

SURVEY REPORT

2006

GEODETTIC CONTROL DENSIFICATION  
AND RESTORATION

of

JEFFERSON COUNTY, KENTUCKY

JUNE 2006

Jacobi, Toombs and Lanz, Inc.  
401 West Main Street, Suite 600  
Louisville, Kentucky 40202



# SURVEYOR'S REPORT

## Opening Statement:

This report provides an explanation of the methods used in the execution of this restoration and densification survey of the existing GPS network established by the Louisville/Jefferson County Information Consortium. Several other documents and exhibits are provided within this report which further elaborate the survey computations and procedures.

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**Introduction:**

Within the last few years the Louisville/Jefferson County Information Consortium (LOJIC) has put together an accurate GPS network throughout Jefferson County, Kentucky and portions of the surrounding counties. LOJIC has employed Jacobi, Toombs and Lanz, Inc. (JTL) to provide monument restoration in areas where monuments have been reported missing and densification of the current GPS network.

**Scope:**

Curt Bynum, LOJIC GIS Coordinator and Project Administrator, requested the Contractor, JTL, to provide densification of the current Geodetic Control Network. This project required JTL to coordinate with LOJIC and define areas where restoration and densification were needed and set monuments where GPS observations could be taken.

**Reference Datums:**

All restored monuments were to be on the following datums:

Horizontal datum: North American Datum of 83 (NAD 83) tied to the NGS's High Accuracy Reference Network (HARN)

Vertical Datum: North American Vertical Datum of 1988 (NAVD88)

**New Monument Installation:**

All monuments were constructed with a 3½" standard survey disk set in a poured-in-place 10" diameter concrete cylinder to a depth of 40". These monuments were installed intervisible with the remaining station or azimuth mark.

**Contractor's Responsibility:**

The Contractor's responsibility was to compile reports of missing or disturbed monuments and then field verify whether these reports were accurate. In cases where the monument was no longer useable, a new monument was placed in the vicinity of the original monument and referenced with new control monument description sheets and digital photographs.

The Contractor's responsibility also included compiling information and determining areas where monument densification was needed. Factors in determining these areas were:

1. Evaluating where the existing monument spread was greatest (reducing the two-mile grid to a one-mile grid).
2. Population growth and development.
3. MSD capital improvement projects.

JTL was instructed to utilize any suitable existing MSD control monuments when available and to install new monuments. Digital photographs as well as new reference ties were completed for future recovery and update of the control sheets. All of the monuments were incorporated into the existing GPS network using proper GPS field procedures and reducing by Least Squares to compile coordinate values.

## **Project Areas:**

### ***Areas of Restoration***

- Area No. 1: LOJIC monument STA014-2001 located along Broad Run Road 1.3 miles south of Back Run Road was reported damaged.
- Area No. 2: LOJIC monument AZI014-2001 located along Broad Run Road 1.42 miles south of Back Run Road was reported damaged.
- Area No. 3: LOJIC monument WC 2 located within the West County Treatment Plant was reported damaged.
- Area No. 4: LOJIC monument GPS 86-14 located on top of a flood levee just off of Lower River Road (0.3 miles north of Mill Creek) was reported damaged.
- Area No. 5: LOJIC monument AZITV1-2001 located at the corner of Hikes Lane and Breckenridge Lane was reported damaged.
- Area No. 6: LOJIC monument STA028-2001 located along Taylorsville Road 2.1 east of the Gene Snyder Freeway was reported damaged.
- Area No. 7: LOJIC monument BK 09-01, located at the end of a dead end street off of Lavel Drive, coordinate values did not match the location of the monument.
- Area No. 8: LOJIC monument BL 09-01, located behind house No. 5501 Landcross Drive coordinate values did not match the location of the monument.

### ***Areas of Densification***

- Area No. 1: Greenwood Road just west of Dixie Highway.
- Area No. 2: Preston Highway just North of Miles Lane.
- Area No. 3: Taylorsville Road just west of Hurstbourne Parkway

## **Reconnaissance Report:**

### ***Restoration***

- Area No. 1: The monument was destroyed due to recent construction; a new monument was set in this area.
- Area No. 2: The monument was destroyed due to recent construction; a new monument was set in this area.
- Area No. 3: The monument was destroyed due to recent construction of a new roadway. A new monument was set in this area.
- Area No. 4: The monument was recovered but was missing the aluminum cap. A new monument was set in this area.

- Area No. 5: The monument was destroyed due to recent construction; a new monument was set in this area.
- Area No. 6: The monument was recovered in a concrete headwall that had been hit. A new monument was set in this area.
- Area No. 7: The existing monument was recovered and new coordinate values were established for this point
- Area No. 8: The existing monument was recovered and new coordinate values were established for this point

### ***Densification***

- Area No. 1: One existing monument set by Park Aerial Survey Inc. was used and a new monument was set in this area.
- Area No. 2: Once field reconnaissance was complete and all utilities were marked, and new monuments were set at this area.
- Area No. 3: Once field reconnaissance was complete and all utilities were marked, and new monuments were set at this area.

### **GPS Equipment and Procedures:**

Four Trimble 5700 GPS receivers were used throughout the static network. Each session was a minimum of 20 minutes. At the end of each day the receivers were checked in and data entry logs were collected. Mission planning was utilized so GPS observations were taken at times when the Position Dilution of Precision (PDOP) was four or below. Once all of the sessions were complete, Trimble Geomatics Office software was used to calculate and evaluate loop closures, and perform the network adjustment.

### **Network design:**

Once the new monuments were in place, existing LOJIC monuments were selected as project control. The control was selected in a configuration to optimize the stability of the GPS network both horizontally and vertically. A significant amount of redundancy was incorporated in this network for quality control.

### **Evaluation/Comparison of Coordinate Values:**

In any survey adjustment, a decision must be made on which monuments should be held or constrained. For Network #1 (West) adjustment Louisville South Base, AZIBU0701-2001, STA044-2001 and GPS86-11 were constrained to horizontally. Then Louisville South Base, AZIBU0701-2001, AZI8614-2001, and GPS86-11 were constrained to vertically. For Network #2 adjustment STA049-2003, GPS86-38 and AZI8641-2001 were constrained to horizontally. Then GPS86-38, STA009-2001, TV-1, and AZI028-2001 were constrained to vertically. Table 1 shows the differences between the published coordinates and the measurements produced by this network.

**TABLE 1  
COMPARISON OF COORDINATE VALUES**

NAME	△ HORIZONTAL (FEET)	△ VERTICAL (FEET)	CONSTRAINED	
			HORIZONTAL	VERTICAL
Network #1 (West)				
Louisville South			✓	✓
GPS86-11			✓	✓
STA044-2001		0.025	✓	
AZIBU0701-2001		0.032	✓	
AZI8614-2001	0.044			✓
STA005-2001	0.374	0.126		
WC 1	0.066	0.109		
BH11-01	0.032	0.095		
STA002-2001	0.021	0.026		

Network #2 (East)				
GPS86-38			✓	✓
STA049-2003		0.108	✓	
AZI8641-2001		0.217	✓	
TV-1	0.033			✓
STA009-2001	0.018			✓
AZI028-2001	0.047			✓
RILEY-3	0.020	0.051		
STA036-2001	0.023	0.012		

As a result of the constrained network, all but two of the non-constrained points were within 0.01 to 0.06 feet of their published coordinates horizontally and within 0.01 to 0.11 feet vertically. The two exceptions were point STA005-2001 that was 0.37 feet horizontally and 0.13 feet vertically from its published coordinates and AZI 8641-2001 that was 0.22 feet vertically from its published coordinates. To verify these findings, additional GPS observations were taken and added to the network for further verification. The additional data produced the same results.

The Network Adjustment Report can be found in Appendix B and Appendix C which includes adjustment style settings, statistical summaries, Geoid model statistics, weighting strategies, and adjusted coordinates with corresponding statistical data.