

A Primer on Land Survey Part Two

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A Primer on Land Surveys – Part Two

The purpose of this material is to provide a basic understanding of what land surveying is, what land surveyors seek to accomplish when they practice their profession, and what kind of process is necessary to perform a land survey.

A fundamental knowledge of a land surveying should include these topics:

- A. Land Record Systems
- B. Survey Preparation
- C. Survey Plat Information
- D. Survey Plat Evaluation
- E. Survey Limitations

Examples of surveys will be reviewed and discussed to reinforce these concepts.

A. Land Record Systems:

Public land records were first instituted in the Plymouth and Massachusetts Bay colonies around 1640, and were a novel American undertaking. While much of our legal heritage hails from England's traditions, England had no public land records; instruments of title and conveyance were handed from owner to owner, and held by the landowner and/or his attorney. Currently every US state mandates public maintenance of land title records.

Accurately describing a parcel of land is crucial to the public land records systems. In order to identify any given parcel of land, each parcel must be distinguishable in writing from all other parcels of land. Two basic systems of identification are generally used to describe property within the United States:

1. the "metes and bounds"
2. the United States Public Land System (aka: US Government Survey)

The metes and bounds system was the first system to be employed in the United States and is the basis for property identification in most areas that were under private ownership before the Revolutionary War. This system is the most common system of land identification used in the original thirteen colonies (CT, DL, GA, MD, MS, NH, NJ, NY, NC, PN, RI, SC, VA and MD) as well as Maine, West Virginia, Kentucky, Tennessee, Texas, Vermont, Hawaii and parts of Ohio. The metes and bounds system identifies property in reference to natural and artificial monuments, as well as adjoining property boundaries, and describes the parameters of the parcel in direction and distance of each boundary line.

Key elements within the metes and bounds description are these:

- The beginning point of the property description (commonly known as the "Point of Beginning")
- The bearing and distances that describe the perimeter of the property, together with reference to any natural features along the boundaries
- The description of the natural and/or artificial monuments that mark the location of the corners of the property

While not required, the area of the property and a reference to a prior survey are commonly featured within a metes and bounds description.

The metes and bounds description draws a picture. The description leads the reader from a relatively well-known landmark to and around the parcel being defined.

Historical metes & bounds surveys may feature measurements in chains (66 feet) or in poles, rods or perches (each equivalent to 16-1/2 feet).

The U.S. Public Land System (USPLS) was inaugurated in 1784 to divide property belonging to the new nation of the United States in order for the government to sell this land and generate revenue. These lands include those turned over to the federal government by the colonial states and the larger areas acquired by purchase or treaty by the United States. Thirty states (including Alaska) constitute the public land survey states that have been, or will be, subdivided into rectangular tracts.

The USPLS is essentially a grid system with a north-south reference line called a Principal Meridian and an east-west line called a Baseline. Using these reference lines, the land was divided into quadrangles approximately 24 miles on a side. The quadrangles were further divided into “survey townships” or “congressional townships” approximately six miles wide. County lines generally follow boundary lines encompassing a number of townships.

Within both the metes and bounds system and the US Public Lands System exists the platted subdivision system, which is a method used to describe property in those instances where a larger tract is divided into smaller tracts. This process usually produces a subdivision plat whereby the smaller parcels are identified by a unique identifying label. This usually takes the form of a lot “number” or “letter.” Lots may also be called “parcels,” “plots,” or “tracts.” If the parent parcel produces a large number of lots, the individual lots may be grouped into blocks and identified by a block number in conjunction with a lot number. The distinguishing feature that denotes a platted subdivision is the creation of two or more parcels of specific size from one or more existing parcels where the division is based upon a drawing of the parent tract.

This platted subdivision system has many advantages. The primary advantage is that considerably less verbiage is needed to describe any particular lot than that which is required for a metes and bounds description. Title transfers can be described using the subdivision name and lot number, rather than the more lengthy metes and bounds description. If used as the basis for property transfer, the subdivision plat is recorded in the public land records. Deeds that refer to the lot and block identifiers may be supplemented by a metes and bounds description.

B. Survey Preparation:

In its basic essence, a boundary survey is a professional opinion of the location of the boundaries of a tract of land. Land Surveyors do not establish land boundaries; they locate the boundaries. Surveyors locate a written description on the ground, but they do not determine the actual boundaries of ownership. The establishment of boundaries or limit of ownership is a function of law.

Boundary surveys can be divided into two basic types of surveys--original surveys and retracement surveys or resurveys. An original survey is one in which a parcel of land is created for the first time. An original survey creates boundaries. A subdivision of a tract that creates new lot or boundaries lines is an example of an original survey.

The retracement survey, or a resurvey, is the more common type of boundary survey. In this situation the surveyor attempts to retrace or “follow in the footsteps” of the surveyor who created the original survey. A resurvey does not establish new boundaries.

A boundary survey, therefore, is a conclusion that a surveyor makes on the basis of evidence the surveyor collects during the preparation of the survey. This evidence can be placed into two general categories – ‘research’ and ‘field data’.

Research for a surveyor begins with the initial contact with the client. Ideally, when a surveyor’s services are retained, the client will provide the surveyor with some basic information about the property. In these situations the client can rarely give the surveyor too much information.

Before beginning the survey, the surveyor needs to know the location of the property and a description of the property’s boundaries. The minimum amount of required information is the address of the property and/or the tax parcel identification number, as assigned to the property by the county tax assessor. Because nearly all counties have a Geographic Information System (GIS) that can be accessed through the Internet, land record research is generally easier and quicker than it was just a few years ago. Many of the more sophisticated GIS databases have links to the local deed registry, which permits deed research to be performed online.

The surveyor, however, does not simply use a parcel’s boundary description to replicate it on the ground. The task of the surveyor also includes reconciling the description of a boundary line in the subject property’s deed with the description of the same boundary line in the adjoiner’s deed. Therefore, in addition to having a copy of the subject parcel’s deed, the surveyor also needs copies of all the adjoining landowners’ deeds.

The surveyor also must search the chain of title to the property being surveyed to determine if there have been conveyances out of the subject parcel. These conveyances could change the properties being surveyed. An example is a road right-of-way that is conveyed in fee simple to the Department of Transportation. This chain of title should reveal the granting of any easements and is important to determine junior and senior rights of parcels of land derived from a common grantor. The surveyor, though, generally does not do a complete and exhaustive title search of the property being surveyed.

Drawings of the the subject property and/or those of the surrounding parcels can be invaluable to a surveyor, from the simplest tax maps to the most complicated subdivision plat in the record room. Too much information is seldom a problem for a surveyor.

Once the surveyor has reached a reasonable level of completion of the research of the subject property and adjoining properties descriptions, he or she seeks to become familiar with the boundary description of the property. To accomplish this task, the surveyor usually creates a drawing, to scale, of the bearings and distances of the property lines as stated in the deed description. The surveyor and/or field crew can then use this sketch as an aid when conducting the field investigation.

The field procedures generally begin with a reconnaissance of the property boundaries. The field crew looks for evidence of title boundary lines of the owner and/or the adjoiners, in particular seeking the evidence that is called for in the deed description, the most common of which is the “call for monuments.” Monuments are physical objects that mark the location of ends and, sometimes, points along each line. These monuments fall into two categories, natural and artificial. Natural monuments may consist of rivers, trees, rock formations and other distinct features. Artificial

monuments are man-made; the most common ones are iron pipes, concrete markers, posts and even roads. For monuments to be controlling, they must be called for in the deed description. Because monuments can be moved or destroyed, it is, in fact, the location of the called-for monument that is considered controlling.

During the reconnaissance the field crew also should take note of evidence of possession by the subject tract's owner or an adjoiner. This evidence of possession may be in the form of a fence location, plantings, and areas maintained by grass cutting or placed under cultivation. Evidence of possession often gives solid clues as to the boundary location, but this kind of evidence can also be an indication of unwritten rights that could create title issues.

After the field crew completes the reconnaissance, they begin a traverse around the property. A traverse is a series of survey lines in which the direction and length of the line segments formed by concurrent stations are measured. The traverse usually goes wherever it is convenient for the surveyor after considering a number of factors, including the visibility between traverse stations. Hence, it is often called a random traverse. Ideally, the traverse includes the monuments at the boundary corners; however, this process is not necessary if the traverse station (or traverse point, as they are more commonly known) is placed where the monument can be located by angle and distance from the traverse point.

The field crew begins at or near a monument and then goes around the general location of the boundary lines until they return to the beginning point, thereby creating a closed polygon with the sides of the traverse. This closed polygon is commonly known as a "closed" or "loop" traverse. While having a closed polygon is not necessary, the vast majority of traverses are performed in this manner. An exception to the closed polygon is the traverse that begins and ends at points with known coordinates.

As they progress along the traverse, the field crew locates evidence such as corner monuments, fences, roads and other evidence of possession. In addition, depending upon the scope of work and purpose of the survey, the field crew will locate other physical features such as buildings, parking areas, driveways and utilities. If a topographic survey is included in the scope of work, the crew will take the elevations of several locations throughout the site.

When the gathering of the field data is completed, the information is brought into the office for analysis. The first procedure is to check the mathematical precision or "closure" of the traverse, although, ideally, the crew also performs this step in the field before they leave the job site. By checking closure in the field, the crew can correct any errors in the measurement of the traverse without having to make an additional trip to the site.

Usually the surveyor will enter the "raw," i.e. unadjusted, traverse data into a computer software program. This software calculates the error of the closure based on this data, which consist of angles and distances measured in the field. Each state has a statute that gives the minimum closure that must be obtained for a survey, depending upon whether the survey is conducted in a rural, suburban or urban setting. This closure is stated as an error ratio. Lands perceived to have a lower value, typically rural lands, have a lower closure requirement than do suburban lands, which, in turn, usually have a lower closure requirement than urban lands. If the error of closure must exceed only one foot in 10,000 feet for an urban survey, the measurements of the angles between the line segments of the traverse and the

measured lengths of the traverse lines should mathematically bring the surveyor back to his or her starting point within 1/10,000 of the total distance of the traverse.

After the closure is checked and found to be within allowable limits, the data of angles and distances is mathematically adjusted to distribute the error throughout the traverse. This adjustment is commonly known as “balancing the traverse.” There are a number of mathematical methods of adjusting a traverse. For the scope of this presentation, it is sufficient to say that the adjustment takes the closure error and distributes that error at certain places in the traverse so that the adjusted traverse closes perfectly.

Once the traverse is adjusted, the locations of all monuments and other evidence found in the field are calculated, creating points with coordinate pairs. These points are plotted on a preliminary drawing, commonly called a “worksheet,” so that the surveyor can visualize and calculate the relationships between the points. The surveyor analyzes the data and tries to reconcile the differences between the measured and recorded locations between boundary points. The surveyor then uses his or her expertise to make a determination of the boundary corner locations. This determination is accomplished most often through a “hierarchy of calls” that ranks the elements of the evidence described. The most common hierarchy of calls are these:

- A. Right of Possession or Unwritten Title
- B. Senior Rights
- C. Written Intentions of the Parties to the Conveyance
 - 1. Call for a Survey or an Actual Survey on which the Conveyance is Based
 - 2. Call for Monuments
 - a. Natural Monuments
 - b. Artificial Monuments
 - 3. Adjoiners or record boundaries
 - 4. Calls for Directions and Distances
 - 5. Calls for Directions only (Distance in North Carolina)
 - 6. Calls for Distances only (Direction in North Carolina)
 - 7. Area (Quantity)

In determining the boundary locations, the surveyor seeks to reconcile the elements of the deed description with the physical evidence found. Any elements of a description of a parcel or of evidence found in the field may be rejected or overruled, based upon a review of the best evidence available. However, if the results obtained by applying the above ranking of elements is contrary to the overall intent of the deed, the clearly stated intent of the deed will control.

After taking into consideration the evidence found in the field and the evidence found in the written description of the property, the surveyor makes a decision that, in his or her professional opinion, locates the boundaries of a parcel as intended by the parties who established the boundaries in the first place. Monuments should then be set in the field at significant points along the boundary.

Once the boundary determination is made, the surveyor prepares a map or plat of the property. This plat, drawn to scale, contains information that, at a minimum, shows the location, direction and distance of the boundary lines; the existence or non-existence of monuments locating the end of the boundary lines; and the area of the parcel. Each state

has Minimum Technical Standards for the preparation of a land survey in that state, which includes the items that should be on a plat.

C. Survey Plat Information:

Scale: The scale shown on a survey plat represents the relationship of the dimensions on the original plat to the dimensions of the survey. The scale is most often expressed as a ratio of one inch equaling a certain number of feet, i.e. 1"=20'; 1"=50'; 1"=100'; 1"=200'. This ratio is usually stated on the face of the plat as the ratio and in the form of a bar graph. The bar graph is particularly helpful in showing the reader of the plat whether or not the copy of the original drawing has been altered in size.

Monuments: As stated earlier, monuments fall into two categories, natural and artificial or man-made. The best monuments are made of permanent or semi-permanent material (an iron or steel stake, as opposed to a wooden one). One should always remember that monuments represent the location of a corner, as opposed to being the corner.

Evidence of Possession: Indicators of evidence of possession are numerous and varied, including items such as fences, walls, landscaping, and cultivated land. Evidence of possession may not only indicate boundary line locations but also the presence of unwritten rights.

Building Location: Unless specifically stated in the scope of work that is negotiated with the client, the surveyor may or may not show the locations of buildings on the site. However, if a building is near or, especially, if it is over a property line, the location of the building is generally shown.

Roads: Roads can be either public or private, and the right of way of the road may be an easement or held in fee simple ownership. The road may form the boundary of a parcel, or the property lines may extend into or past the road. All property should have access to a road, either by being adjacent to a roadway or by an easement that crosses the properties of other land parcels.

Utilities: The notation of utilities on a plat indicates that an easement or right of way is present, even if the limits of the easement or right of way are not shown. Utilities may or may not be shown based on the specified scope of work.

Fences, Walls and Other Improvements: Generally, fences and walls are evidence of possession of a landowner and, thus, are an indication of a boundary line location. If nothing else, they are usually at least the intent of the boundary line location, because their placement is normally intended to be on or very near the boundary of the parcel.

One of the issues that can arise when a fence, wall or other improvements such as shrubbery or trees are placed on a boundary line is that they also encroach over the boundary line. To prevent a conflict with a neighbor, a landowner who wants to erect a fence or wall or plant shrubbery would be wise to make sure that the construction of the structure or the plantings falls within the boundaries of his or her land parcel.

Alleys and Driveway: Alleys and driveways, like roads, are a track for travel that forms a means of communication between one place and another. Alleys, like public roads, are dedicated streets that are commonly created to give a way through the middle of a block to give access to other properties. Alleys may also provide access for utilities. Normally, alleys do not cause boundary problems except sometimes they are never opened or used. In disputed cases, the landowner may think that he owns land that he does not. Only a legal document can verify such ownership.

Driveways are normally intended for private use to provide access to a particular parcel. When the driveway terminates at the subject parcel, this generally does not create a problem. However, when the driveway or crossing continues along the subject parcel to provide access to another property, an easement or unwritten right may evolve over a period of time under certain conditions if an easement does not specifically already exist for this driveway. In either instance it is a burden to the property that is best shown on the survey.

Flood Zones: Flood zones, or the flood plain, is land along the course of a river, stream or tributary that is subject to inundation during periods of high water that exceed normal bank-full elevation. The Federal Emergency Management Agency (FEMA) has produced Flood Insurance Rate Maps (FIRM) for all the counties and most significantly sized communities in the United States. FIRMs are used to determine if a parcel is in the flood plain and, if so, how much of the property is within the flood plain. The FIRM provides this information by graphically showing the limits of the flood plain and, in areas where more detail study has been conducted, the maps that show the elevation limits of the flood plain. The existence and location of a flood plain may determine whether or not a homeowner is required to have flood insurance, especially if that property has a mortgage on it.

Zoning, Building and Subdivision Restrictions: As a survey matter, zoning, building and subdivision requirements may place restrictions upon the amount of area within a parcel that the landowner can develop. Most financial lenders who require that a survey be made of the subject property want the zoning shown on the face of the plat. In addition, they usually require that the building setback lines be stated and/or shown on the drawing. Building height restrictions are sometimes required as well, and the height of an existing building may need to be shown to confirm that it falls within the local zoning height restrictions.

Contours and Elevations: A contour is an imaginary line on the ground, all points of which are at the same elevation above a specified datum surface. A contour can be illustrated by the shoreline of a body of water whose surface is at the elevation represented by the contour. A contour interval is the difference in elevation between adjacent contours on a map.

An elevation is the vertical distance from a datum to a point or object on the earth's surface. A spot elevation is a point on a map whose height for that particular point is noted. The reference datum is generally mean sea level, but an arbitrary reference datum may also be used.

Contours and spot elevations are used to create topographic maps. Topographic maps present the horizontal and vertical positions of the features represented on the subject property. These maps, commonly called "topo maps," depict how the land rises and falls because of changes in grade across the property.

Interior Lot Lines: Sometimes surveys are performed so that, instead of subdividing a larger parcel into smaller parcels, a number of smaller parcels are combined into one larger parcel. This type of survey is commonly called a recombination survey. Showing these interior lot lines, which are the former boundary lines, is a common practice in the preparation of recombination plats. This information assists the reader in knowing which of the smaller parcels were absorbed into the larger parcel and what their position was within the larger parcel.

D. Survey Plats Evaluation:

Plat Evaluation Checklist: A general checklist of items one can expect to see on a survey plat are these:

1. North arrow and bearing base
2. Date of the survey
3. Name and address of the surveyor
4. Signature and seal of the land surveyor
5. Adjoining property owners
6. Dimensions of all the property sides
7. Bearings along all the property sides
8. Type of survey
9. Client's name or the entity for which the survey was prepared
10. Certification
11. Notes
12. Area
13. State Corporate Seal or Certificate of Authorization number (if required)

Evaluating the Age of the Survey: There is more to evaluating the age of the survey than simply reading the date of the survey plat. The "age" of the survey is an indication of the methods used by the surveyor who conducted the work. Often the precision of the work and, thereby, the confidence that can be placed in the accuracy of the results, is directly related to the "age" of the survey.

Most lending agencies have strict rules regarding the acceptable amount of elapsed time between a survey and a mortgage loan. These agencies have learned, through experience that the possession and use of the land can change quickly in a short period of time. Buildings can be erected, expanded or removed. Fences can indicate the intention of a person to possess part of his neighbor's land. There are many activities or occurrences that can alter the use and enjoyment (and thereby the title) of real property.

Determining the Purpose of the Survey: A survey plat in and of itself indicates that a business arrangement was created between a land surveyor and others interested in some aspect of the subject property. The plat would be performed for the original client's specifications and the likelihood that this would fit the needs of others is remote. Many items that could be of particular interest to an additional third party, such as easements or flood hazard, may not even be a concern of the surveyor if the original scope of work did not include those particular details.

If a specific reason for the performance of a survey exists, the surveyor must be completely aware of the purpose so that she or he may tailor the work to suit the needs of the client. Often, a survey, alone, may not reveal items of particular concern.

Examining the Survey for Gross Discrepancies: Surveys that are performed and plats that are drawn by human beings are subject to the possibility of errors or omissions. The most difficult blunders to detect in the surveying profession often occur during the final drafting or printing of a survey map. These errors can take the form of spelling errors, misprints, obvious omissions or the transpositions of numbers or letters. If a given distance or bearing seems impossible, the client should contact the surveyor for an explanation. If the discrepancy is the result of a refinement or a correction of a former value, the surveyor will inform the client. If an error has indeed occurred, the surveyor will appreciate the opportunity to correct the mistake before the error has a chance to go into perpetuity.

The Survey Plat vs. The Deed: Differences between deed data and survey data is not uncommon. These differences are usually the result of the improved or updated information about the subject parcel of land that would be shown on the plat.

The surveyor must make several judgmental decisions during the interpretation of boundary evidence discovered during a survey. Therefore, the information contained in a deed can be slightly to significantly different from the information shown on the survey. Distance corrections are common and are likely the result of improved technology, or simply new evidence, among other contingencies. Directions (bearings) are more prone to vary from the deed information than distances.

Easements: An easement is a nonpossessing interest or right held by one person in the land of another. An easement gives one person the right to use the land of another within the easement area for a specific purpose. An easement, however, does not keep the owner from enjoying the portion of his or her property burdened by the easement. An easement may be the result of a written agreement or the easement may be the result of use.

Easements fall into three broad categories:

- Surface easements give the right to use only the surface of the land. Easements for access, flowage and for rights of way fall into this category.
- Subsurface easements give the right to use the land at a designated distance below the surface of the land. Pipelines, underground power and telephone lines, water and sewer lines are in subsurface easements.
- Overhead easements grant the right to use the space at a designated distance above the surface of the land. Overhead power and telephone lines, aviation (flight) and scenic easements are examples of overhead easements.

Easements may take one of two forms: those that are obvious (apparent) and those that are hidden. The surveyor will discover easements that are obvious, i.e. those with physical indications of their existence on the ground.

Easements that are hidden from obvious view may not be discovered by the surveyor. Hidden easements that are written and recorded will be discovered by a title examination only. Surveyors do not normally perform complete title examinations unless they are requested to do so by the client. If a client wants to have all of the easements or other statutory restrictions associated with a real property parcel shown on a survey plat, the surveyor must be informed of their existence.

The client should compare each survey plat with the title report for evidence of hidden, but recorded, easements. Many clients will provide a surveyor with a copy of a title insurance commitment, if one was prepared, and include in the scope of work with the surveyor a requirement to address any easements noted in the title report. The surveyor should indicate the location of the easement by either showing the location of the easement on the drawing or addressing the easement's condition in the surveyor's notes.

Encroachments: Encroachments are physical objects that invade upon the rights of another. An encroachment occurs when that object crosses the boundary lines of the property. Encroachments create title and title insurance problems for property owners, title insurance companies and lenders. Most standard survey specifications and state

minimum technical standards require the surveyor to show encroachments because of the effect these encroachments can have upon a property.

Encroachments are not limited to aboveground issues. Underground encroachments that are not visible can also be present. These encroachments can include building foundations, underground storage facilities, and underground utilities.

E. Survey Limitations

Surveyor Specified Limits: Because of the increasing litigious nature of our society, surveyors in recent years have taken greater pains to state what a survey does or does not show. Many survey plats state that the survey was performed either with or without the benefit of a title search or title commitment. If a survey was prepared without the benefit of a title search, then, most likely, the surveyor did not conduct a complete examination through the chain of title. Therefore, issues such as easement may not appear on the drawing.

Another limiting issue is the location of underground utilities. Many surveyors include a statement on their plats that the surveyor makes no guarantee that all the underground utilities are shown nor that they are in the exact location shown. The only way this information can be accurately portrayed on a drawing is for the utilities to be physically excavated. Most survey specifications are not that stringent.

An important fact to remember is that surveyors are not title abstractors. The role of the surveyor is to show visible acts on the ground that encumber the property, while the attorney's responsibility is to evaluate the written or legal factors that are contained within the title of the subject property. These two services in combination comprise a full record of a real property parcel.

Client Specified Limits: Just as there are standard features on every car, there are standard features that should appear on every survey. Automobiles increase in cost with the addition of extraneous details, as do the costs of surveys. Educated clients are aware of the needs to be met with each survey and give these directions to the surveyor in the initial meeting. These needs may not fit the requirements of a third party, so caution is urged regarding the use of a survey created for others.

Title Insurance Limits: Most, if not all, title insurance policies contain exceptions to the policy that the title company will not insure. Among these exceptions are anything that would have been revealed by the preparation of a current survey. A current survey may reveal unwritten title issues that would give notice to all the parties with an interest in the property.

In conclusion, the land surveying process and the professional land surveyor meet a critical need in the development of the earth's surface. Nearly everyone, at sometime in his or her life, has depended on information provided by a reputable surveyor. As new technologies are discovered and new techniques are perfected within this profession, the role of the surveyor may change as well. However, the need for clear, accurate, and precise information regarding designated ownership and boundaries of land and, perhaps, even space will certainly continue to exist.

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