

STANDARDS OF PRACTICE  
FOR  
PROFESSIONAL LAND SURVEYORS  
IN THE  
COMMONWEALTH OF PENNSYLVANIA



- November 19, 2021 -



# **STANDARDS OF PRACTICE FOR PROFESSIONAL LAND SURVEYORS IN THE COMMONWEALTH OF PENNSYLVANIA**

## **Pennsylvania Society of Land Surveyors**

**(November 19, 2021)**

These Standards of Practice were produced through the voluntary efforts of the PSLS Standards of Practice Committee, PSLS Chapter affiliates, PSLS members and other surveying professionals throughout the Commonwealth of Pennsylvania. The document will be reviewed and revised, if necessary, on a regular basis in order to evolve contemporaneously with advances in technology. Comments concerning the Standards of Practice should be forwarded to the below address.

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Standards are not intended to be used in place of professional judgment, professional practice or to usurp the requirements for a Land Surveyor to the exercise of responsible charge demonstrating competence in each branch of surveying. It must be understood that there will be circumstances and conditions that make it impossible to comply with some provisions of a standard. If the Professional Land Surveyor deviates from the standard or guideline, this deviation should be noted and described along with the reasoning for the deviation.

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## SECTION A

### INTRODUCTION TO THE STANDARDS OF PRACTICE

Licensing and Registration of Land Surveyors are the subject of the Engineer, Land Surveyor and Geologist Registration Law (Act of 1945, P.L. 913, No. 367, as amended) as well as the administrative Regulations published by the State Registration Board for Professional Engineers, Land Surveyors and Geologists, 49 Pa. Code §§37.1 – 37.111. Refer to this law, regulations, and subsequent amendments for existing statutory and regulatory requirements related to the practice of professional land surveying in the Commonwealth of Pennsylvania.

Standards are not intended to be used in place of professional judgment. It must be understood that there will be circumstances and conditions that make it implausible, impossible, or unreasonable to comply with some provisions of a standard. If the professional surveyor deviates from the standard or guideline, this deviation should be noted, described, and justified.

The professional land surveyor must practice with the standard of care and expertise expected of other land surveyors, with consideration for the health, safety and welfare of the public. “Professional standard of care” is defined as the expectation to exercise the care and skill ordinarily used by other professional land surveyors practicing under similar circumstances, at the same time, and in the same or similar locality. The standard of care is judged at the time the professional services are rendered and not according to later standards. It is a reasonable expectation that professionals who are committed to continuous professional development will, over time, raise the standard of care for all professional land surveyors.

Finally, these Standards are not intended to replace other applicable requirements as specified by the Commonwealth of Pennsylvania Registration Law, ALTA/NSPS Land Title Survey Standards, Pennsylvania Department of Transportation Survey & Mapping Manual, the PA DEP Bureau of Mining Programs Mine Mapping Standards, or other agencies or authorities having jurisdiction which may have additional and/or more detailed requirements applicable to a project. Where conflicts between the standards set forth herein and any such agency or authority having jurisdiction over a project occur, the statutory, regulatory, or contractual provision should apply. However, to indicate that the survey meets these Standards of Practice, the more stringent requirements must apply.

At the time of this revision to the “Manual of Practice for Professional Land Surveyors in the Commonwealth of Pennsylvania” (last revised July 10, 1998), 44 of 50 States have legislated Minimum Survey Standards. This revision is mindful of potential use of the Manual as a basis for statutory Minimum Standards, should they be adopted legislatively in the future. Notably, the title is revised from “Manual of Practice ...” to “Standards of Practice ...” to reflect that these are guidelines for use by a Professional Land Surveyor in their practice.

## **SECTION B**

### **SCOPE OF THE STANDARDS OF PRACTICE**

#### **1. SCOPE OF THE STANDARDS OF PRACTICE**

- a. The focus of the Standards of Practice is the way in which most surveyors practice the profession in common circumstances, with consideration for the health, safety and welfare of the public.
- b. Therefore, the guidelines presented in the Standards of Practice are valid for all licensed land surveyors in the Commonwealth of Pennsylvania, not just for members of the Pennsylvania Society of Land Surveyors. Land surveyors that are not members of the Society may not consider themselves subject to such guidelines, but they practice the profession no differently than members. By the same token, members cannot be held subject to different guidelines by virtue of membership.
- c. While the Engineer, Land Surveyor and Geologist Registration Law does specify certain professional activities that are exclusive to licensed Professional Land Surveyors, the Standards of Practice also includes activities which are not legally exclusive. Writing boundary descriptions, topographic or engineering surveys, and construction staking are such activities. While other professionals, attorneys, contractors, or laypersons are not obligated to subscribe to the requirements of this Standards of Practice (if they are legally permitted to perform the activities), it is worthy to state that professional land surveyors are the rightful persons to provide those services defined within the Standards of Practice, due to their unique knowledge gained by education and experience in their professional practice.
- d. The Pennsylvania Society of Land Surveyors does not have legal authority to impose or power to enforce these guidelines. Adherence to them is strictly voluntary. But, in the best interest of the profession, it has assumed the responsibility to urge all practitioners, members and non-members alike, to excellence in their practice.

#### **2. RULES GOVERNING THE PRACTICE**

- a. The guidelines presented in the Standards of Practice are best described as rules of reason. They are rules which any reasonable professional land surveyor would follow of his own initiative or can reasonably be expected to follow once they are made known.
- b. These rules can be distinguished from rules of law according to their source, and from rules of construction according to their purpose. The rules of law are taken from statutes, regulations, and judicial rulings, whereas the rules presented herein are derived from the well-considered application of the knowledge and skills of the profession. The rules of construction govern the correct retracement of

boundary lines, whereas the rules presented herein govern the orderly performance of the Professional Land Surveyor's services.

- c. The rules presented in the Standards of Practice are of two distinctions. Some are obligatory, others only discretionary. The obligatory are stated in imperative terms, namely, "shall" or "must"; the discretionary only in normative terms, "should" or "may". Deviation from the obligatory is unprofessional, while deviation from the discretionary may only be imprudent.

### 3. USE OF THE STANDARDS OF PRACTICE

- a. The Standards of Practice serves as a reference for determining compliance or non-compliance with professional requirements in various phases of the practice and for various types of survey.
- b. The Standards of Practice currently lack the legal authority to be a basis for disciplinary action, or for criminal or civil prosecution. The focus of these Standards of Practice is to assist practitioners with elevating the practice of Land Surveying and not focus on punitive or disciplinary measures. Any claim or complaint against a practitioner must be examined considering the practitioner's contractual agreement with the client, and not solely by reference to the rules stated in the Standards of Practice.

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## SECTION C

### DEFINITIONS

The following definitions are ascribed to key words in this Standards of Practice. Definitions identified as (per the Act) are defined by the Engineer, Land Surveyor and Geologist Registration Law Act of May 23, 1945, P.L. 913, No. 367, Cl. 63, (as amended) and any subsequent amendments supplant the text contained in this Standards of Practice.

Accuracy – Degree of conformity with a standard or accepted value. Accuracy relates to the quality of a result and is distinguished from precision which relates to the quality of the operation by which the result is obtained. (also see precision)

ALTA/NSPS Land Title Surveys – These are surveys that meet the minimum standard detail requirements for ALTA/NSPS Land Title Surveys.

Bathymetric Surveys - Measures and maps the depth of the bottom lands and contours below the surface of the water.

Benchmark - is a relatively permanent material object, natural or artificial, bearing a marked point whose elevation above or below an adopted datum is known.

Boundary - A legal line of demarcation between real property title, or rights, and capable of being located on, above, or below the surface of the Earth.

Boundary Description – Commonly referred to as a “legal description”, a boundary description is the written description of real estate that identifies its precise location, boundaries and any easements or restrictions for the purpose of a legal transaction, such as a transfer of ownership.

Boundary Surveys (Also known as Plan of Survey, Title Survey, Conveyance Survey, Plat of Survey, Metes and Bounds Survey, Retracement Survey) - The primary purpose of these surveys is to establish or retrace the boundaries of a parcel of land, to show the existing permanent features upon or along the boundaries of the parcel of land and to show the relationship between the two. These surveys are used as part of the legal conveyance of real property, certificates of occupancy and other purposes in which a map showing the relevance of existing features to the boundary of a parcel is usually required.

Certification - A statement that attests that a product of a professional service meets specified requirements or standards.

Contour - an imaginary line on the ground, all points of which are of the same elevation above or below a specified datum.

Easement Surveys - Define and identify the easement location pertaining to a parcel of land and the property features associated with those easement locations as noted in title documents and/or as observed by the land surveyor in the field.

Engineering Land Surveys – (per the Act) means surveys for:

1. the development of any tract of land including the incidental design of related improvements, such as line and grade extension of roads, sewers and grading but not requiring independent engineering judgment: Provided, however, that tract perimeter surveys shall be the function of the professional land surveyor;
2. the determination of the configuration or contour of the Earth's surface, or the position of fixed objects thereon or related thereto by means of measuring lines and angles and applying the principles of mathematics, photogrammetry or other measurement methods;
3. geodetic survey, underground survey and hydrographic survey;
4. storm water management surveys and sedimentation and erosion control surveys;
5. the determination of the quantities of materials;
6. tests for water percolation in soils; and
7. the preparation of plans and specifications and estimates of proposed work and attendant costs as described in this subsection. 63 P.S. § 149(j).

Evidence - In regard to Professional Land Surveyors and surveying services, evidence is a term used to describe information, observations, or objects that aid the surveyor in determining the position of a boundary.

Hydrographic Surveys - Measures and maps data relating to bodies of water, such as depth of water and configuration of the bottom; directions and force of currents; heights and times of tides and water stages; and location of fixed objects for charting and navigation purposes. The term may also be applied to the survey of drainage areas and proposed locations of reservoirs for the storage of water.

Mining Surveys - Measure, calculate and map existing features and contours of a mine for the purpose of ascertaining and documenting information at all stages from prospecting to exploitation and utilizing mineral deposits both by surface and underground work.

Monument - an identifiable object or marker which physically identifies the location of a property corner or other survey point. A monument can be manufactured (e.g. iron pipe, rod, fence post) or natural (e.g. stone or tree).

Plan of Survey - a drawing prepared at an appropriate scale to show the results of the findings and conclusions of a survey.

Plat of Survey - a Plan of Survey recorded for public use.

Positional Tolerance - the maximum acceptable amount of positional uncertainty for any physical point on a survey relative to any other physical point on the survey.

Positional Uncertainty - the uncertainty in location due to random errors in measurement of any physical point on a survey based on the 95 percent confidence level.

Practice of Land Surveying - (per the Act) "the practice of that branch of the profession of engineering which involves the location, relocation, establishment, reestablishment or retracement of any property line or boundary of any parcel of land or any road right-of-way, easement or alignment; the use of principles of land surveying, determination of the position of any monument or reference point which marks a property line boundary, or corner setting, resetting or replacing any such monument or individual point including the writing of deed descriptions; procuring or offering to procure land surveying work for himself or others; managing or conducting as managers, proprietors or agent any place of business from which

land surveying work is solicited, performed, or practiced; the performance of the foregoing acts and services being prohibited to persons who are not granted certificates of registration under this act as a Professional Land Surveyor unless exempt under other provisions of this act.” 63 P.S. § 149(d).

Practitioner - Any person performing professional services, primarily one that is licensed, but also anyone else acting consistently with the law (under the responsible charge and direct supervision of a licensed professional land surveyor).

Precision – <sup>1</sup>The degree of refinement in the performance of all operation, or the degree of perfection in the instruments and methods used when making the measurements. <sup>2</sup>A measure of the uniformity or reproducibility of the result. Precision relates to the quality of the operation by which a result is obtained and is distinguished from accuracy which relates to the quality of the result. (also see accuracy)

Professional Land Surveyor - (per the Act) “an individual licensed and registered under the laws of this Commonwealth to engage in the practice of land surveying. A Professional Land Surveyor may perform engineering land surveys but may not practice any other branch of engineering.” 63 P.S. § 149(f).

Remote Sensing Surveys - Remote sensing is the process of indirect measurement to identify the physical characteristics of an area by measuring its reflected and emitted radiation at a distance using various modes (e.g. stationary/terrestrial, aircraft, unmanned aircraft vehicle (UAV) aka “drone”, vehicle/mobile), including but not limited to:

1. Photogrammetric: Obtain spatial information from photographic images and process/analyze aerial or terrestrial photographs to obtain information about physical objects and the environment and create topographic mapping.
2. LiDAR: LiDAR (Light Detection and Ranging), is a remote sensing method that uses light in the form of a pulsed laser to measure ranges (variable distances) to the Earth. These light pulses combined with other data recorded by the airborne system generate three-dimensional information about the shape of the Earth and its surface characteristics.

Record - Writing that provides evidence of an action and of its intent, usually recorded with a legally designated official and available to the public.

Reference monument – a monument which is offset from the position of a survey marker, monument, boundary point, or line, which is used for the purpose of identifying the actual position of the survey marker, boundary point, or point on line through the use of distance measurements or angular measurements, or both.

Relative Positional Precision - the length of the semi-major axis, expressed in meters or feet, of the error ellipse representing the uncertainty in the position of the monument or witness marking any boundary corner of the surveyed property relative to the position of the monument or witness marking an immediately adjacent boundary corner of the surveyed property resulting from random errors in the measurements made in determining those positions at the 95 percent confidence level.

Report - A narrative compilation and analysis of facts and circumstances concerning a survey. Sometimes, including a certification of the survey.

Research - The search for evidence, both public and private.

Rights-of-Way (R.O.W.) and Route Surveys - Surveys performed for the acquisition and/or definition of rights of way or easements associated with real property.

Standard - A model, example, or rule established by statute or by customary use or general consent, differentiated into imperative (will, shall, or must) and discretionary/optional (should or may).

Subdivision, Consolidation, and Re-subdivision Surveys – The survey for the purpose of preparing a Subdivision, which is the division, consolidation, or re-division of a lot, tract or parcel of land by any means into lots, tracts, parcels or other divisions of land including changes in existing lot lines for the purpose, whether immediate or future, of lease, partition by the court for distribution to heirs or devisees, transfer of ownership, or building or lot development.

Survey - The aggregate of services which make use of the principles of surveying for the location of points and/or lines on, above or below, the surface of the Earth, both land and sea.

Survey Limit - the area designated by the client to be included as part of a scope of work.

Topographic Surveys - A Topographic Survey identifies and maps the elevations and contours on, above, and below the Earth's surface and the existing natural and manmade features above, on or below that surface. Topographic surveys are generally utilized for land planning and quantitative purposes.

Utilities - services provided by governmental and private entities that provide the following: electric power, telephone, water, sanitary and storm sewer, gas, etc. Witness marker – a physical object, stake, or mark which identifies the location of a monument or other surveyed point for the use of recovery or identification (e.g. wood lath w/ ribbon).

Witness monument – a monument which is offset from the position of a survey marker, monument, boundary point, or line, which is used for the purpose of identifying the actual position of the survey marker, boundary point, or point on line.

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## SECTION D

### GENERAL PRACTICE GUIDELINES FOR PROFESSIONAL LAND SURVEYING SERVICES

#### 1. INTRODUCTION

General practice guidelines for Professional Land Surveying services includes the following items for consideration.

#### 2. RECORD KEEPING

Record of survey documents, plans, field measurements, calculations, and other instruments of service, should be stored safely and in durable form, either physical or electronic format. The instruments of service should be stored in accordance with a company's written document retention policy and may be stored for a duration of time appropriate to fulfill statute of repose limits in the Commonwealth of Pennsylvania (see 42 PA. C.S. § 5537).

#### 3. PROFESSIONAL PRACTICE / ETHICS / MISCONDUCT

Professional land surveyors are obligated to perform their duties in compliance with Section 4.(g), 63 P.S. § 151(g), "A Code of Ethics for Engineers, Land Surveyors, and Geologist" in the Engineer, Land Surveyor and Geologist Registration Law Act of May 23, 1945, P.L. 913, No. 367, Cl. 63, (as amended). The State Registration Board has also outlined specific instances of misconduct by a professional land surveyor in its regulations. *See* 49 Pa. Code § 37.81.

#### 4. AGREEMENTS

A clear and specific written engagement or agreement with a client is a precondition of rendering professional services satisfactorily. The written engagement or agreement should set forth the scope of services to be performed, the fee and terms of service.

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## **SECTION E**

### **PSLS SURVEY STANDARDS FOR BOUNDARY SURVEYS**

#### **1. INTRODUCTION**

Standards are not intended to be used in place of professional judgment. It must be understood that there will be circumstances and conditions that make it impossible to comply with some provisions of a standard. If the professional land surveyor deviates from the standard or guideline, this deviation should be noted, described, and justified by the surveyor.

#### **2. RESEARCH / WRITTEN EVIDENCE**

The search for written evidence is required in the performance of a boundary survey. Any relevant information (e.g., title report, prior surveys, etc.) in the possession of the client should be sought by the surveyor.

- a. The search of public records must include as a minimum, the current deed of the subject property and adjoining properties.
- b. The search of public records should be extended to pertinent information recorded in the Office of the Recorder of Deeds, filed in other county offices, or kept in state or municipal offices (e.g. Plans of Subdivision, Highway Plans, Valuation Maps, Easements, Vacations).
- c. The search of private records should include privately held information referenced in obtained public records, seeking the client's assistance as necessary.

#### **3. IDENTIFICATION / PHYSICAL EVIDENCE**

The identification of physical evidence is required in the performance of a boundary survey.

- a. The surveyor must note the location and the condition of monuments or features referenced in written evidence,
- b. The surveyor must note location and the condition of monuments and features found but not called for in the public record,
- c. The surveyor should note apparent evidence of occupation or possession lines,
- d. The surveyor should report any extrinsic evidence that may impact on the location of a boundary or their opinion on a boundary location.

#### **4. MEASUREMENTS**

Land surveying consists largely of determining measurements related to land, and existing or proposed features. The reliability of the measurements depends on the equipment and techniques employed in performing the measurements.

The surveyor in conducting a boundary survey must conduct field measurements to correlate found evidence. In addition, the surveyor:

- a. should use appropriate field equipment that is maintained and calibrated according to the manufacturer's recommendations,
- b. must employ appropriate measuring techniques;
  - i. sufficient redundant measurements must be made to prevent and detect blunders, errors, omissions, and oversights;
  - ii. confirming instrument observations and/or repeat measurements must be made to minimize systematic errors;
  - iii. apply proper corrections for the equipment in use and measurement conditions.
- c. must complete adequate data reduction and/or measurement adjustments,
  - i. data reduction must be appropriate for the equipment and measurement techniques used;
  - ii. necessary data adjustments to minimize random errors, and resolution of measurement inaccuracies must be performed.
- d. must comply with the Minimum Measurement Standards
  - i. make all measurements to a precision compatible with the size and geometric shape of the parcel, and consistent with the precision desired for the class of property being surveyed (precision and class of property are defined in Section D of these standards);
  - ii. utilize equipment and methods capable of attaining required precision appropriate to the project.

## 5. BOUNDARY ANALYSIS

The Surveyor in conducting a boundary survey must:

- a. compare and analyze record and physical data gathered and reach a professional opinion as to the most probable location of the property boundaries;
- b. based upon boundary law and rules of construction, use professional judgement regarding the evaluation of observed evidence and record data;
- c. consult authoritative references, such as "Boundary Retracement Principals and Procedures for Pennsylvania" (Knud E. Hermansen), for appropriate methods and approaches when necessary.

## 6. IDENTIFICATION AND RESOLUTION OF CONFLICTS

Professional land surveyors are said to have a quasi-judicial function. While surveyors do not have power to adjudicate boundary disputes, they must exercise sound judgment, in accordance with the law, in resolving boundary differences. Professional land surveyors do not determine ownership but do determine the locations of boundary lines.

- a. Questionable Boundaries
  - i. Every reasonable effort should be made by a land surveyor to determine:
    1. the degree of conformity of the record evidence of adjoining property boundaries, and;

2. the quantitative, i.e. measured, differences between record boundaries and apparent occupation lines or lines of possession.
- ii. Upon discovery of any irreconcilable difference(s), the surveyor should:
  1. communicate the existence and the extent of the circumstance to the client;
  2. identify the nature of the issue, describe the difference in numbers, and if possible, provide an explanation for the difference;
  3. relate to the client, to the extent it can be anticipated, any possible effect on the use and ownership of the property;
  4. apprise the client of foreseeable options and mention the advisability of legal counsel;
  5. place explanatory notes and appropriate disclaimers on the survey plan; and
  6. conclude the fieldwork and set monuments when appropriate.
- b. Disputed Boundaries
  - i. When a surveyor is called upon after a dispute has arisen, the surveyor should:
    1. determine the stage to which the dispute has progressed, most notably whether legal counsel has been retained, litigation has been initiated, or the case has already been heard or decided;
    2. attempt to determine the necessary scope of the surveying services, or the effective contribution of a survey, to the resolution of the dispute and;
    3. decide about
      - a. their availability
      - b. their ability to serve as an expert witness; and
      - c. the propriety of his/her involvement in the dispute.
  - ii. When the surveyor has been retained in connection with a boundary dispute, the surveyor may:
    1. if litigation has not yet commenced, suggest alternate dispute resolution, such as an amicable agreement, mediation or arbitration; or
    2. if litigation has commenced, coordinate their efforts with the attorney for the client and prepare to serve as an expert witness for the client.

## 7. MONUMENTATION

Setting boundary corners is one of the undeniable obligations of a professional land surveyor, by statute, to protect the welfare of the public and is fundamental to the practice of land surveying.

### a. Monument Descriptions:

All monuments must be thoroughly described and specifically identified as set or found, whenever shown on maps or referred to in documents prepared by the

Surveyor. Descriptions of monuments must be sufficient in detail to facilitate future recovery by other surveyors and to enable positive identification.

b. Setting Monuments:

i. Boundary corner monuments must:

1. whenever possible, be composed of or include ferrous or other material detectable by an electromagnetic locator, (where a ferrous monument is not practical, a mark should be permanent in nature, i.e. cross in stone/concrete, drill-hole, brass monument in concrete);
2. be of sufficient length and width to provide substantial stability to retain the established position as set, and to minimize the likelihood of disturbance; and
3. be of a composition, length and width determined either tacitly by common practice in a given area, noted in writing by ordinances or other specifications, and be appropriate to the circumstances.

ii. Boundary corner monuments must be set:

1. at boundary corners and angle points not already witnessed by an existing monument, adequate to provide an accurate retracement of the boundary survey;
2. as determined necessary by the Professional Land Surveyor, this may also include bends, points of curvature or tangent, along road centerlines, or intersection of road right-of-ways;
3. set on an offset in locations where the true location is impractical (reference monument). The offset must be noted on the plan of survey and written on any witness marker.

iii. The professional surveyor should, if conditions warrant, act accordingly to his or her professional judgement to determine whether to replace and set a new monument in order to perpetuate the original corner monument location if said original monument has been deemed compromised (See also Section E.7.b.ii.1).

iv. Safety must be considered in setting boundary monuments.

c. Existing boundary monuments must;

- i. not be removed, reset, or disturbed in any way;
- ii. be field located in their current location; and
- iii. be shown upon the plan of survey, including when their location is determined to not represent the boundary corner location.
- iv. be dimensioned relative to the boundary corner on the plan when determined to be in an incorrect position in relation to the boundary corner.

d. Identification

- i. Boundary corner monuments found or set should be made conspicuous to anyone that has reason to look for them, and identified as boundary monuments.

- ii. At the time a boundary corner monument is set, it should include the following identification:
  - 1. A metal or plastic cap with the surveyor's name and licensenumber or company's name.
  - 2. A witness marker with written identification as to purpose.
- e. Existing Structures as Monumentation
  - i. Boundary monumentation by location of permanent structures (buildings) with perpendicular reference ties shown to the perimeter boundary lines can be a long term effective secondary boundary monument system. Primary boundary monuments are the preferred property monumentation of corners. The use of the existing structures as monumentation does not reduce the requirement to set perimeter boundary corners.
  - ii. When a structure is within a reasonable proximity of the outside perimeter boundary of the subject property, perpendicular reference ties between the structure and the property boundary should be shown.

## 8. PLAN OF SURVEY AND CERTIFICATION

A boundary survey should include a plan, showing the results of the survey. If a plan is prepared, it must bear the seal and signature of the surveyor in accordance with regulatory requirements of the Commonwealth and may be accompanied by a written boundary description. It can be amplified by a written report and a certification.

The specifications of a plan of survey are as follows:

- a. the plan of survey depicts the results of the survey in a manner that can be
  - i. viewed comprehensively;
  - ii. reproduced in a reasonable quantity; and
  - iii. stored for future reference in possession of the surveyor.
- b. The plan of survey must:
  - i. be drawn at a legible and standard scale;
  - ii. be of an appropriate size (no less than 8-1/2" x 11"); and
  - iii. satisfy the needs of the client as defined in the contract for services.
- c. The plan of survey must identify (usually in a title block)
  - i. the type of survey (specific to the intended use);
  - ii. the ownership and address of the property;
  - iii. the municipality and county in which it is located;
  - iv. the date and scale of the plan;
  - v. name, registration number, address, phone number, and email address of the Professional Land Surveyor responsible for the plan;
  - vi. name and address of the firm of the Professional Land Surveyor, if not a sole proprietor.
- d. The plan of survey must contain:
  - i. a North arrow and its origin reference;

- ii. geodetic datum / coordinate system, with scale factor and origin, if applicable;
  - iii. vertical datum with GEOID, if applicable;
  - iv. an accurate representation of the boundary;
  - v. the geometry of the lines (bearings/angles, distances, and sufficient curve information to provide a geometrically closed figure);
  - vi. the corner monuments / monuments identified per Section 7 above (found/set) and any points of reference;
  - vii. the names of record adjoiners and other property identifications (e.g. deed information, tax parcel numbers);
  - viii. evidence of potential encroachments;
  - ix. any differences between record and apparent occupation or possession lines.
- e. The plan of survey should, if appropriate, contain
- i. significant planimetric features;
  - ii. the location of permanent building structures with perpendicular reference ties between the structure and the property boundary, including the following information:
    1. Distance shown to a precision relative to the class of the survey;
    2. Reference ties should be shown perpendicular to the outside boundary line when possible;
    3. Note on plan if the dimension shown is by actual field observation or by calculation from the locations of the point;
    4. When necessary for clarity, note the material the measurement was taken from (brick, foundation, concrete, siding, wood, etc);
  - iii. encumbrances (potential encroachments and disclosed easements);
  - iv. disclosed restrictions (zoning and deed);
  - v. any dependence on or disagreement with a prior survey, as well as any acknowledgment or disclaimer;
  - vi. notation indicating “this plan of survey conforms to the Standards of Practice for Professional Land Surveyors in the Commonwealth of Pennsylvania, Section E” (may be included in certification as appropriate).
- f. Written Certification
- i. When agreed to by both the client and the surveyor, the surveyor must provide a signed written statement on the plan.

## 9. CLASSIFICATION AND MEASUREMENT STANDARDS

The various classifications of property surveys and the measurement standards of these classes are described in Section F of these standards.

Other standards may be required by contract, agency, or municipality. If conflict in standards arise, the more stringent must be followed.

## 10. BOUNDARY DESCRIPTIONS OF PROPERTY

Since Metes and Bounds or Boundary Descriptions (aka Legal Descriptions) describe property boundaries, the survey of which is limited to the practice of land surveying by statute, composing such descriptions should be exclusive to licensed professional land surveyors. While other professionals, attorneys, or laypersons are not obligated to subscribe to the requirements of this Standard, it is worthy to state that professional land surveyors are the most qualified persons to write such descriptions, due to their unique knowledge gained by education and experience in their professional practice.

- a. A new written description of the property must correlate the record description of the property with survey adjustments or observations noted during the course of the survey. The written description must also conform to the graphic depiction of the property on the survey plan or plat.
- b. Unless referencing a recorded plan or plat that contains sufficient geometric information, the description must be written in the common form of a metes-and-bounds description, and must include:
  - i. an identification and location of the property;
  - ii. if applicable, reference to the subdivision by which it was created, or other source of the origin of the property description (record deed or title reference);
  - iii. a description of all individual property lines in sequence, preferably clockwise, along with the identification of the corner monuments (found and set) and calling for adjoining properties;
  - iv. the computed area of the property; and
  - v. sufficient information to be able to be closed geometrically within the same precisions as required by the corresponding survey. Exception parcels to the property boundary must not be described by merely a reference to a deed, but must also be described by metes-and-bounds to produce a geometrically closed boundary.
- c. A new legal description written in metes-and-bounds, should include the source or origin of north commonly referred to as the "basis of bearings" shall be recited in the legal description., e.g. True north from astronomical observation, geodetic north, PA Grid North (North Zone), Magnetic North (2021), deed north per Warren County deed book 100, page 100: (Johnson to Smith, east line N 0° 1' E),
- d. If appearing in a document separate from a plan or plat of survey, the written boundary description will include the Surveyor's name, registration number and professional seal, with a reference to the source documents used in the preparation of the description (e.g. surveys, recorded subdivisions, and other documents).

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## SECTION F

### PSLS CLASSIFICATION AND MEASUREMENT STANDARDS FOR BOUNDARY SURVEYS

#### 1. MEASUREMENT STANDARDS

The following measurement standards address Relative Positional Precision, or required measurement precision, for the monuments or witnesses marking the corners of the surveyed property.

#### 2. RELATIVE POSITIONAL PRECISION

Relative Positional Precision can be estimated by the results of a correctly weighted least squares adjustment of the survey.

Alternatively, Relative Positional Precision can be estimated by the standard deviation of the distance between the monument or witness marking any boundary corner of the surveyed property and the monument or witness marking an immediately adjacent boundary corner of the surveyed property (called local accuracy) that can be computed using the full covariance matrix of the coordinate inverse between any given pair of points, understanding that Relative Positional Precision is based on the 95 percent confidence level, or approximately 2 standard deviations.

Under circumstances where a survey may be performed using conventional survey methods (e.g. survey traverse), “traditional” measurement standards are also defined herein. However, please note that ALTA/NSPS Land Title Survey requirements have replaced these measurement standards with Relative Positional Precision standards.

#### 3. ASSESSING UNCERTAINTY

Any boundary lines and corners established or retraced may have uncertainties in location resulting from:

- a. the availability, condition, history and integrity of reference or controlling monuments;
- b. ambiguities in the record descriptions, plans, or plats of the surveyed property or its adjoiners;
- c. occupation or possession lines as they may differ from the written title lines, or
- d. Relative Positional Precision.

Of these four sources of uncertainty, only Relative Positional Precision is controllable, although, due to the inherent errors in any measurement, it cannot be eliminated. The magnitude of the first three uncertainties can be projected based on evidence.

Relative Positional Precision is estimated using statistical means (see Section F.2 above and Section F.6 below).

The first three of these sources of uncertainty must be weighed as part of the evidence in the determination of where, in the surveyor's opinion, the boundary lines and corners of the surveyed property should be located. Relative Positional Precision is a measure of how precisely the surveyor is able to monument and report those positions; it is not a substitute for the application of proper boundary law principles. A boundary corner or line may have a small Relative Positional Precision because the survey measurements were precise, yet still be in the wrong position (i.e., inaccurate) if it was established or retraced using faulty or improper application of boundary law principles.

#### 4. PROCEDURE

For any measurement technology or procedure used on a Boundary Survey, the surveyor must:

- a. use appropriately trained personnel;
- b. compensate for systematic errors, including those associated with instrument calibration; and
- c. use appropriate error propagation and measurement design theory (selecting the proper instruments, geometric layouts, and field and computational procedures) to control random errors such that the maximum allowable Relative Positional Precision outlined in Section F.6 below is not exceeded.

It is recognized that in certain circumstances, the size or configuration of the surveyed property, or the relief, vegetation, or improvements on the surveyed property, will result in survey measurements for which the maximum allowable Relative Positional Precision may be exceeded (as defined in Section F.6). In this case, the reason must be noted on the Plan or Plat of Survey why the applicable precision is not attainable, and note the attained precision reflective of the conditions.

#### 5. CLASSIFICATION OF SURVEY BY LAND USE

The degree of precision and precision necessary for a particular property survey must be based upon the intended use of the land. If the client does not include information regarding the intended use, the classification of the survey must be based upon the current use of the land.

The classifications of surveys are as follows:

- a. Urban Surveys - Urban surveys are performed on land lying within or adjoining a city or town, and include commercial and industrial properties condominiums, townhouses, apartments, and other multi-unit developments, regardless of geographic location. All ALTA/NSPS Land Title Surveys are included in this classification.
- b. Suburban Surveys - Suburban surveys are performed on land lying outside of urban areas and developed for single family residential use.
- c. Rural Surveys - Rural surveys are performed on undeveloped land lying outside of urban and suburban areas such as farms.

## 6. MEASUREMENT PRECISION

<u>Positional Method</u>		<u>Classification of Survey</u>			<u>Remarks</u>
		<u>Urban</u>	<u>Suburban</u>	<u>Rural</u>	
Relative Precision	Positional	0.07 feet (21 mm) plus 50 ppm	0.13 feet (40 mm) plus 100 ppm	0.5 feet (152.4 mm) plus 200 ppm	Precision is given at the 95 percent confidence level
<u>Conventional Method</u>					
Angular Closure		10" $\sqrt{N}$	15" $\sqrt{N}$	30" $\sqrt{N}$	N = No. of Stations
Unadjusted Closure	Linear	1:15,000	1:10,000	1:5,000	1:10,000=100PPM

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# SECTION G

## PSLS STANDARDS FOR TOPOGRAPHIC / ENGINEERING LAND SURVEYS

### 1. INTRODUCTION

This standard is written to provide the Professional Land Surveyor (Surveyor) and the client with a guideline for preparation of topographic surveys.

### 2. APPLICATION OF THE STANDARD

- a. This standard applies to topographic surveys or engineering land surveys that are intended to show the contour of the Earth's surface and/or the position of fixed objects thereon. The Surveyor in making topographic surveys uses accepted conventional, GNSS, or remote sensing surveying methods.
- b. This standard may not adequately address topographic surveys or engineering land surveys using aerial photogrammetric or aerial LiDAR methods. Refer to the American Society for Photogrammetry and Remote Sensing (ASPRS) Standards for additional guidelines related to those methods.
- c. Topographic surveys or engineering land surveys that additionally depict the location of surveyed boundary lines must also be in compliance with the current standard for boundary surveys. If property line depictions are not surveyed (e.g. from tax parcel information) the source must be explicitly identified along with a notation that the parcel lines do not constitute a boundary survey, and should not be considered as such.
- d. Engineering Land Surveys include professional services also shared with professional engineers (see Engineer, Land Surveyor and Geologist Registration Act of May 23, 1945, P.L. 913, No. 367 Cl. 63, Section 2 (j)). Such Engineering Land Survey elements not covered in these standards must meet the applicable local, state, or other agency requirements.

### 3. RESEARCH AND INVESTIGATION

The Surveyor must determine the elevation and datum of all benchmarks to be used in the survey. The elevation used must be based on a nationally accepted datum whenever practical or unless otherwise defined in the contract for services. The client must specifically describe or otherwise indicate the survey limits to be surveyed.

### 4. THE SURVEY

The topographic survey or engineering land survey must be performed to obtain the information required in this standard and additional information requested by the client. The Surveyor must select the equipment and procedures necessary to obtain the horizontal and vertical positional precision indicated by these standards or as required by agreement with the client.

## 5. PLAN PREPARATION

A topographic map or plan must be prepared of a scale and size to clearly and accurately depict the results of the survey.

## 6. DATA

The Surveyor must locate and show on the topographic survey or engineering land survey map or plan the following information:

- a. Contours lines indicating the shape and elevation of the existing ground surface, should be shown as appropriate for the intended purpose of the survey, as negotiated with the client.
- b. Location and elevation of at least two benchmarks within the limits of the survey.
- c. The location of permanent structures including retaining walls, bridges, and culverts.
- d. The location of street or road paving, entrance drive openings and sidewalks.
- e. The official street or road names and address numbers assigned to the parcel.
- f. North arrow and scale of the plan of survey.
- g. Legend depicting the symbols and abbreviations used on the plan of survey.
- h. Location of lakes, rivers, streams or drainage courses within the survey limits as specified in the contract (elevations of top and/or bottom is under optional items).
- i. Description, location and elevation of benchmarks used in the survey.
- j. Optional items required in Section G.8.

## 7. POSITIONAL TOLERANCES

The following relative positional tolerances are provided as a guide for topographic surveys or engineering land surveys.

### **Vertical Positional Tolerances in Feet**

Contour line 1' interval	± 0.5 ft
Contour line 2' interval	± 1.0 ft
Contour line 4' interval	± 2.0 ft.
Contour line 5' interval	± 2.5 ft
Contour line 10' interval	± 5.0 ft
Floor elevations	± 0.1 ft
Spot paving elevations	± 0.1 ft
Spot ground elevations	± 0.2 ft
Sewer invert elevations	± 0.1 ft
Well defined planimetric features	± 0.1 ft

Positional precision is given at the 95 percent confidence level. Additional specifications may be included on long linear projects regarding relative positional precision, as deemed appropriate by the professional land surveyor.

Horizontal tolerances are dependent on the source of the mapping information and method of measurement. For boundary-specific precisions, refer to Section F.

## 8. OPTIONAL ITEMS

The following items may be included in the requirements to be shown on a topographic survey or engineering land survey if specifically and mutually agreed upon by the client and surveyor:

- A. Boundary survey of the parcel. (Must comply with boundary survey standards)
- B. Plot the location of easements and rights-of-way as shown on the recorded subdivision plat and all easements evidenced by a recorded document provided by the client. The reference book and page, or document number of each must be shown.
- C. Vicinity map with subject property highlighted.
- D. Observable evidence of site use as a solid waste dump, sump or sanitary landfill.
- E. Observable evidence of recent earth moving work, borrow or fill.
- F. Location and the top elevation of soil borings or monitoring wells if ascertainable. (Performed by others)
- G. Cross-section of offsite drainage courses for engineering studies.
- H. Existing contours shall not be drawn, but the plan of survey shall show existing elevations in both directions over the parcel at 25-foot intervals in rough ground and 50-foot intervals on level ground and spot elevations at any abrupt changes.
- I. Elevations at the inside of walk, top of curb, and gutter at an agreed upon section interval.
- J. Spot elevations covering the entire survey limits showing high points, low points, grade changes, and at sufficient intervals to represent the general character of the terrain.
- K. Provide main floor elevations of buildings.
- L. Dimensions of curb, sidewalk, and gutter lines or ditch lines and centerline of all streets, alleys or roads adjoining the parcel. Indicate type of paving surface and condition.
- M. Location, width, and elevation of existing sidewalks. Include a description of the material and general condition (when appropriate) of the sidewalk.
- N. Location, diameter, and species of all trees over an agreed upon diameter.
- O. Perimeter outline only of thickly wooded areas unless otherwise directed.
- P. Electric utilities – the location of power poles, guy wires, anchors, vaults, etc., on the parcel or in the streets, roads, alleys, or railroad right of way adjoining the parcel.

- \_\_\_\_\_ Q. Storm, sanitary or combined sewers – the location of all observable manholes and other structures such as culverts, headwalls, catch basins and clean-outs on the parcel or in streets, roads alleys or railroad right of way adjoining the parcel. Include elevations of the top and bottom of manholes and catch basins. Show type, size, direction of flow, and invert elevation of all pipes or culverts.
- \_\_\_\_\_ R. Water – the location of any water valves, standpipes, regulators, fire hydrants, etc. that are visible on the parcel.
- \_\_\_\_\_ S. Gas – the location of all valves, meters, and gas line markers that are visible on the parcel. Show elevation on top of any valves when appropriate.
- \_\_\_\_\_ T. Telephone – the location of all poles, manholes, boxes, etc that are visible on the parcel.
- \_\_\_\_\_ U. Street lighting – the location of all lamp poles, boxes etc
- \_\_\_\_\_ V. Heating – the location of all steam manholes and vaults that are visible on the parcel.
- \_\_\_\_\_ W. Location and dimensions of any existing buildings, tanks, fences, miscellaneous structures, driveways, or other substantial features on the parcel.
- \_\_\_\_\_ X. Location and description of any building or major structure on adjoining land within an agreed distance of the parcel being surveyed
- \_\_\_\_\_ Y. Location and elevation of top and/or bottom of lakes, rivers, streams or drainage courses within the survey limits.
- \_\_\_\_\_ Z. Location of a special flood hazard area, if applicable, for the surveyed parcel.
  
- \_\_\_\_\_ AA. If there has been a field delineation of wetlands conducted by a qualified specialist, locate any delineation markers observed in the process of conducting the fieldwork and show them on the face of the survey.
- \_\_\_\_\_ AB. Location of defined geologic features as defined by other experts.
- \_\_\_\_\_ AC. Information about the utilities providing service to the parcel, including the name of the corporation and contact information as may be determined from placing a PA One-Call design ticket.

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## SECTION H

### STANDARDS REFERENCES

These Standards were developed from the following documents:

Pennsylvania Society of Land Surveyors (PSLS) Manual of Practice for Professional Land Surveyors in the Commonwealth of Pennsylvania, dated July 10, 1998 (with subsequent unpublished revisions).

National Society of Professional Surveyors (NSPS) Model Standards of Practice, Dated February 8, 2003.

Published or draft versions of Standards of Practice as available from adjoining states including Delaware, Maryland, New Jersey, New York, Ohio, and West Virginia, for use in examples for content and comparison.

In some sections the text is verbatim from the source documents, other sections are a combination of the source documents, with additions and extensive editing. It is not the intent of this committee to plagiarize or take credit for the text contained in these Standards, but only to provide what we feel is the best application for the source documents for use in the profession of land surveying in the Commonwealth of Pennsylvania – for the good of the profession and the general welfare of the public.

References noted in the PSLs Manual of Practice :

1. Professional Engineers, Land Surveyors and Geologists Registration Law of the Commonwealth of Pennsylvania, Act 367, as amended.
2. Definitions of Surveying and Associate Terms, American Congress on Surveying and Mapping (now National Society of Professional Surveyors), latest addition
3. Black's Law Dictionary, latest addition

Although not explicitly referenced in previous revisions of the PSLs Manual of Practice, a reference text widely recognized in the Commonwealth of Pennsylvania as an authoritative resource is "Boundary retracement principles and procedures for Pennsylvania: A guide for Professional Land Surveyors", by Knud E. Hermansen, P.L.S., P.E., Ph.D., Esq.

References noted in the NSPS Model Standards:

## 1. TEXTS

- Analysis and Adjustment of Survey Measurements, by Mikhail and Gracie, 1981.
- Errors in Practical Measurements in Science, Engineering and Technology, by Bro. Barry 1978.
- Adjustment Computations, by Paul R. Wolf, 1980.
- Urban Surveying and Mapping, by Blachut, Chrzanowski, Saastamoinen, 1979.
- Evidence and Procedures for Boundary Location, by Brown and Eldridge, 1967.
- Surveying Measurements and their Analysis, by R.B. Buckner, 1983.

## 2. ARTICLES

- “Positional Tolerance in Land Surveying”, by David Tyler, Journal of Survey Engineering October, 1987.
- Principles of Error Theory and Cartographic Applications: Technical Report No 96.* United States Air Force aeronautical chart and information center St Louis MO. By C.R. Greenwalt and M.E. Shultz.

## 3. STANDARDS

- Standards and Guidelines for Cadastral Surveys using Global Positioning System Methods*, US Forest Service and Bureau of Land Management. April 28, 2000.
- Standards and Specifications for Cadastral Control Surveys*, Bureau of Land Management, March 1989.
- Implementing the National Standard for Spatial Data Accuracy*, Minnesota Governor’s Council on Geographic Information, GIS Standards Committee, October 1998
- American Society for Photogrammetry and Remote Sensing (ASPRS) Specification and Standards Committee. 1990. “ASPRS Accuracy Standards for Large Scale Maps.” *Photogrammetric Engineering & Remote Sensing*. Washington, DC. V56, no7,pp 1068-1070.
- Federal Geographic Data Committee. 1998. *Geospatial Positioning Accuracy Standards; Part 3: National Standards for Spatial Data Accuracy FGDC-STD-007.3.* FGDC. Washington D.C.
- Federal Geographic Data Committee. 1998. *Content Standards for Digital Geospatial Metadata (version 2.0)* FGDC-STD-001. FGDC. Washington, DC.
- Best Practice Guidelines – Use of the Global Positioning System (GPS) for Surveying Applications* from Australia and New Zealand