

Survey Tie Guidelines

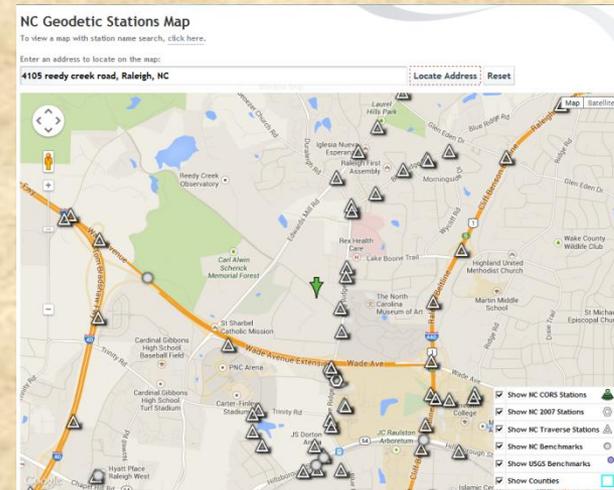
Purpose of guidelines

- Interpretative guide for proper ties to comply with Board Rule 21.56-1602(g)**
- Is not a finite list of proper ties**
- Variations of the examples are acceptable, if the intent of the rule is met**

The purpose of a tie is to reproduce a boundary when all or most of the property corners have been destroyed, or to verify the position of any given corner without the necessity or resurveying the entire tract of land.

Grid tie

- ❑ Required when property is within 2000' of a geodetic monument
- ❑ Recommended when possible



- ❑ Available Tools
 - OPUS-S/OPUS-RS
 - Real Time Kinematic Network (RTKN)
 - Traverse connection

OPUS-S/OPUS-RS

- ❑ **Acceptable methods for a grid tie**
- ❑ **Provide summary of results**

21 NCAC 56.1607 GLOBAL POSITIONING SYSTEMS SURVEYS

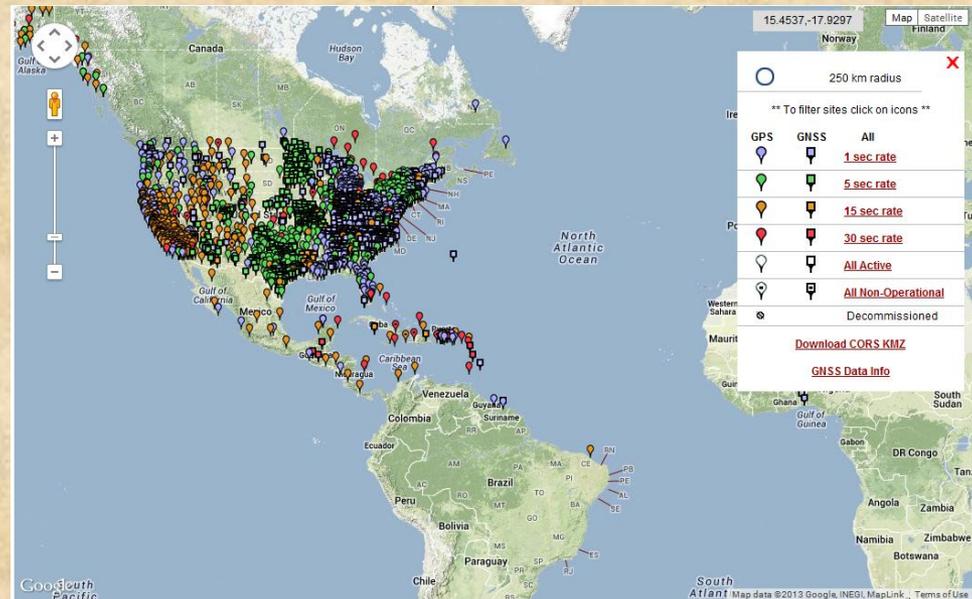
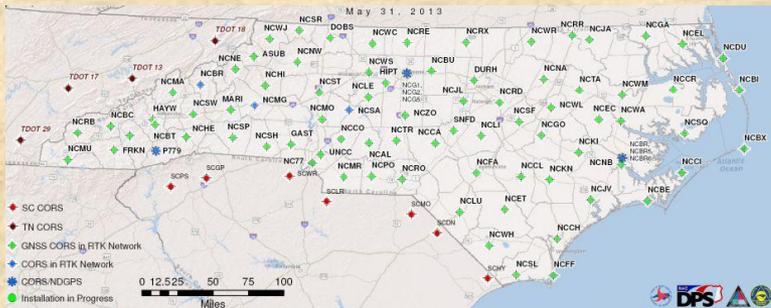
(a) General. Global Positioning Systems (GPS) are defined as the navigation and positioning systems that comprise the Global Navigation Satellite System (GNSS), which includes NAVSTAR, GLONASS, GALILEO, COMPASS, and any other satellite-based navigation and positioning systems.

(b) The Professional Land Surveyor in responsible charge of the GPS survey shall certify all prepared documents. When a map or document consists of more than one sheet, only one sheet must contain the certificate and all others must be certified. The certificate or metadata notes shall contain the following information:

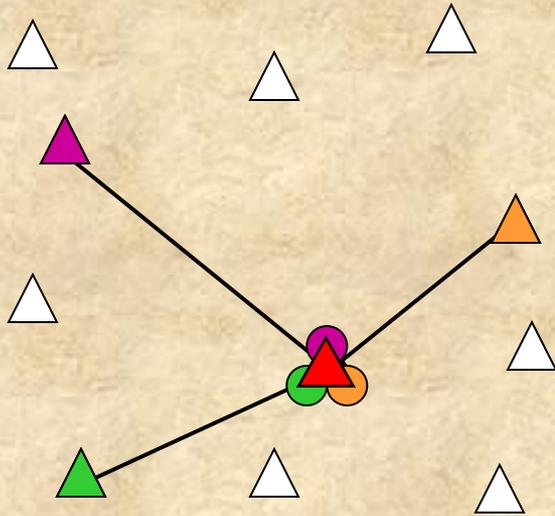
- (1) Class of GPS survey as defined in the Standards of Practice (or list the sections);
- (2) Type of GPS field procedure, such as Static, Kinematic, Pseudo-Kinematic, Real-time Kinematic, Real-time Kinematic networks, and Online Position User Service;
- (3) Positional accuracy;
- (4) Dates of survey;
- (5) What datum and epoch coordinates or geographic positions are based on;
- (6) Designation of fixed-control stations and their positional data;
- (7) Geoid model used;
- (8) Combined grid factor(s); and
- (9) Units.

What is OPUS?

- ❑ On-line **P**ositioning **U**ser **S**ervice
- ❑ Fast & easy access to the **N**ational **S**patial **R**eference **S**ystem (**NSRS**) for GPS users



How does OPUS compute positions?



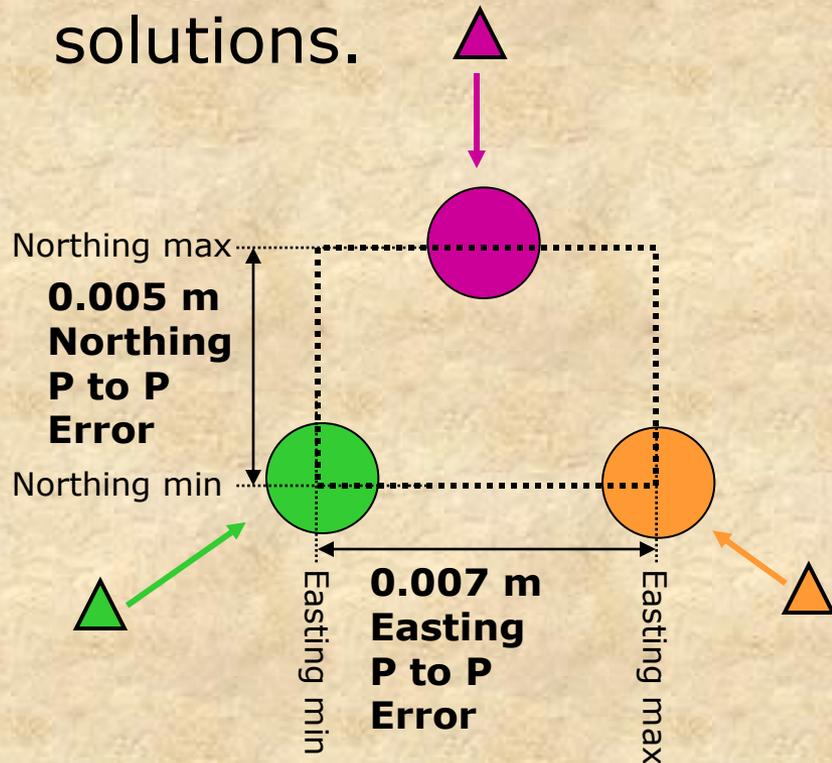
- 1. OPUS chooses the 3 best nearby CORS**
- 2. Computes 3 baselines**
- 3. Determines 3 positions**
- 4. Averages the 3 positions by a simple mean (equal weights) to a single position**

Note: Differences between positions include any errors in CORS coordinates

Peak to Peak Errors

□ OPUS Peak to Peak Errors

- Separation of the maximum and minimum component values from the 3 separate CORS solutions.



OPUS Static solution report

FILE: 40732440.DAT 000365396

NGS OPUS SOLUTION REPORT

USER: scott.lokken@noaa.gov
RINEX FILE: 40732441.05o

DATE: September 06, 2005
TIME: 20:10:24 UTC

SOFTWARE: page5 0411.19 master16.pl
EPHEMERIS: igr13384.eph [rapid]
NAV FILE: brdc2440.05n
ANT NAME: TRM33429.00+GP
ARP HEIGHT: 2.0

START: 2005/09/01 11:32:00
STOP: 2005/09/01 13:48:00
OBS USED: 4544 / 4655 : 98%
FIXED AMB: 33 / 34 : 97%
OVERALL RMS: 0.017(m)

REF FRAME: NAD_83(CORS96)(EPOCH:2002.0000)

ITRF00 (EPOCH:2005.6672)

X: 919178.547(m) 0.036(m)
Y: -5079512.938(m) 0.169(m)
Z: 3734025.188(m) 0.077(m)

919177.873(m) 0.036(m)
-5079511.465(m) 0.169(m)
3734025.044(m) 0.077(m)

LAT: 36 3 49.18906 0.041(m)
E LON: 280 15 25.67545 0.013(m)
W LON: 79 44 34.32455 0.013(m)
EL HGT: 205.291(m) 0.185(m)
ORTHO HGT: 235.970(m) 0.186(m)

36 3 49.21526 0.041(m)
280 15 25.65943 0.013(m)
79 44 34.34057 0.013(m)
203.937(m) 0.185(m)

[Geoid03 NAVD88]

	UTM COORDINATES	STATE PLANE COORDINATES
	UTM (Zone 17)	SPC (3200 NC)
Northing (Y) [meters]	3991740.943	256914.963
Easting (X) [meters]	613214.002	542677.824
Convergence [degrees]	0.74013195	-0.42876127
Point Scale	0.99975793	0.99997288
Combined Factor	0.99972572	0.99994066

US NATIONAL GRID DESIGNATOR: 17SPV1321491741(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
AI4198	HIPT HIGH POINT CORS ARP	N355756.487	W0800048.938	26717.9
DG7016	NCAS ASHEBORO CORS ARP	N353749.456	W0794553.601	48115.4
DF9213	NCBU BURLINGTON CORS ARP	N360529.586	W0792612.176	27750.6

NEAREST NGS PUBLISHED CONTROL POINT

DE7964	35W 200	N360349.195	W0794434.332	0.3
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Metadata stats

ITRF

UTM and SPC

Metadata stats

NAD83

NGS OPUS SOLUTION REPORT
=====USER: scott.lokken@noaa.gov
RINEX FILE: 4082208r.05oDATE: February 22, 2006
TIME: 16:32:16 UTCSOFTWARE: page5 0601.10 master29.pl
EPHEMERIS: igs13333.eph [precise]
NAV FILE: brdc2080.05n
ANT NAME: TRM33429.00+GP NONE
ARP HEIGHT: 2.0START: 2005/07/27 17:05:00
STOP: 2005/07/27 19:19:00
OBS USED: 3603 / 3646 : 99%
FIXED AMB: 18 / 27 : 67%
OVERALL RMS: 0.026(m)

REF FRAME: NAD_83(CORS96)(EPOCH:2002.0000)

ITRF00 (EPOCH:2005.5692)

X:	1089872.681(m)	0.090(m)	1089872.009(m)	0.090(m)
Y:	-5125746.179(m)	0.239(m)	-5125744.683(m)	0.239(m)
Z:	3623660.943(m)	0.084(m)	3623660.790(m)	0.084(m)
LAT:	34 50 37.98863	0.075(m)	34 50 38.01428	0.075(m)
E LON:	282 0 13.92566	0.138(m)	282 0 13.91203	0.138(m)
W LON:	77 59 46.07434	0.138(m)	77 59 46.08797	0.138(m)
EL HGT:	-9.461(m)	0.231(m)	-10.865(m)	0.231(m)
ORTHO HGT:	26.467(m)	0.233(m)	[Geoid03 NAVD88]	

	UTM COORDINATES	STATE PLANE COORDINATES
	UTM (Zone 18)	SPC (3200 NC)
Northing (Y) [meters]	3859825.607	121809.557
Easting (X) [meters]	226036.083	701405.274
Convergence [degrees]	-1.71288291	0.57940289
Point Scale	1.00052518	0.99989777
Combined Factor	1.00052666	0.99989926

US NATIONAL GRID DESIGNATOR: 18STD2603659826(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DG5759	NCLI LILLINGTON 2004 CORS ARP	N352512.546	W0784840.339	98008.3
DG4687	NCRD RALEIGH DOT CORS ARP	N354549.508	W0783444.395	115000.6
AM7011	CASL CASTLE HAYNE CORS ARP	N342040.707	W0775231.382	56479.3

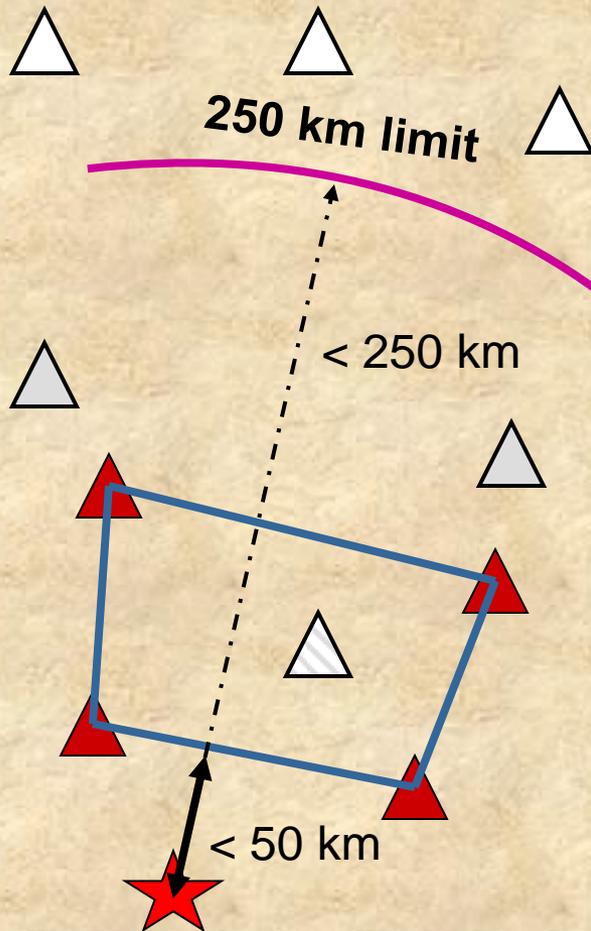
NEAREST NGS PUBLISHED CONTROL POINT

EB1945	ROSE HILL FIRE TOWER	N344949.143	W0780104.093	2490.4
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Peak to Peaks Errors are relatively large:

- **Horz: 14 cm**
- **Vert: 23 cm**

OPUS-RS search algorithm



- 1. Sort stations in CORS network by distance from rover.**
- 2. Select up to 9 CORS that are < 250 km from rover and that have suitable data.**
 - No solution is computed if < 3 CORS are selected.
 - No solution computed if distance from rover to polygon enclosing selected CORS is > 50 km.

OPUS-RS solution report

FILE: GPS20722.DAT 000816027

NGS OPUS-RS SOLUTION REPORT

USER: gary.thompson@ncmail.net
RINEX FILE: gps2072t.08o

DATE: March 13, 2008
TIME: 01:22:35 UTC

SOFTWARE: rsgps 1.19 RS30.prl 1.23a
EPHEMERIS: igul4703.eph [ultra-rapid]
NAV FILE: brdc0720.08n
ANT NAME: TRM22020.00+GP
ARP HEIGHT: 2.0

START: 2008/03/12 19:43:15
STOP: 2008/03/12 20:28:30

OBS USED: 5040 / 5670 : 89%
QUALITY IND. 23.41 / 38.54
NORMALIZED RMS: 0.275

REF FRAME: NAD_83(CORS96)(EPOCH:2002.0000)

ITRF00 (EPOCH:2008.19628)

X:	1175881.439(m)	0.008(m)	1175880.727(m)	0.008(m)
Y:	-5116235.353(m)	0.024(m)	-5116233.855(m)	0.024(m)
Z:	3610239.640(m)	0.019(m)	3610239.495(m)	0.019(m)

LAT:	34 41 48.27049	0.004(m)	34 41 48.29654	0.004(m)
E LON:	282 56 37.30132	0.009(m)	282 56 37.28724	0.009(m)
W LON:	77 3 22.69868	0.009(m)	77 3 22.71276	0.009(m)
EL HGT:	-31.208(m)	0.030(m)	-32.622(m)	0.030(m)

ORTHO HGT: 5.979(m) 0.039(m) [Geoid03 NAVD88]

UTM COORDINATES

STATE PLANE COORDINATES

	UTM (Zone 18)	SPC (3200 NC)
Northing (Y) [meters]	3841338.101	106766.534
Easting (X) [meters]	311654.751	787663.934
Convergence [degrees]	-1.17086076	1.12184283
Point Scale	1.00003725	0.99991919
Combined Factor	1.00004215	0.99992409

US NATIONAL GRID DESIGNATOR: 18SUD1165541338(NAD 83)

BASE STATIONS USED

PID	DESIGNATION	LATITUDE	LONGITUDE	DISTANCE(m)
DI4788	NBR6 NEW BERN 6 CORS ARP	N351029.898	W0770259.335	53057.5
AM7011	CASL CASTLE HAYNE CORS ARP	N342040.707	W0775231.382	84742.4
DI1071	NCKN KENANSVILLE CORS ARP	N345630.497	W0775849.945	88818.6
AJ2915	WASR WASHINGTON CORS ARP	N353334.802	W0770331.543	95734.4
DI1680	NCET ELIZABETHTOWN CORS ARP	N343913.601	W0783111.734	134217.6
DJ8943	NCWH WHITEVILLE CORS ARP	N341649.590	W0784259.331	159323.7
DH9594	NCFA FAYETTEVILLE 2006 CORS ARP	N350202.489	W0785214.731	170068.0
DG5759	NCLI LILLINGTON 2004 CORS ARP	N352512.546	W0784840.339	179068.4
DG5313	NCPI PEA ISLAND CORS ARP	N354102.040	W0752856.350	180389.4

NEAREST NGS PUBLISHED CONTROL POINT

EA1381	SIMKINS RM 1	N344151.	W0770325.	102.7
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OPUS Projects

Controls

? ← ↻

Preferences

Design

Serfil

Solutions

Show File

Send Email

Set up Adjustment

Review and Publish

Delete Project

LEGEND

MARKS: ● meet preferences ○ do not meet preferences ⊗ are not included ⊗ have error

CORS: ● meet preferences ○ do not meet preferences ⊗ are not included

Baselines: —

Map Satellite Terrain

Map data ©2011 Google - Terms of Use

LEGEND

MARKS

● albe

● marl

Add MARKS

CORS

▲ ncco

▲ nccr

▲ ncel

▲ ncli

▲ ncwi

Add CORS

Sessions & Solutions				
MARKS	2010-347	2010-354	network 1stFCA dj	MARKS
albe	⊗	⊗	●	albe
marl	⊗	⊗	●	marl



OPUS-Projects Manager Training

July 11-12, 2011

Courtyard by Marriott San Diego Downtown

530 Broadway

San Diego, CA 92101

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Contact Us

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Fax: (540) 373-4327

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Class is full. To be added to the waiting list, e-mail us.

NGS is currently beta-testing a Network Processing Option for OPUS known as **OPUS-Projects**. This feature will allow the processing, adjustment and publishing of multiple stations over multiple days. Because of the increased complexity of this capability, the creation and management of Projects for OPUS is limited to those who have completed an OPUS-Projects Workshop.

Workshop Outline

Introduction

Step 1: Creating a Project

Step 2: Uploading Data To Your Project

Step 3: Session Processing

Step 4: Network Adjustment and Publishing

Open Discussion

One-on-one

What Is OPUS-Projects?

- Web-based access to process multiple marks and multiple occupations
- Data uploading through OPUS
- Data processing using the PAGES software
- Visualization and management aids

Do We Really Need Another OPUS Flavor?

- Yes. The NGS and other groups have a history of projects whose specifications can't be entirely supported by OPUS
- Yes, again. As good as OPUS does, and that is very good indeed, sacrificing simplicity for flexibility can improve results in many cases

What's In This Workshop?

- By attending this workshop, you should have enough information to successfully use OPUS-Projects for your own projects. Once the training is completed, you'll be given an opportunity to register your email address thereby authorizing you to create and process new OPUS-Projects.
- This is an interactive workshop, which means attendees should bring their own laptop for use during the workshop. Wireless internet connectivity will be available.
- A project containing a training data set will be assigned to you. You'll have an opportunity to work along with the presentations plus time is allotted for you to explore your project individually.

Real Time Network (RTN)

- ❑ **Acceptable methods for a grid tie**
- ❑ **Proper field procedures should be used to insure the quality of the data collected**
- ❑ **Redundant observations when possible**

21 NCAC 56.1607 GLOBAL POSITIONING SYSTEMS SURVEYS

(a) General. Global Positioning Systems (GPS) are defined as the navigation and positioning systems that comprise the Global Navigation Satellite System (GNSS), which includes NAVSTAR, GLONASS, GALILEO, COMPASS, and any other satellite-based navigation and positioning systems.

(b) The Professional Land Surveyor in responsible charge of the GPS survey shall certify all prepared documents. When a map or document consists of more than one sheet, only one sheet must contain the certificate and all others must be certified. The certificate or metadata notes shall contain the following information:

- (1) Class of GPS survey as defined in the Standards of Practice (or list the sections);
- (2) Type of GPS field procedure, such as Static, Kinematic, Pseudo-Kinematic, Real-time Kinematic, Real-time Kinematic networks, and Online Position User Service;
- (3) Positional accuracy;
- (4) Dates of survey;
- (5) What datum and epoch coordinates or geographic positions are based on;
- (6) Designation of fixed-control stations and their positional data;
- (7) Geoid model used;
- (8) Combined grid factor(s); and
- (9) Units.

Grid ties

Other methods of grid ties:

■ Static GPS

■ RTK GPS

■ Traverse

F. SAMPLE CERTIFICATE Combining a boundary survey, GPS certificate

I, _____ certify that this plat was drawn under my supervision from an actual survey performed under my supervision (deed description recorded in Book ____, page ____, etc.) (other); that the boundaries not surveyed are clearly indicated as drawn from information found in Book ____, page ____; that the ratio of precision as calculated is 1: ____; that the Global Positioning System (GPS) survey and the following information was used to perform the GPS (GNSS if dual constellations are used) survey:

Class of survey _____

Positional accuracy _____

Type of GPS field procedure: _____

Dates of survey: _____

Datum/Epoch: _____

Published/Fixed-control use: _____

Geoid model: _____

Combined grid factor(s): _____

Units: _____

That this plat was prepared in accordance with G.S. 47-30 as amended (if the survey is not a G.S. 47-30, remove this sentence).

That this plat meets the requirement of G.S. 47-30 section F-11-____ (insert the section in F-11 that matches this survey if it is a 47-30 survey)

Witness my original signature and seal this the _____ day of _____.

Board Rule 56.1607

The certificate shall be substantially in the following form:

"I, _____, certify that this map was drawn under my supervision from an actual GPS survey made under my supervision and the following information was used to perform the survey:

- (1) Class of survey: _____
- (2) Positional accuracy: _____
- (3) Type of GPS field procedure: _____
- (4) Dates of survey: _____
- (5) Datum/Epoch: _____
- (6) Published/Fixed-control use: _____
- (7) Geoid model: _____
- (8) Combined grid factor(s): _____
- (9) Units: _____"

(c) GPS surveys performed to provide control networks shall be performed in such a manner that a 95 percent confidence level of the positional accuracy of each point relative to the published positions of the control points used and shall meet the accuracy standards of a Class AA survey as set out in Rule .1603.

(d) GPS surveys performed to provide local horizontal or vertical Grid control on a parcel of land where the boundary or topography of that parcel will be shown relative to NC Grid horizontal or vertical datum shall be performed using techniques that will provide the standards of accuracy for the class of survey being performed while determining the horizontal or vertical positions of objects as set out in Rule .1603 or Rule .1606 as applicable.

(e) Fixed station(s) used for the project shall appear on the map, plat, or report. The minimum data shown for each fixed station shall be station name, horizontal position (northing and easting) or latitude, longitude, elevation (ellipsoid or orthometric), and datum and epoch.

History Note: Authority G.S. 89C-10; 89C-20;

Eff. November 2, 1992;

Amended Eff. August 1, 2011; May 1, 2009; August 1, 2002; August 1, 2000.

Policies

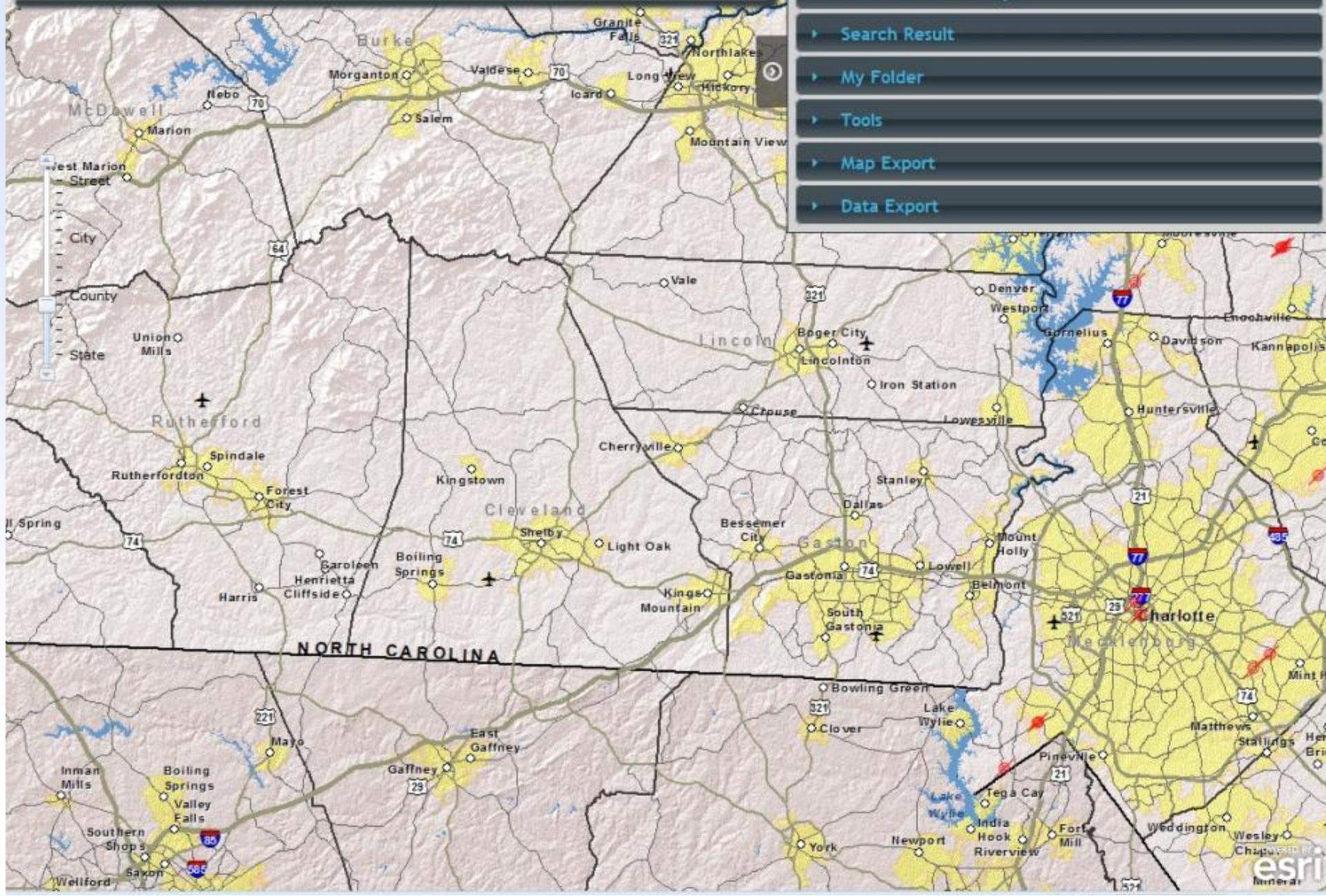
Positional Tie Reporting Policy BP-1012-02 Rev 1

When tools such as Online Positioning User Service (OPUS) or a Real Time Network (RTN) are used to position a property corner, in lieu of reporting the Continuous Operating Reference Station(s) (CORS) positions (State Plane Coordinates or geographic position) as required by 21 NCAC 56.1602 (g) and .1607(b)(6) & (e), a statement by the PLS indicating that OPUS or a RTN was used to determine the position(s) of a property corner(s) or control monument(s) and report of the positional information provided by the tool, such as OPUS or RTN will meet the requirement of reporting the positional information of the published control as required in 21 NCAC 56.1602(g) and .1607(b)(6) & (e).

Map Theme       

Display distances in **US Survey Feet** 

- [▶ Monument Summary](#)
- [▶ Search Result](#)
- [▶ My Folder](#)
- [▶ Tools](#)
- [▶ Map Export](#)
- [▶ Data Export](#)



NC Geodetic Survey Geodetic Database
Monument Report

Monument

Name	PID	County
Radio	FZ2601	Alleghany
Condition Disk	Owner	Type
Traverse Station Disk	NGS	Disk

Vertical Stability

Commonly subject to surface ground movements.

Map



Position

Date	Latitude	Longitude	Northing	Easting
7/1/2008	36° 22'	081° 13'	963,317.47 ift	1,344,757.60 ift
	35.45488"	32.66915"		
Order	Convergence	Scale Factor	Elevation Factor	Combined Factor
No order	GEOID09	-105.3 ift		
Datum	Source	Technique	Local Accuracy	Network Accuracy
NAD83/2007				

Position History

Date	Datum	Order	Latitude	Longitude	Northing	Easting
6/19/2006	NAD83/1986	Second Order	36° 22'	081° 13'	963,318.54 ift	1,344,756.94 ift
			35.46530"	32.67747"		

Radio, FZ2601, 1, 20100817



Radio, FZ2601, 3SW, 20100817



Tie to control corners

- **Control monuments within a previously recorded subdivision may be used in lieu of grid control**
- **NC General Statute 39-32.1**
 - One or more corners of such development to be designated as “control corner “
 - And two or more street center lines or offset lines within or on the street right-of-way lines to be permanently monumented at intersecting center lines or offset lines, points of curvature or such other control points, which monuments shall also be designated as “control corners”

Article 5A.:

Control corners in real estate developments

§ 39-32.1. Requirement of permanent markers as "control corners."

Whenever any person, firm or corporation shall hereafter divide any parcel of real estate into lots and lay off streets through such real estate development and sell or offer for sale any lot or lots in such real estate development, it shall be the duty of such person, firm or corporation to cause one or more corners of such development to be designated as "control corner" and shall cause two or more street center lines or offset lines within or on the street right-of-way lines to be permanently monumented at intersecting center lines or offset lines, points of curvature or such other control points, which monuments shall also be designated as control corners and to affix or place at such control corner or corners permanent markers which shall be of such material and affixed to the earth in such a manner as to insure as great a degree of permanence as is reasonably practical. (1947, c. 816, s. 1; 1959, c. 1159.)

Tie to natural or artificial mons

Massive objects

- Natural or man-made objects that are easy to identify and have, or can accept, finite points that can be measured to with certainty

Other artificial monuments

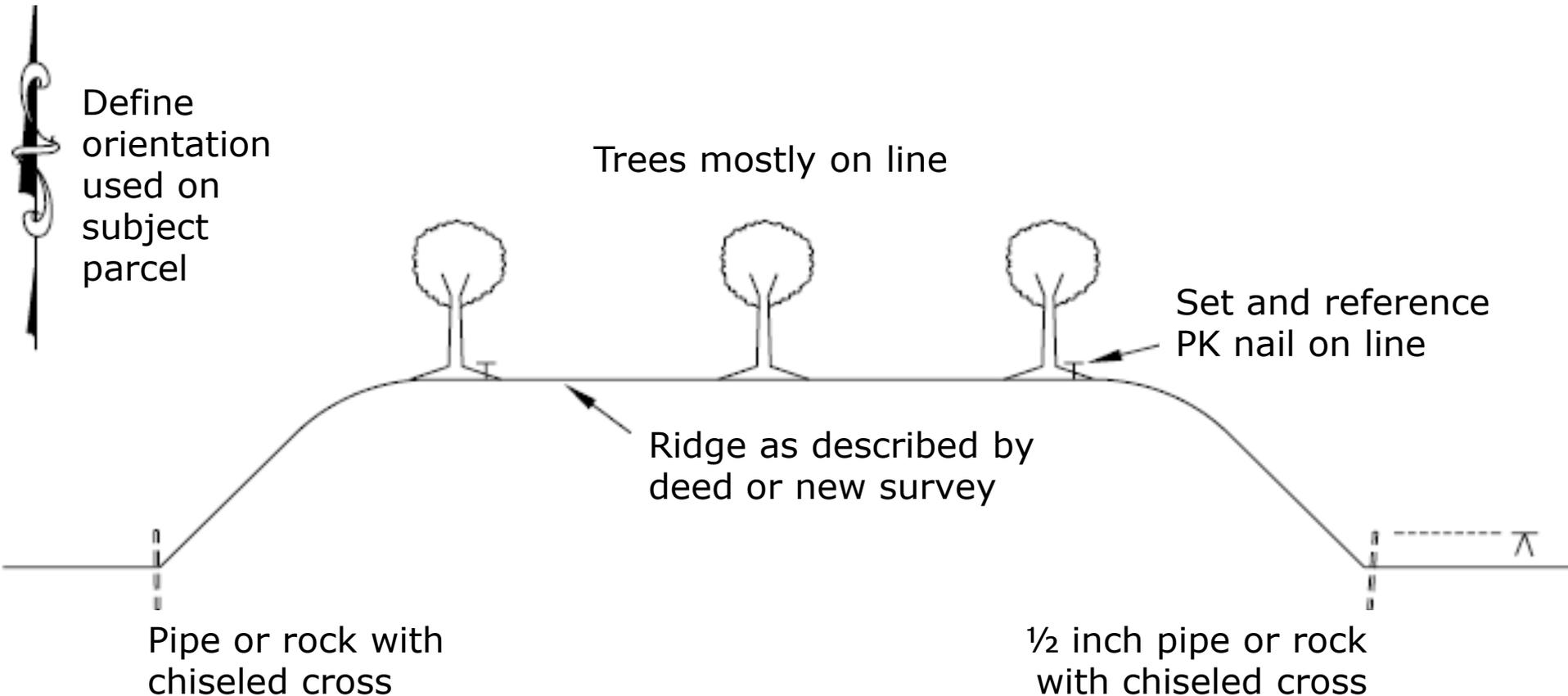
- Use property corners of the highest permanent quality
 - Include corner metadata
 - The use of adjoining property corners requires the use of:
 - At least two (2) adjoining record corners
~ or ~
 - One (1) record corner and one (1) other point that is visible from the referenced adjoining corner

Artificial monuments

□ PK nails and spikes

- Tend to be less permanent and more likely to be destroyed
- Artificial points should be used when no other alternative is available
- Artificial points in road intersections are acceptable, but they are considered to be the lowest preference

Example of reference points on line



Set as many points as would be necessary on ridge lines (that represent existing or proposed boundary line) that would be needed to re-establish or retrace boundary line with minimal work.

Reference monuments

- **Board Rule 21-56.1602(e) states:**
Where a corner falls in a right-of-way, in a tree, in a stream, or on a fence post, boulder, stone, or similar object, one or more monuments or metal stakes shall be placed in the boundary line so that the inaccessible point may be located accurately on the ground and the map.

Legend

- **All symbols, acronyms, and line types used on a plat should be clearly defined in the legend per Board Rule 21-56.1604(d)(11)**

Note: Other Professional Land Surveyors may be familiar with the symbol or acronym, but the public in most cases will not understand the meaning of the symbols or acronyms.

Metadata

- ❑ **Data about data**
- ❑ **Metadata provides a description of the data included in the plat or report**
- ❑ **Examples**
 - Horizontal/vertical datums
 - Units
 - Property corner description
 - ❑ Material
 - ❑ Found or set
 - ❑ Above, below, or flush with ground level

METADATA: Data about data

□ **Datums:**

- **Horizontal:** NAD 27, NAD 83(1986), NAD83 (199X), etc.
- **Vertical:** NGVD29, NAVD88, MLLW, MSL, MHW, etc.

□ **Units:**

- Meters, U.S. survey feet, international feet, chains, rods, poles, links, smoots, etc.

□ **Accuracy:**

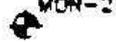
- A, B, 1st, 2nd, 3rd, 3 cm, scaled, etc.

Vertical control datums

- **A set of fundamental elevations to which other elevations are referred.**
- **Datum types:**
 - **Geodetic:**
 - Directly or loosely based on Mean Sea Level at one or more points at some epoch
 - Examples: NGVD 29, NAVD 88, IGLD85, etc.
 - **Tidal:**
 - Defined by observation of tidal variations over some epoch of time
 - Examples: MSL, MLLW, MLW, MHW, MHHW, etc.

Where's the METADATA??

- Horizontal & vertical datums ??
- Plane Coordinate System ??
- Units of measure ??
- Accuracy ??

LEGEND:	
	EXISTING CONTOURS
	EXISTING SANITARY SEWER
	EXISTING STORM DRAIN
	EDGE OF VEGETATION
	EXISTING STREET LIGHT
	EXISTING UTILITY POLE
	NEW CONTOURS
	MONITORING POINT

MONITORING POINTS

<u>POINT No.</u>	<u>NORTHING</u>	<u>EASTING</u>	<u>ELEV. (MLLW)</u>
MON-1	708,407.42	1,178,660.64	16.91
MON-2	708,270.52	1,178,806.49	18.89
MON-3	708,133.66	1,178,952.30	19.14
MON-4	707,996.80	1,179,098.10	17.39
MON-5	707,859.83	1,179,243.87	18.00

Good METADATA

Station Name: LT16

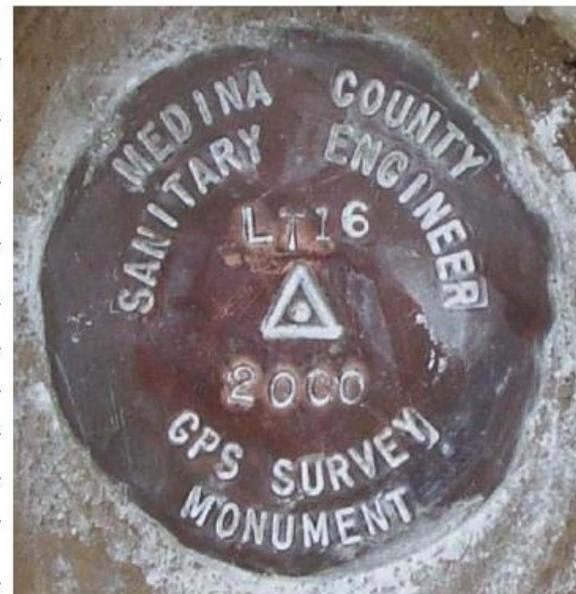
Alias: 45 (DF7225)

USGS Quad: MALLET CREEK (1994)

Township: LITCHFIELD

Type: 3½ INCH DIA BRONZE DISK IN A 12 INCH
DIA 48 INCH DEEP CONCRETE MONUMENT WITH A
12 INCH PVC SLEEVE

Set By: MCSE Date Set: 01/15/2000



Horiz. Datum	<u>NAD83(1995) OHIO NORTH</u>	Horizontal Order	<u>FIRST</u>
Latitude	<u>41° 08' 09.54479" N</u>	Longitude	<u>81° 58' 33.63918" W</u>
Northing US Feet	<u>535740.8372</u>	Easting US Feet	<u>2112831.3309</u>
Northing Meters	<u>163294.1338</u>	Easting Meters	<u>643992.2776</u>
Convergence	<u>0° 20' 39.25"</u>	Scale Factor	<u>0.99993985</u>
Vertical Datum	<u>NAVD88</u>	Vertical Order	<u>SECOND (GPS DERIVED)</u>
Ortho Ht. US Ft.	<u>1149.8462</u>	Ortho Ht. Meters	<u>350.4738</u>
Ellipsoid Ht. US Ft.	<u>1039.5604 (316.8586 m)</u>	Geoid Ht. US Ft.	<u>-110.2858 (-33.6151₃₂m)</u>

Changes to NAD83

(using North Carolina as an example)

- **NAD83(1986)**-Started as Classic horizontal network
- **NAD83(1995)**-High Accuracy Reference Network (HARN)
 - Observed with GPS using some CORS as control
- **NAD83(2001)**-Federal Base Network (FBN) and Cooperative Base Networks (CBN)
 - Observed with GPS with Tight CORS control. Also aimed at increasing ellipsoid height accuracy
- **NAD83(NSRS2007)**
 - CORS system primary control, used only quality GPS projects. CORS system well developed.
- **NAD83(2011)** - Current Adjustment

Report of Survey

- The map or report of survey is required for property boundaries, easements authoritative encumbrances of property boundaries and to wetland boundaries. It is not required for construction staking.

Report of Survey

- In lieu of preparing a plat for the client a “Report of Survey” can be provided to the client that includes the following information:
- Outline of Report of Survey:
 - General description of survey
 - Who performed the survey
 - Recipient of survey
 - General description of what was surveyed and purpose of survey

Report of Survey

- Provide information concerning deeds and plats that were examined for the survey
- Report the evidence that was recovered
- Provide a description of corners that were set

Report of Survey

- General metadata of survey
 - Bearing reference
 - Horizontal/Vertical datums
- Certification Statement to Standards of Practice

Report of Survey: Sample

I certify that this survey was done under my responsible charge in compliance with the Standards of Practice for Land Surveying (21-56.1600) for (name of recipient of survey) for the purpose of locating the boundaries and corners of Lot #6 and #7 of the Acme Subdivision recorded on plat book B-214 in Waldon County North Carolina Register of Deeds.

That before I performed the survey I examined the following deeds and plats recorded in the Waldon County Register of Deeds:

Plat recorded in B-214
Deed Book 216-192

Plat recorded in Plat Book 8-95
Deed Book 218-200

That after examining the deeds and plats, I examined the property and found:

1/2" iron pipe flush with the ground at the southeast corner of Lot #6
1/2" iron pipe flush with the ground at the southwest corner of Lot #6
No other corners were found.

Upon completion of the survey, I set new 1/2" iron rods flush to the ground at remaining corners of Lot #6 and #7. No visible encroachments were observed.

All bearings are referenced to the North Carolina State Plane Coordinate System (NAD(NSRS2007)), and all distances are horizontal distances.

This _____ day of _____, 20_____.

Seal

Professional Land Surveyor

Questions?

