

# GOING THE DISTANCE

By Landon Blake

## Introduction

In this article we look at the type of distances shown on a boundary survey. We define these distances, talk about why they are important, and look at 4 types of distances on a boundary survey. We also explain why it is so important to show your calculations for certain types of distances and provide a simple checklist you can use for the distances shown on your next boundary survey.

## What Distances Are We Talking About?

I believe it would be helpful to have a simple definition for the term "distance" in the context of a boundary survey that we can use for the purposes of this article. Here is my definition:

### **Distance:**

A measurement of the horizontal length of a straight line or circular arc between two points on a boundary survey. The two points are usually (but not always) property corners on that boundary. A distance can be in a ground coordinate system (scaled to fit the topographic survey of the earth) or on a grid coordinate system (scaled to fit the geometric surface of a map

projection). A distance can be expressed in a variety of different distance units, but is most commonly expressed in US survey feet for boundary surveys in the United States.

## Why Are These Distances Important?

Distances are a critical element of the information conveyed on a boundary survey for the following reasons:

- 1) Distances are one of the 2 primary elements used to convey the shape and dimension of a parcel. The other is direction (or bearing).
- 2) Distances allow the reader to evaluate the fit between surveys, between land records, and between surveys and land records.
- 3) Distance is typically easier to understand than direction for the common person. To meaningfully compare the directions of lines it is necessary to understand basis-of-bearing and to calculate angle values between lines. The

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common person also more commonly interacts with distance values than with angular values. (Most common people in the United States can visualize and understand the value "1.0 feet". Fewer would understand the angular value "128-52-32".)

4) The magnitude in a poor fit between two distances for the same line or arc is relatively constant. In contrast, an error in direction (or angle) increases as the length of the line impacted by the error increases.

## The Four Main Categories of Distances On A Boundary Survey

I like to identify the type of distances on my boundary survey using 4 main categories. (I often find the identification of distance type on surveys I retrace to be inconsistent or confusing. [For example: Why did the surveyor show that distance as measured, but that other distance as calculated?]) I've developed the 4 main categories of distance in my own practice of boundary surveying in an attempt to achieve more consistency.) Here is a short description of the 4

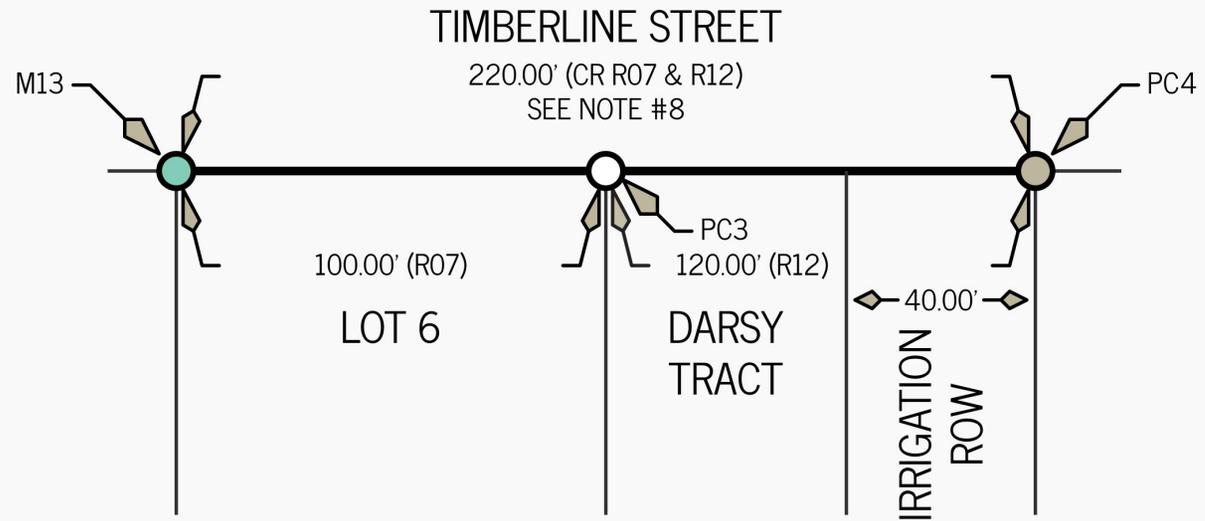
**"When you are determining the type of distances shown on your boundary survey map, it is helpful to properly understand the "current" survey. The current survey is your survey! It is the result of your fieldwork, calculations and analysis. Measured and calculated values are all based on this current survey."**

**"If you are using a distance from a previous survey of yours that has been filed, or from a land description or other document that has been recorded or made official, those distances should be shown as record, not measured or calculated."**

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## DIAGRAM #1



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main categories of distance type I use on my boundary surveys, along with the rules I try to follow for each.

## Category 1: Measured Distances

A measured distance is only shown when the two physical points on the end of the line or arc have been directly observed (measured) during the current field survey.

Rules for Measured Distances:

- a) If you didn't observe physical points at the end of the line, you can't have a measured distance.
- b) A measured value can't be based on calculations, other than standard error adjustment of the values observed during the current field survey.
- c) Measured distances require an identification of the physical point (usually a monument) on each end of the measured line to be shown on the survey.

**"Do you remember when you were in elementary school or junior high and your math teacher told you to "show your work" on your homework or exam? You need to do the same thing when you use calculated distances on your boundary survey."**

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**"Distances allow the reader to evaluate the fit between surveys, between land records, and between surveys and land records."**

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## Category 2: Record Distances

A record distance has a value taken directly from a previous survey or land record.

Rules for Record Distances:

- a) Record distances must be shown on the survey with a record reference. If you don't have a record reference that directly shows the distance, it isn't a record distance.
- b) Record distances can be scaled to fit the coordinate reference system you are using for the survey, but shouldn't be manipulated otherwise.

## Category 3: Calculated Distances

A calculated distance is determined using one or more mathematical calculations. It usually involves the use of at least one physical point directly observed (measured) during the current field survey.

## What is the "Current" Survey

When you are determining the type of distances shown on your boundary survey map, it is helpful to properly understand the "current" survey. The current survey is your survey! It is the result of your fieldwork, calculations and analysis. Measured and calculated values are all based on this current survey. If a distance value is based entirely on data from previous surveys or existing land records, it is likely a record distance or calculated record distance.

Remember, if you are using a distance from a previous survey of yours that has been filed, or from a land description or other document that has been recorded or made official, those distances should be shown as record, not measured or calculated. They are from your survey, but they aren't from the "current" survey.

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Rules for Calculated Distances:

- a) If you didn't perform a bit of math to calculate this value, it isn't a calculated distance.
- b) Calculated distances require a note on the survey. (More on this later.)

Category 3: Calculated Record Distances

A calculated record distance is based on math using only record data. This could be record data shown on a single survey/land record, or on multiple surveys/land records.

Rules for Calculated Record Distances:

- a) Calculated record distances must be shown on the survey with one or more record references. If you don't have a record reference that directly shows the distance, it isn't a calculated record distance.

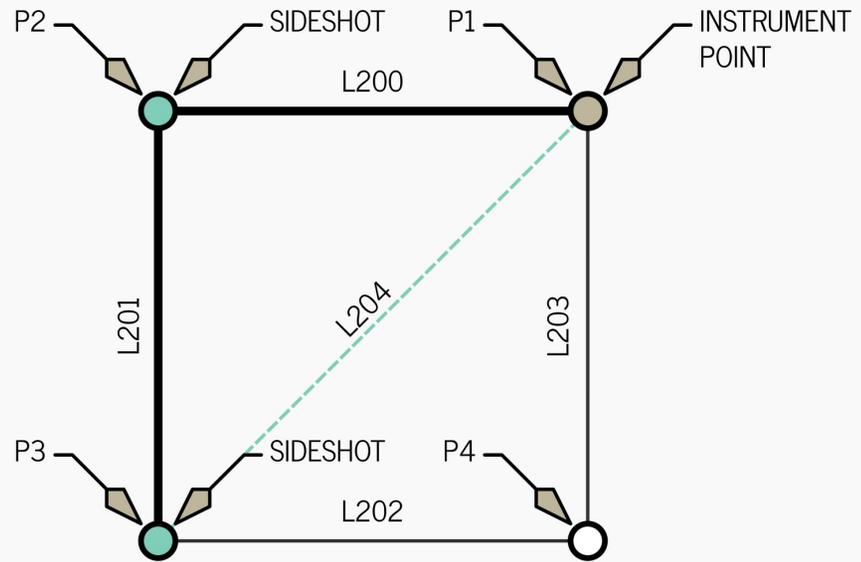
## Is it Directly Measured, or Is It Calculated?

Let's take a few minutes to understand that a distance doesn't have to be directly measured during a field survey to be shown as a measured distance on your boundary survey map. An example will help. Consider Diagram #3. During this field survey a total station was set on Point "P1". A side shot was then made to Point "P2" and to Point "P3". There was no physical monument or other physical point to measure at Point "P4". In this example, Line "L200" was directly measured by the total station. It could be shown as a measured distance on the boundary survey map. Line "L201" was not directly observed during the field survey, but its end points at Point "P2" and Point "P3" were directly observed by the total station. Line "L201" could be shown on the boundary survey map as a measured distance, even though it wasn't directly observed during the field survey. Because there was no physical point to measure at Point "P4", Line "L202" and Line "L203" shouldn't be shown on the boundary survey map as a measured distance.

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## DIAGRAM #2



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## Show Your Work!!!

Do you remember when you were in elementary school or junior high and your math teacher told you to "show your work" on your homework or exam? You need to do the same thing when you use calculated distances on your boundary survey. What does this involve? It involves 3 main things:

- 1) Identify the basic type of calculation.
- 2) Provide essential elements a retracing surveyor would need to understand our calculation.
- 3) Describe how your calculation fits with other measurements or evidence on the ground.

I frequently accomplish these 2 things with a simple note on my map. Consider an example where record values from two maps are being added together to form a calculated record distance used to determine the length of a line on the boundary of the subject parcel being surveyed. At the west end of

the line is a found iron pipe monument accepted as the best available evidence of the property corner position on that end of the line. Here is what the note on your map for this distance might read like:

The distance of 220.00 feet for L22 was calculated by adding distances shown along the south line of Timberline Street from R07 and R12. R07 shows the distance from the iron pipe monument accepted on this survey as the best available evidence for the corner identified as M13 to the northeast corner of Lot 6 as 100.00 feet. R12 shows the distance from the northeast corner of Lot 6, across Darsy Tract, to the east line of the 40' wide irrigation easement, as measured along the south line of Timberline Street as 120.00 feet. This gives a total distance of L22 (from M13 to the east line of the irrigation easement) as 220.00 feet. (When rotated to a common basis of bearing, R07 and R12 show a slight bearing break in the south line of Timberline Street. For the purposes of this survey, and this distance calculation, the south line of Timberline Street was held at a constant bearing. See Note #3 for more information.) The calculated position for the property corner identified on this survey as "PC4" established using this calculated distance matches well with

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the physical location of Darsy Canal inside of the 40' irrigation right-of-way as located during our field survey.

In this example, we nailed the 3 main things needed to explain a calculated distance. We identified the basic type of calculation. In this example, it was the addition of record distances. We then provided the essential elements needed to retrace our calculation. In this example, it was the record distances being added, a description of their controlling elements, and their source documents. We concluded with a description of our calculated distance fit with physical occupation on the ground, the location of Darsy Canal as it was located during our field survey.

A sketch of this example is shown in Diagram #2.

## A Basic Checklist for Distance Types On Boundary Surveys

How can you make sure that distance types are properly identified and shown on your boundary survey map. I always like to use checklists as part of my

### If You Hold A Record Distance – Tell Me That

It can get a little tricky if you hold a record distance to reestablish a property corner on a boundary survey. What type of distance is this, and how should you identify it on your survey? In the past, I would label these distances as calculated, but I've started to reconsider that practice. I'm not really calculating a new distance value, I'm holding the record value from a specific land record. There is a difference. In a future article I want to talk more about how to label and show distances on a boundary survey map. In the meantime, here are two (2) possible ways to identify a record distance held to establish a property corner on your boundary survey map:

- 1) Label the distance as record, include the record reference from which the distance is taken, and include a simple note indicating that the record distance was held as part of the boundary resolution on the current survey. (You may also want to include a longer note explaining why that specific record distance was held as part of your boundary resolution.)
- 2) Give record distances held on your survey their own label and

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peer review process. Here is a short list of items you could include on a boundary survey map review checklist related to the concepts we've discussed in this article:

- 1) There is a physical point observed during the field survey at both ends of each line or arc shown with a measured distance.
- 2) Measured distances haven't been manipulated or changed by calculations.
- 3) Record distances are shown with a record reference that identifies their source.
- 4) Record distances haven't been manipulated or changed by calculations.
- 5) Calculations for calculated distances and calculated record distances were explained.
- 6) Calculated record distances are shown with one or more record references

explanation. For example: You could use the label "CR" for calculated record distances and the label "HR" for held record distances.

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that identify their source.

7) The math for calculated and calculated record distances has been checked.

## Conclusion

In this article we talked about the 4 types of distances you can show on a boundary survey map, and offered a few tips on how to determine and document distance types on boundary surveys. I'd like this to be the first in a series of articles that help land surveyors to draw better boundary survey maps. In the next issue of Cornerstone, I'd like to talk more about distances. We'll look at some examples of how to show distance information your boundary survey map, as well as some CAD tools that can help you automate this process. I also want to put together a couple of short videos about this topic. In one video I'd like to review the information discussed in this article with a couple of marker board drawings. In the second video, I'd like to work through a couple of examples that show how you can use the distances shown on a boundary survey map to determine how a land surveyor retraced a parcel boundary.