

PAS 128:2022

Underground utility detection, verification and location – Specification



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Foreword

This PAS was sponsored by the Institution of Civil Engineers (ICE). Its development was facilitated by BSI Standards Limited and it was published under licence from The British Standards Institution. It came into effect on 30 April 2022.

Acknowledgement is given to George Tuckwell (RSK) and Andy Rhoades (Buried Asset Protection Consultancy Ltd) as the technical authors, with contributions from Sam Roberts (Met Geo Environmental Ltd).

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- Chartered Institution of Civil Engineering Surveyors (CICES)
- EuroGPR
- Ordnance Survey
- The Geological Society
- The Survey Association
- Transport for London
- University of Birmingham
- Co-opted members

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Acknowledgement is also given to the members of a wider review panel who were consulted in the development of this PAS.

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The PAS process enables a specification to be rapidly developed in order to fulfil an immediate need in industry. A PAS can be considered for further development as a British Standard, or constitute part of the UK input into the development of a European or International Standard.

Supersession

This PAS supersedes PAS 128:2014, which is withdrawn.

Information about this document

This is a full revision of the PAS, and introduces the following principal changes:

- addition of guidance on training and qualifications of practitioners (Clause 4);
- updates to the application of post-processing in detection surveys (Table 2);
- new specification for buried utility detection and avoidance to support on-site permit to break ground (Annex A);
- new guidance on the accuracy of detection methods (Annex C); and
- new guidance on the technical factors that dictate the effort required for a detection survey (Annex D).

Acknowledgement is given to the following who were involved in the development of the previous edition of this PAS: Ian Bush (Black & Veatch, ICE, ICES) as the technical lead and Peter Barker (SUMO Services Ltd, The Survey Association), John Robinson (Subscan Technology Ltd) and Nick Zembillas (Subsurface Utility Engineering LLC) as the drafting panel.

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Where websites and webpages have been cited, they are provided for ease of reference and are correct at the time of publication. The location of a webpage or website, or its contents, cannot be guaranteed.

Hazard warnings

WARNING 1. This PAS calls for the use of procedures that can be injurious to health if adequate precautions are not taken. It refers only to technical suitability and does not absolve the user from legal obligations relating to health and safety at any stage.

WARNING 2. For all excavations, assume that underground utilities are present and act accordingly. To avoid buried services effectively it is necessary to positively identify and locate the services that are present.

Attention is drawn to laws, rules and regulations applicable to vacuum excavating or hand digging near or atop dangerous utilities such as electric, gas, fuel or petroleum.

Attention is drawn to HSE's publication, *Avoiding danger from underground services* (HSG47) [1].

Annex A sets out the application of this specification to the detection, location and avoidance of buried services in support of excavations and intrusive ground investigations.

WARNING 3. This PAS refers to physical entry into confined spaces, which is not to be attempted without suitably trained operatives and safety equipment.

Attention is drawn to HSE's publication, *Confined spaces – A brief guide to working safely* (INDG258) [2].

Use of this document

It has been assumed in the preparation of this PAS that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

Presentational conventions

The provisions of this PAS are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is "shall".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Requirements in this PAS are drafted in accordance with *Rules for the structure and drafting of UK standards:2017*, subclause **G.1.1**, which states, "Requirements should be expressed using wording such as: 'When tested as described in Annex A, the product shall ...'". This means that only those products that are capable of passing the specified test will be deemed to conform to this PAS.

Where words have alternative spellings, the preferred spelling of the Shorter Oxford English Dictionary is used (e.g. "organization" rather than "organisation").

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0 Introduction

0.1 Background

As the demand on the nation's infrastructure continues to grow due to new developments, and the need to replace and/or maintain existing utilities increases, it is essential to have accurate information on the existence and location of underground utilities.

The accurate detection, identification, verification and location of utility assets have always been difficult tasks, subject to interpretation and inaccuracies. Not having sufficient or reliable information leads to:

- risk to the safety of workers and to the public;
- abortive and unnecessary work;
- damage to third party assets;
- inefficient design solutions; and
- potentially compromising the resilience of the existing network.

Accurate utility data could also afford the opportunity for as yet unrealized benefits, such as the use of remote robotic techniques to maintain asset networks in busy highways in future to reduce the need for intrusive maintenance practices (road excavations). Similarly, accurate mapping of utility networks could improve asset modelling capabilities with more determined outcomes.

NOTE *Given the wide use and varying connotations associated with the word "survey", the word "location" has been used throughout this PAS to define the act of geospatially referencing utility assets or topographical features.*

The purpose of this PAS is to set out clear and unambiguous provisions to those engaged in the detection, verification and location of active, abandoned, redundant or unknown utilities.

This PAS aims to provide:

- clarity in the service provided and methods employed;
- consistency in the approach to data capture;
- classification of the results and the confidence that can be associated with them;
- an indication of the effort required to be confident that the survey is capable in principle of achieving higher accuracy levels in different settings;

- standardization of the format of deliverables; and
- accountability for the work undertaken.

It is expected that time, education and experience in the application of this PAS will lead to more effective planning and safer execution of street works, civil works, ground works and utility-based activities.

In creating this PAS, the development of other similar work, such as guidelines and standards undertaken in the USA, Canada and Australia, have been taken into account.

Different survey types and methods provide different levels of accuracy and certainty around results. For example, verification provides more accurate results than a desktop utility records search. It is recognized that an increase in accuracy and certainty inevitably means an increase in effort, cost and time to deliver those results.

0.2 The survey type

This PAS takes a hierarchical approach to the survey types used in recognition that different clients at different stages of an asset life cycle require different levels of accuracy and confidence in the data provided. This PAS defines four types of survey:

- desktop utility records search (survey type D) – where underground utilities are identified through the collation and analysis of existing paper/online utility records;
- site reconnaissance (survey type C) – where existing records are supported and validated by the visual inspection of physical evidence observed or recorded during a site visit;
- detection (survey type B) – where underground utilities are detected and located by geophysical techniques and geospatially located; and
- verification (survey type A) – where underground utilities are observed within and located at a manhole or inspection chamber or are excavated and exposed.

These represent the different levels of survey required for obtaining information on the location of utilities, whereby the desktop utility records search usually requires the least effort and verification the most.

A survey type D is a prerequisite for survey types C, B and A. Survey type C is also a prerequisite for a survey type B but can be carried out as an independent site reconnaissance visit by the person writing the type B survey scope or as an integral part of a type B survey. Survey types A and C are independent of each other. For example, a verification survey can conform to this PAS without the need to conduct a survey type C or B, although carrying out each stage in order further reduces project risk.

More information on the different survey types is contained in Annex B.

0.3 Detection methods

This PAS defines a hierarchy of methods to be used to detect underground utilities in terms of the minimum equipment types to be used, the minimum techniques to be applied and the survey search resolution, and relates this to the maximum quality levels achievable that can be attained using a particular detection method (see Table 2 and Annex C).

The detection methods are usually selected taking into account density of services of the survey area and whether post-processing is undertaken or not. In a PAS 128 survey, both electromagnetic locators (EML) and ground penetrating radar (GPR) are deployed as a minimum in conjunction with each other for each segment of a utility within the survey area. In addition to EML and GPR, other detection methods can be applied to the survey area.

NOTE *A multiple antenna array GPR only survey can be used to increase confidence in type D information so that a more targeted type B survey can be carried out.*

By requiring the practitioner to indicate in their method statement the methodologies they intend to use and thus the level of work their price is based on, the client can assess and compare tenders on an equal basis. More importantly, this PAS defines for the practitioner the minimum standard expected for detection associated with each typical application.

0.4 Quality levels

The quality level is a classification applied to each segment of utility surveyed based on survey type undertaken (D, C, B or A), location accuracy achieved (B and A survey type), whether post-processing was undertaken and level of supporting data obtained in determining the quality level (see Table 1). It reflects the method the practitioner has used and the confidence in the accuracy at which they state they have determined the location of the service.

0.5 Absolute geospatial location of underground utilities

To improve accuracies and how data are exchanged and integrated, this PAS encourages the absolute geospatial location of utilities referenced to three dimensions using a national coordinate grid system and datum. In Great Britain this is the Ordnance Survey's National Grid (OSGB36) and Ordnance Datum Newlyn (ODN) coordinates. In Northern Ireland this is the Irish Grid (IG) as used by Ordnance Survey Northern Ireland.

NOTE *The coordinate system for Ireland is the Irish Transverse Mercator (ITM).*

1 Scope

This PAS specifies requirements for the detection, verification and location of existing and new underground utilities.

It applies to the detection, verification and location of active, abandoned, redundant or unknown underground utilities and the location of their associated surface features (e.g. manhole covers and utility markers). It applies regardless of where these utilities are located (e.g. in urban or rural areas, in the street, or on private sites such as hospitals or airfields).

This PAS sets out the accuracy to which the data are captured, the quality expected of these data and a means by which to assess and indicate the confidence that can be placed in such data.

More specifically it covers:

- a) project planning and the scoping process;
- b) the classification system for quality levels based on survey type, location accuracy, inclusion of post-processing and level of supporting data;
- c) desktop utility records search;
- d) detection;
- e) verification;
- f) location; and
- g) deliverables.

It does not cover the detection, verification or location of the following:

- 1) emergency utility works (as defined by the New Roads and Streets Works Act 1991 (NRSWA) [3]) or where there is imminent risk to life, limb or environment;
- 2) underground basements, underground tunnels (including railways, road tunnels and underground pedestrian walkways), plant rooms and non-utility based features (although clients are made aware if such a structure is detected although not surveyed); or
- 3) above surface utility infrastructure (such as overhead power or telecommunication lines).

This PAS is for use by practitioners (usually a surveyor, geophysicist or subsurface utility engineer). The PAS might also be of interest to clients (such as engineers, constructors, project managers and utility owners) who are responsible for recording information about underground utilities. Annex B and Annex D are aimed specifically at the client and explain how to use this PAS and some of the limitations associated with the two main utility detection techniques specified. Annex E sets out an example project workflow which, if adopted, and if appropriate for the scope and nature of the project, can maximize the benefit to both client and practitioner of this PAS.

Where ground investigation, borehole, trial pit works and other construction works are proposed, a current utility mapping survey conforming to this PAS can be used as an indicator of the presence or absence of underground utilities before conducting further ground investigation prior to breaking ground.

It is good practice to undertake a full detection survey prior to the development of a site, so this information can support and inform the safety and progress of the project from before the initial ground investigation through to design and construction phases. If a full detection survey is not available prior to a ground investigation, then this specification can be used to support the detection, location and avoidance of buried services as part of a permit to break ground safe system of work, as set out in Annex A.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes provisions of this document.¹⁾ For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

Standards publications

BS EN ISO 19650-1:2018, *Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) – Information management using building information modelling – Part 1: Concepts and principles*

BS EN ISO 19650-2:2018, *Organization and digitization of information about buildings and civil engineering works, including building information modelling (BIM) – Information management using building information modelling – Part 2: Delivery phase of the assets*

Other publications

[N1] ROYAL INSTITUTION OF CHARTERED SURVEYORS. *Guidelines for the use of GNSS in land surveying and mapping. 2nd edition. London: RICS Business Services Limited, 2010.*

¹⁾ Documents that are referred to solely in an informative manner are listed in the Bibliography.

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this PAS, the following terms and definitions apply.

3.1.1 absolute accuracy

degree to which the position of an object on a map conforms to its true or accepted location on the earth in a specified reference (coordinate) system

3.1.2 absolute coordinates

easting, northing and height that define the absolute geospatial location in a specified reference (coordinate) system

3.1.3 accuracy level

level of accuracy required and/or achieved

NOTE In this PAS, these are defined under the Quality Levels B and A in Table 1.

3.1.4 attribute data

structured data relating to specific descriptive characteristics associated with the underground utility

3.1.5 building information modelling (BIM)

use of a shared digital representation of a built asset to facilitate design, construction and operation processes to form a reliable basis for decisions

[SOURCE: BS EN ISO 19650-1:2018, 3.3.14]

3.1.6 BIM execution plan (BEP)

plan that explains how the information management aspects of the appointment will be carried out

NOTE The pre-appointment BIM execution plan focuses on the delivery team's proposed approach to information management and their capability and capacity to manage information.

[SOURCE: BS EN ISO 19650-2:2018, 3.1.3.1]

3.1.7 client

person or organization who has commissioned the underground utility survey

3.1.8 deliverables

outputs provided to the client by the practitioner

3.1.9 detection

use of geophysical and other techniques and methods to establish the presence of an underground utility that can be either marked on the ground for later location or post-processed to determine location

3.1.10 exchange information requirements (EIR)

information requirements in relation to the delivery of an appointment (agreed instruction for the provision of information)

[SOURCE: BS EN ISO 19650-1:2018, 3.3.6, modified]

3.1.11 geospatial

relating to or denoting data which are associated with a particular location at or near the earth's surface

3.1.12 interpretation

analysis and identification of signals and images in the data that are representative of buried features, and the correlation of these signals and images to map linear segments representative of one or more underground utilities

3.1.13 location

process of recording geospatial data of an underground utility

3.1.14 location accuracy

accuracy to which an object on a map conforms to its true positions on the earth's surface

3.1.15 mapping

process of graphically representing the spatial relationships of entities within a defined area

3.1.16 metadata

information about a resource

[SOURCE: BS EN ISO 19115-1:2014+A2:2020, 4.10]

3.1.17 null level

level that implies no real value has been observed

NOTE For example, -999.0.

3.1.18 post-processing

enhancement and interpretation of GPR data via a GPR processing software tool to help identify responses indicative of the presence of underground utilities that are not visible and/or are not interpretable in the raw GPR data

3.1.19 practitioner

qualified person(s) carrying out the specified utility survey

NOTE A practitioner is usually a surveyor, geophysicist or subsurface utility engineer. See Clause 4 for recommendations on training, qualifications and competency.

3.1.20 quality level

classification applied to a utility segment post survey based on survey type, location accuracy achieved, whether post-processing was undertaken and level of supporting data obtained

3.1.21 relative accuracy

measure of location accuracy on a map between one data point and other, nearby data points

NOTE Relative accuracy compares the scaled distance between objects on a map with the same measured distance on the ground and is only to be used for filling in gaps where accurate techniques cannot be applied. See Clause 11 for limitations on use of relative measurements.

3.1.22 segment

part or section of an underground utility represented on a drawing in terms of linear length (QL-B) or point (QL-A) to which a quality level applies

NOTE The linear length of any segment should not exceed 5 m and should be terminated by two points of similar quality level.

3.1.23 site reconnaissance

visual inspection of the survey area(s) (as defined by the survey boundary) or interrogation of surface imagery acquired at the site to ascertain facts and information about relevant topographic features and evidence pertaining to underground utilities

NOTE Site reconnaissance can include interviewing site personnel to ascertain operational or "local" knowledge pertaining to buried utilities.

3.1.24 survey area

area defining the extent of works

3.1.25 underground utility ("utility")

item or network of pipes and/or cables ducted or directly buried, located beneath the surface level

NOTE 1 Underground utility is referred to as "utility" throughout this PAS.

NOTE 2 It includes exposed or submerged utilities.

3.1.26 utility owner

person or organization responsible for maintaining the utility asset and/or utility network

NOTE A utility owner could be, for example, a statutory undertaker, roads/street authority, local authority, company or private individual.

3.1.27 utility record

information relating to the underground utility infrastructure

NOTE Utility records can include, for example, drawings (including "as-builts"), maps, spreadsheets, schematics, photographs, reports.

3.1.28 verification

act of reviewing and inspecting, by existing access chambers or direct physical access using safe digging practice, in order to determine the absolute geospatial location and detailed attributes of the exposed underground utility or using gyroscopic mapping techniques to survey the internal centreline of a utility

3.2 Abbreviated terms

BEP	BIM execution plan
BIM	building information modelling
CAD	computer-aided design also known as computer-aided drafting
CCTV	closed-circuit television
COSHH	control of substances hazardous to health
EIR	exchange information requirements
EML	electromagnetic locator
GIS	geographic information system
GNSS	global navigation satellite system
GPR	ground penetrating radar also known as ground probing radar
MDPE	medium density polyethylene
NRSWA	New Roads and Street Works Act 1991
RDP	relative dielectric permittivity
RFID	radio-frequency identification
RTK	real-time kinematic
SFCW	stepped frequency continuous wave systems
SRWR	Scottish Road Works Register
TWTT	two-way travel time
VLF	very low frequency

4 Training, qualifications and competency

Practitioners shall be able to evidence the training and competency of staff through a nationally recognized qualification achieved through evidence of competence in practice, or through qualification in engineering, surveying or geophysics combined with a demonstrable track record of competence in practice.

Surveys shall be designed, and deliverables signed off, by a senior experienced and competent person who takes responsibility for the standard of practice and accuracy of deliverables on behalf of their organization.

NOTE *The competence of a senior person might be demonstrated by professional accreditation, for example, chartered status, where this has been achieved through the demonstration of competence in underground utility detection, verification and location.*

5 Project planning

COMMENTARY ON CLAUSE 5

Utility surveys should be approached holistically both in the planning and execution; they are a synthesis of the results of a number of technologies and methodologies deployed on the site. Utility surveys should be planned by the client in conjunction/consultation with a trained, skilled and experienced practitioner. The project requirements should be clearly specified in tender and/or contract documentation. For guidance on specifying a utility survey, see Annex B.

Survey techniques and methodologies vary considerably, with each having their own advantages and disadvantages. The more intensive utility surveys have the potential to produce results that are more accurate but at an increased cost.

When responding to a client's specification, the practitioner should address whether the client has taken into account some or all of the following in the scope of work at the earliest possible opportunity.

- a) Has a desktop utility records search been undertaken?
- b) Are the results to be marked onto the ground?
- c) Are the results to be fully mapped in CAD/GIS/BIM/augmented reality?
- d) What consideration should be given to any CAD/GIS/BIM/augmented reality outputs?
- e) Is the existing base mapping at a scale suitable for the proposed project or is there a need to commission a new survey?
- f) Have the legal rights or permission for the use of any existing base mapping been obtained?
- g) Has the survey area been clearly defined?
- h) Are there any areas of particular concern that the client should be highlighting (e.g. any risks associated with not knowing the accurate location of utility infrastructure)?
- i) Are there any sections within the survey area where key information is needed and where the highest intensity of survey is to be undertaken?
- j) Are there any health and safety issues, hazards or risks associated with this site (e.g. working on highways including road category/speed limits, ongoing construction activities, confined space entry requirements, industrial premises where there is a potential presence of asbestos)?
- k) Are there access requirements via road works planning tools such as Scottish Road Works Register (SRWR) or Street Manager?
- l) Is there other material relevant to the project (e.g. geological information)?
- m) Has the suitability of the survey area for geophysical investigation been assessed?
- n) What utility attributes need to be included in the deliverables?
- o) What level of detail is to be recorded against accessed manholes, inspection chambers and pits, etc.?
- p) Is post-processing of the data required to provide greater confidence that the most complete and accurate survey possible has been achieved?
- q) Are all areas to be surveyed accessible and if not, what access arrangements might be required?
- r) Are there any private land or privately owned assets (e.g. chambers) that require specific permission to access?

5.1 Documentation

5.1.1 General

A method statement, programme of works, risk assessment and safety plan for the survey shall be submitted to the client before commencing work on site.

NOTE The client should review and accept these documents, as changes made to the scope or the arrangements required for site access after instruction might result in modified costs.

5.1.2 Method statement

NOTE 1 Some clients might have their own templates for generic method statements which should be addressed in drafting the method statement.

NOTE 2 In planning the survey, the practitioner should take into account the likely depth, size, duty and material of construction of the buried utilities within the survey area to ensure a survey is delivered that meets the client's requirements. An appraisal of the expected utilities and their complexity should be made by considering the type of site. The equipment type, model and frequencies expected to be used should be stated.

NOTE 3 *Gaining access to utility assets such as manholes and inspection chambers and obtaining permission to do so is a contractual arrangement specific to a particular project.*

A method statement containing the following as a minimum shall be produced and submitted to the client:

- a) the survey type(s) to be deployed as specified in Table 1, including the estimated survey extent for each accuracy level;
- b) for survey type B, detection methods to be deployed as specified in Table 2, including the estimated survey extent for each method;
- c) comments on these survey type(s) and, for survey type B, detection methods, with regard to satisfying the client's requirements;
- d) comments on the expected achievable quality level, relating to the survey effort (Table 1) with confidence that the client's requirements are able to be met given the anticipated circumstances of the site;
- e) qualifications, experience and competencies of the project team including the named individual responsible for signing off the survey design and results (see Clause 4);
- f) comments on how traffic, pedestrians, parked vehicles, bus stops, skips, animals and other surface obstructions are to be managed to maximize the area available for survey and to ensure the safe execution of the works; and
- g) health, safety and security requirements and costs.

NOTE 4 *Access to private land is to be negotiated and if work is required in the highway, any permissions are to be sought from the appropriate highway authority(ies).*

NOTE 5 *Before undertaking any excavation, evidence should be obtained that the following are in place:*

- a) permits;
- b) licences; and
- c) footpath/road closure notices.

NOTE 6 *It is usually the client who is responsible for procuring relevant permits, licences, footpath/road closure notices. Attention is drawn to the New Roads and Street Works Act 1991 (NRSWA) [3] and the Traffic Management Act 2004 [4].*

NOTE 7 *Night-time or weekend working should be agreed with the client to ensure safe and considerate impacts on the local environment and community.*

5.1.3 Programme of works

A programme of works shall be drawn up detailing the time allowed for fieldwork, initial reporting, client consultation, any agreed further fieldwork and submission of the deliverables.

NOTE *The programme of works can take a variety of forms (schedule of work, spreadsheet, list of dates, etc.) appropriate to the project.*

5.1.4 Risk assessment and safety plan

A site-specific risk assessment and safety plan or safe system of works shall be compiled.

NOTE *The risk assessment involves:*

- *an examination of the work and workplace to identify what could cause harm to people (a hazard), which should be developed by a site visit and/or current information supplied by the client; and*
- *an assessment of the chance, high or low, that somebody could be harmed by the hazards identified, together with an indication of how serious the harm could be (the risk).*

The safety plan involves taking the results of the risk assessment and developing a plan showing the precautions needed to mitigate the risks and how these precautions would be communicated and implemented.

5.2 Utility records

5.2.1 For a survey type C, B or A, utility records shall be obtained through a desktop utility records search in accordance with Clause 7.

5.2.2 The desktop utility records search deliverable shall provide recent record drawings, with the date of issue clearly indicated, prior to conducting a survey type C, B or A.

5.3 Base mapping

Where existing base mapping has been obtained (in any format, e.g. drawing, electronic such as 3D-CAD/GIS/BIM models), its accuracy, currency and scale shall be assessed for its intended purpose.

NOTE 1 *This subclause specifies requirements for assessing base mapping as part of the planning process. Requirements for on-site checks are specified in 11.5.1.*

NOTE 2 *If there are any obvious omissions, inaccuracies or doubts about any inherited data, or if any data are considered unsuitable, the practitioner should inform the client that a new topographic survey will need to be undertaken.*

NOTE 3 Where Ordnance Survey data are being used, the practitioner should obtain details of an Ordnance Survey licence from the client to include on drawings.

NOTE 4 The practitioner is not responsible for the accuracy of the client or third-party base mapping. The practitioner is only expected to highlight omissions and errors found.

5.4 Other buried features and obstructions

NOTE This PAS does not cover the identification and mapping of other buried features or obstructions. If the client requires additional site investigation work, this should be carried out in accordance with BS 5930.

If buried features or obstructions are discovered whilst undertaking the works, they shall be reported in accordance with 12.5.

5.5 Geology of the site

Any detection or verification methodologies to be used shall take into account the geological bedrock, natural and artificial superficial deposits, soil material and engineered ground materials that might be present beneath the site when known.

When selecting the geophysical technique, the resolution as well as depth of penetration expected in the prevailing ground materials shall be taken into account along with the variability within the subsurface which might exert a strong influence (see Annex D).

When selecting the method of verification, the composition and physical properties of the subsurface shall be taken into account.

5.6 Meetings and site visits

A post-fieldwork meeting shall be held to review the results in terms of the information delivered and any remaining areas of uncertainty, and to discuss whether additional fieldwork is required. The outcomes of this meeting shall be recorded. If a client declines a post-fieldwork meeting, this shall be recorded.

NOTE 1 The meeting may be a face-to-face meeting or a virtual meeting (telephone, video conferencing, online).

NOTE 2 In addition to the post-fieldwork meeting, other meetings, site visits, client visits and progress reports might be required to inform the client on progress and resolve problems as they arise.

6 Quality level

6.1 Survey types

The appropriate survey type(s) shall be selected from the following:

- a) survey type D – desktop utility records search;
- b) survey type C – site reconnaissance;
- c) survey type B – detection; or
- d) survey type A – verification.

NOTE 1 A survey type D is a prerequisite for survey types C, B and A (see 5.2.1). A survey type C is also a prerequisite for a survey type B. A survey type C can be carried out as an independent site reconnaissance visit by the person writing the type B survey scope, or as an integral part of a type B survey by a practitioner. Survey types A and C are independent of each other. For example, a verification survey can conform to this PAS without the need to conduct a survey type C or B, although carrying out each stage in order reduces project risk.

NOTE 2 The practitioner should establish with the client the survey type(s) required and where these are to be performed on the survey area where not already defined in the survey scope, specification and project requirements.

NOTE 3 A client might specify multiple survey types over the survey area. For example, the client might require a survey type D for the whole site, a survey type B in the road carriageways and a survey type A only at a specific location where a potential design element has a possible conflict in a congested area.

NOTE 4 The practitioner should establish the detection methodology required to meet the client's requirements and document this in the method statement presented to the client (see 5.1.2).

6.2 Quality level

The quality level achieved shall be applied to each segment of utility surveyed in accordance with Table 1.

Survey type D can only be classified as QL-D in the deliverables. Survey type C can have utility segments that are classified as QL-C or QL-D in the deliverables. Survey type B can have utility segments that are classified as QL-B1, QL-B1P, QL-B2, QL-B2P, QL-B3, QL-B3P or QL-B4 in the deliverables. Survey type A can have utility segments that are classified as QL-A in the deliverables if utility(ies) are exposed/inspected. Where a survey type B or A was not attempted, the QL-C or QL-D remains in the deliverable showing no type survey carried out. Where a survey type B was attempted but the utility was not detected, the QL-C or QL-D changes to QL-B4, indicating the detection survey was attempted but unsuccessful. This is done to highlight the remaining risk to the client that a utility might exist within the survey area but was not located.

Table 1 – Quality level of survey outputs

Survey type (Establish with client prior to survey)		Quality level (Practitioner to determine post survey)	Post-processing (GPR data analysis)	Location accuracy		Supporting data
				Horizontal ^{A)}	Vertical ^{B)}	
D	Desktop utility records search	QL-D	—	Undefined	Undefined	Copy of utility asset record only.
C	Site reconnaissance	QL-C	—	Undefined	Undefined	A segment of utility whose location is demonstrated by visual reference to street furniture, topographical features or evidence of previous street works (reinstatement scar).
B	Detection ^{C)}	QL-B4	No	Undefined	Undefined	A utility segment which is suspected to exist (either on QL-D or QL-C records) but has not been detected and is therefore shown as an assumed route.
		QL-B4P	Yes			
		QL-B3	No	±500 mm	Undefined (No reliable depth measurement possible)	Horizontal location only of the utility detected by one of the geophysical techniques used.
		QL-B3P	Yes			EML field unable to estimate depth and horizontal accuracies within B2 tolerances with confidence. Features present within the GPR data that indicate the presence of a utility but do not directly correlate to its position (e.g. trench sides or fill detected by GPR without positive identification of utility).
		QL-B2	No	±250 mm Refer to Annex C for accuracy achievable at what depth.	±40% of detected depth	Horizontal and vertical location of the utility detected by one of the geophysical techniques used. ^{D)}
		QL-B2P	Yes			Symmetrical field achieved resulting in peak and null measurements within B2 tolerance and/or present in GPR data where both depth estimates and horizontal location can be confidently established to the required accuracies.

Table 1 – Quality level of survey outputs (*continued*)

Survey type (Establish with client prior to survey)		Quality level (Practitioner to determine post survey)	Post-processing (GPR data analysis) Horizontal ^{A)}	Location accuracy		Supporting data
				Vertical ^{B)}		
		QL-B1	No	±150 mm Refer to Annex C for accuracy achievable at what depth.	±15% of detected depth	Horizontal and vertical location of the utility detected by one of the geophysical techniques used. ^{D), E)} Symmetrical field achieved resulting in peak and null measurements within B1 tolerance and/or present in GPR data where both depth estimates and horizontal location can be confidently established to the required accuracies.
		QL-B1P	Yes			
A	Verification	QL-A	—	±50 mm	±50 mm	Horizontal and vertical location of the top, bottom or centreline of the utility (to be indicated on drawings).

^{A)} Horizontal location is to the centreline of the utility.

^{B)} Vertical location is to the top of the utility. Depths determined to the centre of the utility should be indicated as such by exception.

^{C)} For detection, it is a requirement that a minimum of GPR and EML techniques are used (see 9.2.1.2).

^{D)} Electronic location readings from EML equipment should be obtained by using the signal generator and receiver together. Locations obtained by the EML receiver alone and not confirmed by GPR shall be categorized as a B3.

^{E)} If only detected by one technique, the practitioner should be prepared to make available to the client clear evidence for the accuracy achieved to be classified as a QL-B1 or QL-B1P.

7 Desktop utility records search (survey type D)

7.1 General

7.1.1 Survey type D shall use desktop search techniques to identify existing utility data within the survey area.

7.1.2 The quality level achieved shall be documented as QL-D in accordance with Table 1.

7.2 Methodology

7.2.1 A desktop utility records search shall be produced by the following process:

- a) identify known utility owners within the specified survey area;
- b) request asset information from identified utility owners; and
- c) collate all data on utility owners and their assets.

NOTE 1 *The identification of utility owners and the request for asset information should be extended to land adjacent to the survey area, as this might offer an informative understanding of where utility feeds derive.*

NOTE 2 *When a project takes place on a private site, such as a hospital, industrial or military establishment, a utility owner might not have statutory records covering the survey area. Historical utility data should be obtained from the relevant estate's department, where available.*

NOTE 3 *A practitioner should allow adequate time within their schedule of work to receive the responses from utility owners. A 20-day period is recommended where not specified in regional legislation.*

NOTE 4 *Sources of information can include, for example, internet-based enquiry sites.*

NOTE 5 *The practitioner should consider asking the utility owner whether RFIDs have been used within the survey area.*

NOTE 6 *Subject to the relevant asset owners' terms and conditions regarding the use of the data provided, desktop utility records search deliverable can be provided as a compilation and consolidation of all record data into a digital representation within a CAD/GIS/BIM model file structured to the client's requirements. If a digital representation of the utility records is provided it should contain all information relevant to the utilities present. If the asset owner's terms and conditions restrict what can be reproduced, then this restriction should be reflected in the drawing notes or model data.*

7.2.2 Unless otherwise specified by the client, the information gathered shall include as a minimum:

- a) company details of the practitioner carrying out survey type D;
- b) client details;
- c) a plan showing the boundary for the requested survey area;
- d) a list of utility owners to whom a request was sent;
- e) a list showing utility owner responses and actions taken to obtain a response from non-responders;
- f) any information received from the utility owner by way of plans, maps, diagrams or text and covering letter, along with any asset guidance notes;
- g) the date of issue of any maps supplied by the utility owners and the period of validity if stated; and
- h) an advisory/cautionary note in **BOLD** explaining how this information was constructed, its limitations regarding accuracy and that no on-site survey/geophysical detecting techniques have been used.

NOTE 1 *Any desktop information should be treated as historical as the buried assets present might have changed since the drawing was last updated. Where a period of validity is stated, this should be respected and new plans obtained. Every effort should be made to acquire the most up to date plans available. Attention is drawn to the New Roads and Street Works Act 1991 (NRSWA) [3]. NRSWA has been amended in Scotland by the Transport (Scotland) Act 2019 [5].*

NOTE 2 *Where data have been supplied in imperial measurements this should be noted. Utility diameters given in imperial measurements should not be converted to metric as fittings are different.*

NOTE 3 *Any useful information contained in the utility records should be represented on a compilation plan, as it indicates to the end users the type of utility assets that are in the area and allows appropriate planning to be made to deal with the constraint.*

8 Site reconnaissance (survey type C)

8.1 General

8.1.1 Survey type C shall comprise a visual inspection of all accessible parts of the site to identify physical features that support the existence of utilities within the survey area.

***NOTE** Site reconnaissance may extend beyond the survey area of interest as necessary to identify indications of services which might impinge on the survey area.*

8.1.2 Where the utility records can be matched to surface features, the quality level achieved shall be documented as QL-C in accordance with Table 1.

***NOTE** Where only one surface feature is identified relating to a specific utility, then the QL-C given for that segment comprises a point on the utility. Where two or more surface features reference a specific utility, then the QL-C given for that segment comprises a length on the utility.*

8.1.3 Where the utility records cannot be matched to surface features, the quality level achieved shall be documented as QL-D in accordance with Table 1.

8.2 Methodology

8.2.1 Site reconnaissance shall comprise on-site visual inspection to validate the utility records and to assess if there are any conflicts that need to be resolved.

***NOTE** The utility records might be records and drawings provided by utility owners obtained via a type D survey or might comprise historic drawings, records and digital data from other sources.*

8.2.2 On-site visual inspection shall document:

- a) the presence, type and markings of utility-related surface features (see **8.2.3**);
- b) measurements between known surface features on the ground compared with those depicted on the plan; and
- c) differences between the map/drawing or digital features supplied and those extant on the ground.

***NOTE** Documentation of on-site checks may include, but are not limited to, the mark-up and annotation of existing plans, the inclusion of supporting photographic evidence and/or a written report.*

8.2.3 Surface features to be included in the on-site checks shall include as a minimum:

- a) manhole and inspection chamber covers;
- b) valve covers;
- c) utility markers;
- d) control and distribution pillars and columns, LV power, street lighting, traffic lights; and
- e) historic excavation scar lines.

***NOTE** Where it is not safe to walk the site (such as live motorways), mobile surface imaging solutions can be deployed as an alternative form of visual inspection.*

8.2.4 The following shall be recorded as a minimum as evidence of work carried out, and provided in report format (see **12.1**):

- a) site name and location;
- b) time and date of the site visit(s);
- c) weather conditions;
- d) the names, qualifications and experience of the survey practitioner(s);
- e) type of measurement methods used on site, including the model, serial number and calibration information where appropriate (e.g. total station, mobile mapping tools);
- f) photographs of the site and features present (e.g. trench scars, meter boxes, utility cabinets);
- g) a plan showing the position of photograph locations and the direction of shot;
- h) notes on site limitations or inaccessible areas (e.g. overgrown, immovable obstructions, cars parked);
- i) a register of all utility records available for consultation at the time of the survey;
- j) a polygon representing the extents of the areas inspected;
- k) a digital drawing showing the statutory record information repositioned according to the site features observed during the survey;

- l) additional information that might be collected where required for surveys such as decommissioning surveys, etc.:
- 1) meter, e.g. gas, electric, water;
 - 2) type of meter, e.g. U6, U25, rotary, etc. (gas); direct or CT (electric); 25 mm, 3", etc. (water);
 - 3) size of incoming supply, e.g. 1", 3" 150 mm etc. (gas and water);
 - 4) size of fuse, e.g. 100 amp, 200 amp etc. (electric);
 - 5) meter numbers, e.g. any serial numbers, meter readings, ownership of meter (if labelled);
 - 6) location of meters to be marked on a plan;
 - 7) notes to plan/report about inaccessible areas;
 - 8) any incoming copper or fibre telecoms lines;
 - 9) labels;
 - 10) gas cylinder, oil tanks or other fuels;
 - 11) historic features to be noted but not responsible for mapping; and
 - 12) boundary markers.

8.2.5 Any linear feature indicative of an underground utility identified whilst on site (e.g. trench scar) shall be either followed to a node where the identity of the utility can be established or, where this is not practicable, labelled as "unknown utility" in accordance with **12.4** and presented on the digital drawing (for more information, see PAS 256).

8.2.6 Other features that appear utility related but that cannot be identified shall be photographed and presented in the report.