




MISSOURI STANDARDS
64TH ANNUAL MEETING
MISSOURI SOCIETY OF PROFESSIONAL SURVEYORS


October 15, 2021
 Presented By: Ron Heimbaugh, PLS

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¼ Corner of Sections 27 & 34



1848: Deputy Surveyor Burton – Set 16"x14"x5" sandstone
 1897: County Surveyor Adams – Found GLO stone and both witness trees
 2004: Taney County slide H at page 102 – "Ex. Wagon Tire Iron..."
 2021: Land Survey Program – Found wagon tire iron in pile of stones...found GLO limestone




LSP restored/reestablished 281 USPLSS corners in FY2021



Presentation Outline

- History of Standards for Property Boundary Surveys
- Missouri Standards for Property Boundary Surveys
- Quiz

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History of Standards

- 1964: Missouri Association of Registered Land Surveyors (MARLS) adopted survey standards, 1½ pp
 - Information to be shown on the plat
 - Monument corners with iron pins
 - Lists accuracy requirements for field work
- 1973: Missouri State Land Survey Authority - developed and adopted Missouri's first set of modern survey standards



History of Standards

- 1975: Original "Minimum Standards" filed with Missouri Secretary of State, 5 pp
 - Definition of acceptable permanent monuments
 - Requires two permanent monuments per subdivision block
 - Publication of Results
 - Certification...Survey was executed in accordance with Current Minimum Standards
- 1982-1989: Minimum Standards are revised and filed 5 times by DNR
 - Advancement of surveying equipment



History of Standards

- 1993: Missouri Board for Architects, Professional Engineers, and Land Surveyors (APELS) issued set of Missouri Standards for Property Boundary Surveys and Real Property Reports
- 1994: Land Survey Program (LSP) and APELS jointly promulgate Missouri Minimum Standards for Property Boundary Surveys and all other Surveying Code of State Regulations
 - Standards for Property Boundary Surveys are not intended to replace professional land surveying judgment
 - Addition of the rule for the Use of the Missouri Coordinate System



History of Standards

- 2003: Minimum Standards revised and reissued by LSP & APELSLA
 - “Legal Description” is replaced with **Property Description**
 - Vertical datum shall be defined on plat
 - Identify adjoiners as they appear of record



History of Standards

- 2017: LSP and APELSPLA jointly promulgate Missouri Standards
 - Elimination of the word “**Minimum**” from the title
 - New section called **Deliverables**
 - Suburban accuracy standard renamed to **Rural** and redefined as everything not Urban
 - Note the **adjustment date** on the North American Datum of 1983
 - Include a brief statement of the **method used to obtain positions**



Current Missouri Standards

Effective Date: June 30, 2017

Title 2—DEPARTMENT OF AGRICULTURE
Division 90—Weights, Measures, and Consumer Protection
Chapter 60—Missouri Standards for Property Boundary Surveys

PURPOSE: These standards provide the surveyor and recipient of boundary surveys with a realistic guideline for adequate survey performance



Organizational Outline

- Application of Standards
- Definitions
- General Land Surveying Requirements
- Accuracy Standards for Property Boundary Surveys
- Use of Missouri Coordinate System of 1983
- Approved Monumentation
- Location of Improvements and Easements

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Application of Standards

The standards in this chapter apply to **all property boundary surveys** made for determining the location of land boundaries and land boundary corners, but do not apply to **preliminary plats or plans, plot plans, design surveys, geodetic surveys, or cartographic surveys**. Any individual or corporation registered with the board to perform land surveying services shall be familiar with and comply with these standards.

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Application of Standards (Cont.)

The Missouri Standards for Property Boundary Surveys are not intended to be used in place of professional land surveying judgment. There may be special circumstances and conditions that make it impractical to comply with some provisions of the standards. If the survey deviates from these standards, **this deviation shall be noted, described, and justified on the plat of survey** by the PLS. This provision cannot be used to **intentionally circumvent the basic tenet of these standards.**

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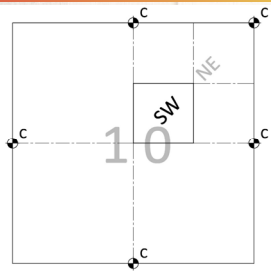


Definitions

Condominium Survey - A property boundary survey that creates and defines condominium property in accordance with Chapter 448, RSMo.



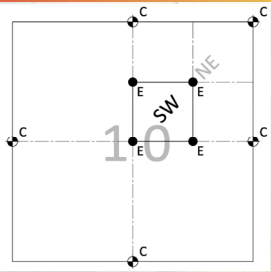
Definitions



Controlling Corners - Corners that determine the location of the exterior corners of the surveyed boundary



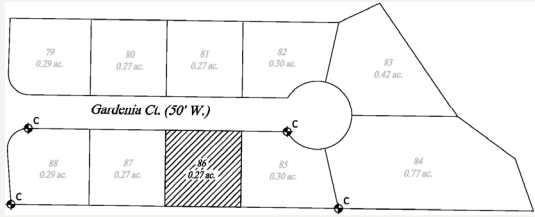
Definitions



Exterior Corners - Corners that define the shape and size of the parcel



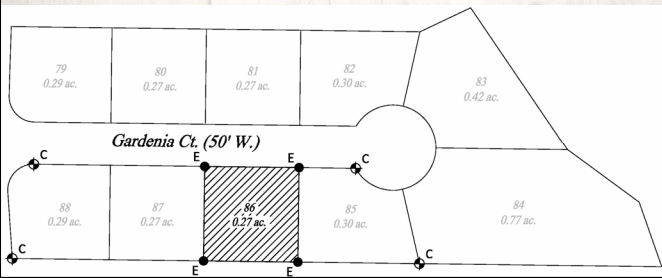
Definitions



Controlling Corners



Controlling and Exterior Corners



Definitions

Material Variations - Differences between surveyed lines and lines of possession or measurement of record...in the professional judgment of the PLS, significant enough to warrant particular notice

Physical Monument - Natural or artificial objects which are accepted and used to mark boundaries and corners



Definitions

Original Survey (current) – A survey which creates a new parcel, or parcels, out of a larger parent tract.

Original Survey (2003) – An original survey is a survey which creates a new parcel out of a large parent tract, for the purpose of conveying the new parcel. Boundary adjustment plats, consolidation plats, riparian plats, lot splits, and minor subdivisions are examples of original surveys.

Original Survey (proposed revision) – A survey which creates a new parcel, or parcels, out of a larger parent tract]. **Boundary adjustment plats, consolidation plats, riparian plats, lot splits, and minor subdivisions are examples of original surveys.**



Definitions

Property Boundary Survey - Any survey that creates, defines, marks, re-marks, retraces, or re-establishes the boundaries of parcels of real property or the subdivision of lands

Property Description – A description of the limits of real property by metes and bounds or by an aliquot part of the United States Public Land Survey System (USPLSS) or by lot or parcel designation referenced to a subdivision, survey or other document recorded in the public records



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Definitions

Random Errors - Unavoidable errors in measurement that are caused by the inability of the operator to make exact measurements. Random errors:

- Generally follow statistical principles
- Can be reduced with care in measurement, but can never be completely eliminated.
- Algebraic sign of the error is unpredictable



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Definitions

Systematic Errors - Errors in measurement that conform to mathematical and physical laws and remain the same under set conditions

Systematic errors are detectable and can be minimized by:

- Ensuring proper adjustment of equipment
- Applying appropriate corrections to observations
- Using appropriate observation techniques

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Definitions

Record Title Boundaries – The limits of real property ownership as evidenced and provable by one (1) or more written means of real property transfer and having provided constructive notification by being duly entered into public records.

Subdivision - A property boundary survey that partitions land into two or more parcels by platting the divisions of land in accordance with Chapter 445

USPLSS Corners - Points that determine the boundaries of the various subdivisions of the USPLSS such as Township corner, Section corner, Quarter-section corner, Grant corner, and Meander corner

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General Land Surveying Requirements

Records Research:

- Survey shall be based on the *property description of the parcel* or *parent tract* taken from the public records
- PLS shall acquire sufficient data to ascertain the record title boundary of the parcel(s)... (such as: adjoining deeds, maps, right-of-way plans, subdivision plats, original plats and notes, and subsequent surveys)
- Does not obligate the PLS to search entire chain of title

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General Land Surveying Requirements

Field Investigation: The PLS or a person under their direct personal supervision shall -

- Search for monuments and accessories at controlling corners and any other physical evidence required to define the location of the exterior corners of the parcel surveyed (such as: location of streets, roads, lines of occupation, and parcel information)



General Land Surveying Requirements

Field Investigation: (Cont.)

- Obtain appropriate and sufficiently redundant measurements to correlate all found evidence
- Evaluate the reliability of the evidence and monuments found and apply proper theory of location in accordance with surveying precedent
- Reach a conclusion on the location of the boundary and set monuments



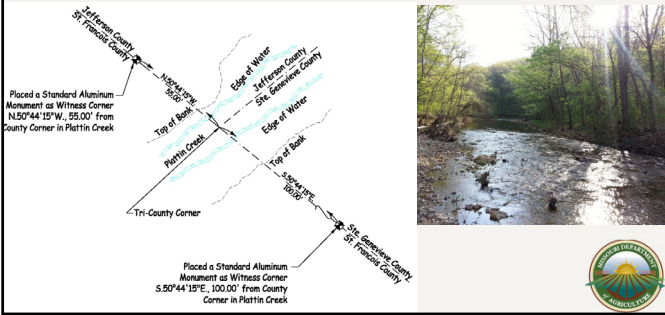
General Land Surveying Requirements

Monumentation:

- Establish semi-permanent or confirm existing monuments at every exterior corner, except for lines running along streams or lakes where witness monuments must be set along the connected sidelines
- When it is impractical to set a monument at a required corner, a witness monument shall be set along a line of the survey or prolongation thereof



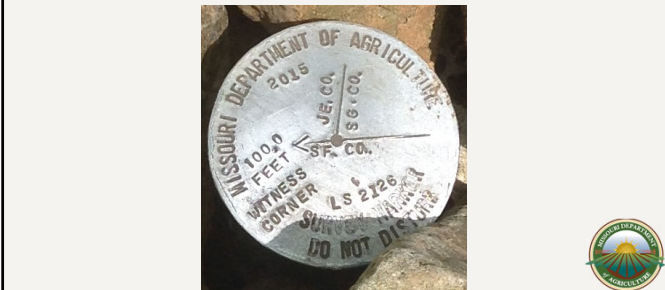
Good place for a Witness Corner...or two
Tri-County Corner in Section 6, T38N, R6E



Witness monument located 55 feet northwest of the
Tri-County Corner along the St. Francois - Jefferson County Line



Witness monument located 100.0 feet Southeast of the Tri-
County Corner along Ste. Genevieve - St. Francois County Line



General Land Surveying Requirements

Monumentation: (Cont.)

- Existing monuments shall be evaluated for permanency by the professional land surveyor. Those needing restoration, preservation or replacement shall be restored in accordance with the requirements in these standards.

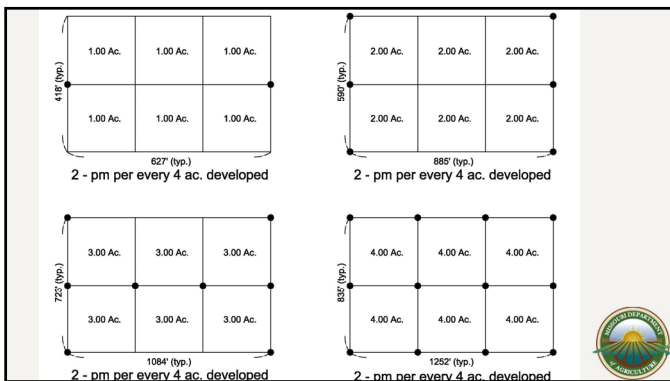


General Land Surveying Requirements

Additional Monumentation for Subdivision Surveys:

- Prior to recording subdivision plat, establish at least two permanent monuments for every four acres of land developed by the subdivision. An exception would be if the survey does not create more than four lots or parcels.






...establish at least two permanent monuments for every four acres of land developed by the subdivision. An exception would be if the survey does not create more than four lots or parcels.

560' (typ.)	2.00 Ac.	2.00 Ac.	2.00 Ac.	2.00 Ac.	335' (typ.)	4.00 Ac.	4.00 Ac.	4.00 Ac.	4.00 Ac.
	2.00 Ac.	2.00 Ac.	2.00 Ac.	2.00 Ac.		4.00 Ac.	4.00 Ac.	4.00 Ac.	4.00 Ac.
1181' (typ.)				1670' (typ.)					
2 ac. lot or larger				2 ac. lot or larger					
Each tract has at least 1 - pm				Each tract has at least 1 - pm					


In cases where the lots of the subdivision are two acres or larger, permanent monuments will be established so each tract has at least one permanent monument.



General Land Surveying Requirements

Additional Monumentation for Subdivision Surveys: (Cont.)


- Set permanent monuments prior to recording the plat or, if likely to be destroyed by construction, monuments may be installed upon completion of construction and no later than 12 months after recording the plat



General Land Surveying Requirements

Additional Monumentation for Subdivision Surveys (Cont.)

- All lot corners shall be monumented with semi-permanent or witness monuments within the same twelve month period
- When the subdivision is a cemetery, four permanent monuments per block shall be installed and the monumentation of all lot corners shall not be required
- Condominium surveys shall meet the requirements for subdivisions



General Land Surveying Requirements

Publication of Results: A plat shall be made showing the results of the survey or subdivision and shall conform to the following provisions:

- Plat shall include a drawing made to a convenient scale on reasonably permanent and dimensionally stable material
- Include the name of the person or entity for whom the survey was made and the date of the survey

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General Land Surveying Requirements

Publication of Results: (Cont.)

- Lettering no less than 0.08" in height. All characters shall be open, well-rounded, and of uniform width
- Boundary lines shall be shown by angles, azimuths or bearings with the directional reference system clearly described on plat
- North arrow, written scale and graphic scale shall be shown on every sheet containing graphic survey data

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General Land Surveying Requirements

Publication of Results: (Cont.)

- Complete dimensions (distances, directions, and curve data) of all parcels surveyed or created
- All linear measurements shall be shown as horizontal distances at the ground surface in feet or meters
- Curved lines shall show at least two elements. For non-tangential curves, include directional component to define direction of curve (preferably chord bearing).

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General Land Surveying Requirements

Publication of Results: (Cont.)

- Vertical measurements shall be shown as elevations above an established or assumed datum in feet or meters
- When elevations are shown, clearly define the elevation datum, the location of, and elevation of the benchmark
- Measurements and calculated areas will be shown on the plat to number of significant figures representative of the actual precision of the measurements

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General Land Surveying Requirements

Publication of Results: (Cont.)

- Plat shall display either a property description for the parcel(s) and/or parent tract or reference the source document from which property description was taken
- Any new parcel created by survey shall have its property description shown on plat
- Subdivision plats shall identify all lots, per Section 445.010, RSMo.

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General Land Surveying Requirements

Publication of Results: (Cont.)

- Plat shall show sufficient data (distances and directions) to locate parcel within the USPLSS, or within the recorded subdivision. If the survey cannot be located by either, it must be referenced to other lines and points established by record.
- All controlling and exterior corner monuments that were found or set shall be identified on plat.

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General Land Surveying Requirements

Publication of Results: (Cont.)

- Any material variation between record and measured dimensions and between surveyed lines and lines of possession at all exterior corners shall be shown on the plat
- Plat shall reference the source document(s) for any pertinent data obtained during the records research
- Plat shall also reference property type (**Urban** or **Rural**)
- Plat shall identify record title documents for adjoining properties

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General Land Surveying Requirements

Publication of Results: (Cont.)

- In addition to the above, all condominium surveys shall show information required in section 448.2-109, RSMo, and descriptions of easements serving or burdening the condominium
- Include statement that survey, or subdivision, was executed in accordance with the **Missouri Standards for Property Boundary Surveys**
- Condominium plat shall also include declaration that plat contains all information required by section (448.2-109, RSMo.)

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General Land Surveying Requirements

Deliverables:

- Furnish to the client a plat containing the drawing and other pertinent information identified above
- Each sheet shall bear the signature and seal of the PLS in responsible charge
- Signed and sealed plat shall be the official plat and shall take precedence over any other formatted data that may be delivered to the client or representatives

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¼ Corner of Sections 1 & 12



1848: Deputy Surveyor Lampton – Set post, 12" Post Oak & 14" Black Oak
 1897: County Surveyor Adams – Found GLO Post Oak – set Limestone
 1992, 1998, & 2002: Found Stone – replaced stone w/ alum. mon.
 2021: Land Survey Program – Found aluminum monument, GLO stump-hole, several subsequent trees, and a limestone w/ "1/4"



Accuracy Standards

- Surveyor shall make an effort to detect and remove systematic errors
- Systematic errors are defined as those errors whose magnitude and algebraic sign can be determined
- Systematic errors are present in all measurements where conditions depart from a standard either from the environmental viewpoint or in the adjustment of the measuring instrument

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Accuracy Standards

Examples of Systematic Errors:

- Applying the incorrect temperature and/or pressure corrections
- Using incorrect instrument heights and/or target heights
- Incorrect prism offset, or phase centers
- Prism pole out of adjustment
- Optical or laser plummet out of calibration

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Accuracy Standards

Random errors

“Random errors are those that remain in measured values after mistakes and systematic errors have been eliminated. They are caused by factors beyond the control of the observer, obey the laws of probability, and are sometimes called *accidental errors*. They are present in all surveying observations.”

From *Elementary Surveying*, by Paul R. Wolf and Charles D. Ghilani, 10th ed., p. 48



ACCURACY STANDARDS FOR PROPERTY BOUNDARY SURVEYS

CLASS OF PROPERTY	SIZE OF SURVEY PROPERTY	DISTANCE/DIRECTION UNCERTAINTY	POSITIONAL UNCERTAINTY
URBAN	Distances less than 2000' Distances 2000' or more	0.10 ft. or 30 mm. 50 ppm.	0.10 ft. or 30 mm. 50 ppm.
RURAL	Distances less than 1000' Distances 1000' or more	0.10 ft. or 30 mm. 100 ppm.	0.10 ft. or 30 mm. 100 ppm.


NOTE: The uncertainty due to random errors of any dimension of direction or distance and the positional uncertainty of any coordinates shown on a plat are computed at the 68% confidence level (one sigma).

DEFINITIONS

Urban Property: Any property that is located wholly or partly within the corporate limits of any municipality or any commercial, industrial, or multi-unit developmental property.

Rural Property: Any property that is not urban property.


Positional Uncertainty: The positive and negative range of values expected for a computed horizontal position as a result of random errors.



Use of Missouri Coordinate System of 1983

When the PLS is specifically requested or required to reference land boundary corners to the Missouri Coordinate System of 1983

- Position of corner shall be based upon a geodetic control station having a horizontal accuracy of second order or higher order
- Survey connecting the corner to the geodetic control station shall meet the accuracy standards for property boundary surveys



Use of Missouri Coordinate System of 1983

The plat or other publication of results shall note the following:

- Geodetic control station(s)
- Coordinates for those control station(s)
- Appropriate adjustment date or realization designation on the North American Datum of 1983
- Epoch date when applicable
- Brief statement of the method used to obtain positions
- Grid factor used

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Approved Monumentation

- Select a type of monument providing a degree of permanency consistent with adjacent terrain and physical features and as required by these standards
- All monuments shall be solid and free from movement
- They shall be set in the ground at least to the depth of the length given unless encased in concrete

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Approved Monumentation

- Except for drill holes and cut crosses, the precise position of the corner shall be marked by a point on a cap
- Cap shall be inscribed with the licensure number of the professional land surveyor in responsible charge or corporate licensure number or name of the company

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Approved Monumentation

Permanent monuments shall be selected from the following:

- Concrete monuments 4 inches square or diameter x 24 inches in length with a brass or alum. cap
- Commercial cast iron or aluminum survey markers no less than 24 inches in length
- Steel, coated steel, or aluminum rods 5/8 inch diameter x 24 inches long with permanently attached cap

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Approved Monumentation

Permanent monuments shall be selected from the following:
... (continued)

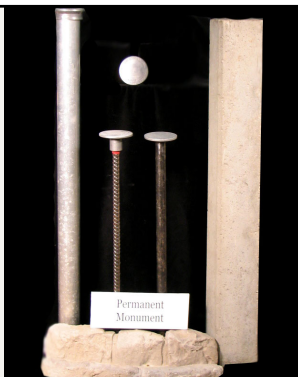
- Iron pipes 3/4 inch (inside diameter) x 24 inches long with permanently attached cap
- Brass or aluminum disks not less than 2 inches in diameter and grouted or cemented into rock or concrete with magnet

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Permanent Monuments

- Aluminum Pipe monument
- 5/8" rebar X 24" in length with an aluminum cap
- 3/4" Inside diameter iron pipe X 24" in length with an aluminum cap
- 4" square concrete monument 24" in length
- 3-1/4" aluminum disk



Approved Monumentation

Semi-permanent monuments shall be selected from the following:

- Iron pipes 3/4 inch outside diameter x 18 inches long with aluminum or plastic caps
- Steel or aluminum rods 1/2 inch diameter x 18 inches long with plastic or aluminum cap
- Cut "+" or drill hole in concrete, brick or stone paving
- In asphalt paving, cotton picker spindles, railroad spikes (center punched or chiseled cross), semi-permanent 1/2 inch rebar, and magnetic spikes (minimum of 8 inches long) that are solid and not easily removed or destroyed.

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Semi-Permanent Monuments



- Railroad Spike
- 1/2" rebar x 18" in length with plastic cap
- 3/4" (outside diameter) iron pipe x 18" in length with plastic cap
- Cotton picker spindle



Location of Improvements and Easements

- When the PLS is specifically requested by the client to locate the improvements on the property surveyed
- Professional land surveyor shall locate, by measurement, all permanent structures having fixed foundation, slabs, or footings and shall reference them to the property boundary on the plat with a minimum of three dimensions
- Dimensions shall be parallel, perpendicular or radial to the property lines

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Location of Improvements and Easements

- When the PLS is specifically requested by the client to show easements on a property boundary survey
- He/she shall show by graphic representation all easements appearing on the recorded subdivision plat and all easements provided to the surveyor by the client
- If requested by the client to locate any easements on the ground, he/she will do so in accordance with the standards

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Land Survey Program

- Department of Agriculture
- Weights, Measures and Consumer Protection
- agriculture.mo.gov/weights/landsurvey
- Land Survey Program
1251A Gale Drive
PO Box 937
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