object related is more precise, as in the real world entities (or objects, such as a house) are defined in terms of geographical position, and have attributes assigned to them.

Once the choice of model type is made, the Client must then decide on the relationships needed for the project.

An example of a basic data relationship is given below.



After defining the data model the record definition is made. A fictitious example definition, which must be made for every record type is given below.

2-D GEOMETRIC RECORD

Purpose

Once a 2-D line or point has been identified then its position has to be defined.

Layout

Assuming a line consisting of two sections joining three points

```

REC-SERIAL NO = 17
GEOMETRY TYPE    = L          (for line)
NO-COORDS        = 3          (number of coords for
                               this line)
X-COORD          = xxxxx.xxx (format as appropriate)
Y-COORD          = yyyyy.yyy
SEPARATOR        = ;
X-COORD          = xxxxx.xxx
Y-COORD          = yyyyy.yyy
SEPARATOR        = ;
.
.
etc
END-OF-RECORD    =<lf>      (line feed for end of record)
  
```


Appendix T

Other Considerations

There are other items which may be relevant to the data model and record definitions, as described below.

Description of line features - typically described by a series of coordinates to be joined by straight lines on output.

Curves may be a series of coordinates sufficient to define the shape by straight lines at nominal scale, or discrete points sufficient to define the shape at nominal scale with a suitable algorithm. The algorithm should be specified.

Text may be defined by a coordinate pair / triplet, to define position, with orientation and height attributes. Default orientation is typically East - West to the nominal grid.

Position will typically be lower left corner of start of text.

Orientation will usually be radial from North in degrees / grads.

Text height will need defining, either in metres or millimetres at nominal scale.

The justification and position of text (for eventual display, as opposed to attribute text) may be relevant. While a default position, with some display overlapping to detail, may be satisfactory for minor descriptions, it may not be so for road names etc.

Alternatively, text can be digitised as line features at nominal scale and orientation.

The data model may also include some attributes of data quality, precision, etc.

DATA INTEGRITY VALIDATION

Validation of data on input to the modelling / CAD system, is particularly important when data volumes or complexity are such that visual inspection of the data on a workstation is inadequate.

There are three elements to data integrity - physical, logical and data validity.

Physical validation concerns the recorded data file. Obvious check of file size and date, may only be valid if the whole system - Survey Contractors, Design Organisations and Clients - use the same computer operating system and same commands to read and write data.

A more rigorous check is some form of sum checking. In this case a program reads the entire file, summing the individual bytes as it proceeds. A repeat of the check using the same algorithm on the receiving system should result in an identical answer.

Precautions are necessary. The most obvious source of potential 'error' is where one system saves to exact file lengths, and another with fixed length blocks. The data are identical but one file is longer.

Logical validation concerns the record structure of the file. Software to check this can be very complex. The objective is to check for valid record construction, order and size: ie the file should begin with a valid header record which should contain certain fields; feature records should be followed by geometry records; etc.

Data validity concerns the range of individual values: ie if a geometry record has specified 15 coordinate triplets, are there 15; are they of the correct magnitude; is there a proper record terminator?

This software is often combined with logical validation programs.