

**MINIMUM TECHNICAL STANDARDS  
FINAL REPORT OF SPECIFIC PURPOSE SURVEY**



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**DIGITAL ORTHOPHOTO IMAGE MAPS FOR  
POLK COUNTY, FLORIDA**

**SOUTHWEST FLORIDA WATER MANAGEMENT  
DISTRICT  
IN COOPERATION WITH THE  
POLK COUNTY PROPERTY APPRAISER**

**DISTRICT ORDER NO. 05PCS0W0030  
DISTRICT WORK ORDER NO. 2**

WOOLPERT PROJECT NO. 63507 AND 63514  
October 14, 2005

**MINIMUM TECHNICAL STANDARDS  
FINAL REPORT OF SPECIFIC PURPOSE SURVEY**



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POLK COUNTY, FLORIDA**

**Prepared By:**

Woolpert, Inc.  
One Purlieu Place, Suite 295  
Winter Park, Florida 32792

LB Number 0006777

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**FINAL REPORT OF SPECIFIC PURPOSE SURVEY**  
**DIGITAL ORTHOPHOTO IMAGE MAPS**  
**Polk County, Florida**

For:  
**Southwest Florida Water Management District**  
2379 Broad Street  
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Phone (352) 796-7211

In Cooperation With The:  
**Polk County Property Appraiser**  
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Prepared by:  
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# REPORT OF SPECIFIC PURPOSE SURVEY

## Digital Orthophoto Image (DOI) Maps For Polk County, Florida

### Purpose/Type of Survey

The purpose of this project was to develop color and color infrared DOI mapping, at a 1-foot pixel resolution, across Polk County, Florida to support engineering, hydrologic and environmental studies. To avoid duplicated effort and reduce the costs, Southwest Florida Water Management District (DISTRICT) and the Polk County Property Appraiser (PCPA) entered into a cooperative arrangement to contract Woolpert, Inc. (Woolpert) for the development of DOI at an intended map output scale of 1"=100'. The approximate size of the mapping area within the county was 2,148 square miles (see Appendix A: Survey Limits/Tile Layout), and the specific areas of responsibility between the District and the PCPA are discussed below under the Survey Area section. The end product complies with the Florida Administrative Code 61G17, Minimum Technical Standards for Surveying and Mapping.

As part of this effort, Woolpert acquired multi-spectral imagery using the Leica ADS40 sensor (panchromatic, red, green, blue and near infrared) at a ground sample distance of 0.66-feet to develop the DOI at a 1-foot pixel resolution (see Appendix B: Aerial Imagery and Ground Control Layout). Additionally, LiDAR data was acquired over the entire county and used to develop a digital elevation model (DEM) with which to rectify the imagery (see Appendix C: LiDAR and Ground Control Layout).

As mutually agreed between the DISTRICT, the County and Woolpert, the DOI horizontal accuracy was specified as the National Map Accuracy Standards for 1"=100' output scale mapping. Ground survey quality control (QC) checkpoints were acquired throughout the project area by the Polk County Property Appraiser and used to confirm the accuracy of the DOI. The accuracy analysis was based on methods outlined in the Geospatial Positioning Accuracy Standards, Part 3: National Standards for Spatial Data Accuracy (NSSDA) developed by the Federal Geodetic Data Committee (FGDC-STD-007.3-1998).

### Date of Survey

Ground control, LiDAR and aerial imagery acquisition for the survey was performed on the following dates:

- The ground control targeting and observations occurred between January 18 and January 27, 2005.
- The LiDAR data was acquired between January 30 and February 20, 2005.
- The aerial imagery was acquired between January 31 and March 2, 2005.

### Survey Area

The project area encompasses approximately  $\pm 2,148$  square miles within Polk County, Florida. Referring to Appendix A: Survey Limits/Tile Layout, the county is subdivided into 3 areas: Peace River Ortho/Topo: District (P692); Polk County Ortho: District (P692); and Polk County Ortho: PCPA. The Peace River Ortho/Topo: District (P692) area is comprised of 1,282 tiles, based on the District 5,000' by 5,000' tile system, and represents where both DOI and DTM were developed for the District. The Polk County Ortho: District (P692) is comprised of 583 tiles (as outlined above) and represents the area within the District's boundary where DOI only was developed for the District. The Polk County Ortho: PCPA is

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comprised of 530 tiles (as outlined above) and represents the area where DOI was developed for the Polk County Property Appraiser.

## Map Reference

There are no printed maps for this survey. All map data was delivered to the District and County in digital form only.

## Name of Responsible Surveyor

Savo Slijepcevic, CP, PSM  
Woolpert, Inc.  
One Purlieu Place, Suite 295  
Winter Park, Florida 32792  
Professional Surveyor and Mapper Number LS-0005438

## Name of Company

Woolpert, Inc.  
One Purlieu Place, Suite 295  
Winter Park, Florida 32792  
Florida Certificate of Authorization No. LB-0006777

## Abbreviations

2D – Two-Dimensional  
3D – Three-Dimensional  
ABGPS – Airborne GPS  
AGL – Above Ground Level  
AT – Aerial Triangulation  
CD – Compact Disc or DVD (Digital Video Disc)  
DEM – Digital Elevation Model  
DISTRICT – Southwest Florida Water Management District  
DOI – Digital Orthophoto Image Map or Image Raster Map  
DTM – Digital Terrain Model  
Dxy – Residual Horizontal Error  
FEMA – Federal Emergency Management Agency  
FCIR – False Color Infrared  
FGCC – Federal Geodetic Control Committee  
GeoTIFF – Georeferenced Tag(ged) Image File Format  
GPS – Global Positioning System  
GSD – Ground Sample Distance  
ID – Identification  
IMU – Inertial Measurement Unit  
Inc. – Incorporated  
LAS – Binary LiDAR File Format  
LiDAR – Light Detection And Ranging  
NAD 83-HARN – North American Datum 1983 High Accuracy Reference Network adjustment

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NAVD 88 – North American Vertical Datum of 1988  
NGS – National Geodetic Survey  
NOAA – National Oceanic and Atmospheric Administration  
NSSDA – National Standards for Spatial Data Accuracy  
PID – Photo Identifiable  
PSM – Professional Surveyor and Mapper  
PCPA – Polk County Property Appraiser  
QC – Quality Control  
RGB – Red, Green and Blue Bands  
RMSE – Root Mean Square Error  
RTK – Real Time Kinematic  
STD – Standard  
TIFF – Tag(ged) Image File Format  
USGS – United States Geological Survey  
US – United States  
Woolpert – Woolpert, Inc.  
XYZ – Easting, Northing and elevation grid coordinates (ASCII format)

## Definitions

**GeoTIFF:** GeoTIFF refers to TIFF files which have geographic (or cartographic) data embedded as tags within the TIFF file. The geographic data can then be used to position the image in the correct location and geometry on the screen of a geographic information display. GeoTIFF is a metadata format, which provides geographic information to associate with the image data. But the TIFF file structure allows both the metadata and the image data to be encoded into the same file (Ruth, 1999).

**Digital Orthophoto Imagery:** A digital image (raster) map produced from a series of aerial photographs that have been rectified to correct for aircraft tilt, terrain relief, and camera lens distortion. The resulting image has a consistent scale throughout, allowing the user to take direct measurements such as distances, angles, positions, and areas. The digital raster image is comprised of a digital grid of pixels, or picture elements. Each pixel has a row and column “address” (an  $X,Y$  coordinate) and an intensity value ranging from 0 to 255.

**Aerial Triangulation (AT):** A method of ground control extension or densification performed mathematically and in conjunction with a limited number of ground control points. This method of control extension or densification has been proven to be accurate and is in common use within the photogrammetric mapping community.

**Bare Earth Coverage:** A set of discrete XYZ values representing the terrain surface.

## Map Data (DOI) Accuracy

The horizontal accuracy of the DOI was independently verified through field survey methods by the PCPA. Fifty-six PID test points were acquired randomly throughout the county. Woolpert provided the PCPA with the DOI measurements of each PID point, and the County calculated the residual errors and provided these values to Woolpert, see Appendix F: DOI Accuracy Analysis.

**Horizontal Feature Accuracy:** Per contract specifications, the horizontal accuracy requirement of the digital orthophoto imagery (image raster mapping) is NMAS for 1"=100' output scale mapping, or 3.3-feet at the 90% confidence level. Based on Woolpert’s accuracy analysis (see Appendix F: DOI

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Accuracy Analysis), the tested horizontal accuracy of the DOI mapping is 1.5-feet at the 90% confidence level. Therefore, **the horizontal accuracy of the delivered DOI exceeds the accuracy requirements of this project by a factor of 2.2.**

## Datums/Coordinate Systems

The digital orthophoto imagery (DOI) data are in reference to the State Plane Coordinate System, Florida West Zone (902), in units of US Survey Feet. The horizontal datum is NAD83-HARN, and the vertical datum is NAVD88.

## Data Sources

Original Control Point Coordinates:      NGS Information Services  
NOAA, N/NGS12  
National Geodetic Survey  
SSMC-3, #9202  
1315 East-West Highway  
Silver Spring, MD 20910-3282  
Phone: (301) 713-3242  
Fax: (301) 713-4172  
[Email: info\\_center@ngs.noaa.gov](mailto:info_center@ngs.noaa.gov)  
<http://www.ngs.noaa.gov/>

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255 North Wilson Avenue  
Bartow, Florida 33830-3951  
Phone: (863) 534-4770  
Fax: (863) 534-4753  
Email: [paoffice@polk-county.net](mailto:paoffice@polk-county.net)  
<http://www.polkpa.org/>

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Fax: (407) 671-2571  
<http://www.woolpert.com>

## Methodology

To support engineering, hydrologic and environmental studies in Polk County Florida, the Southwest Florida Water Management District (DISTRICT) in cooperation with the Polk County Property Appraiser contracted Woolpert, Inc. (Woolpert) to develop color and false color infrared digital image raster maps (digital orthophoto imagery-DOI), with a 1-foot pixel resolution, at an intended output map scale of 1"=100'. The mapping limits encompass approximately 2,149 square miles as depicted in Appendix A: Survey Limits/Tile Layout.

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The methodology Woolpert employed to develop DOI on this project includes ground control targeting and survey, aerial data acquisition to include digital multi-spectral imagery and LiDAR, aerial triangulation of the imagery, classification of LiDAR to bare earth and non-bare earth coverages, differential rectification of the imagery, mosaicking of the imagery, and the extraction of DOI maps based on the DISTRICT 5,000' x 5,000' tile system.

## Ground Control Survey

The photogrammetric ground control network was comprised of 107 control points located to second-order horizontal and third-order vertical accuracies. Of the 107 photo control points, 13 new points were established by Woolpert for this project, and 94 were existing points. All control points were targeted prior to imagery acquisition with an 8' x 8' x 2' cloth or painted target. For a detailed overview of the ground control survey, refer to: Woolpert Photogrammetric Ground Control Survey Report, *Minimum Technical Standards, SWFWMD Peace River Topography (P692) & Polk County DOI Mapping Project, for the Southwest Florida Water Management District in cooperation with the Polk County Property Appraiser, March 2005.*

## Aerial Photography

Panchromatic, red, green, blue and near infrared imagery was acquired using the Leica ADS40 multi-spectral scanner (see Appendix B: Aerial Imagery and Ground Control Layout). The imagery was captured from an altitude of 6,340' AGL, providing a raw ground sample distance of 0.7-feet. A total of 85 flight lines of imagery (see Appendix B: Aerial Imagery and Ground Control Layout) were acquired over 10 sessions conducted on: January 31, 2005; February 5, 11, 12, 13, 18, 19, 20 and 21, 2005; and March 2, 2005.

## LiDAR

Two sets of LiDAR data were acquired using a Leica ALS50 (see Appendix C: LiDAR and Ground Control Layout). One set of data was captured at an average GSD of 1-meter and used to support DTM development in the Peace River (P692) project area. The other set of data was acquired at an average ground sample distance 2.2-meters and was used to develop DEM outside of the Peace River project area to support the orthophoto rectification. The LiDAR datasets were captured over 14 sessions on: January 30 and 31, 2005; February 1, 4, 5, 10, 11, 12, 13, 18, 19 (x2) and 20 (x2), 2005.

The ABGPS data was reduced using the GrafNav software package by Waypoint Consulting, Incorporated. The IMU data was reduced using the PosProc software package by Applanix Corporation. The initial LiDAR “point cloud” was derived through the ALS Post Processor software package by Leica Geosystems.

Once the initial LiDAR “point cloud” was derived, Woolpert performed QC to look for any systematic error within the LiDAR flights using proprietary software. After systematic error was identified and removed, the individual LiDAR flights were clipped to remove overlap between adjacent flight lines to provide a homogeneous coverage over the project extents. Using the homogeneous coverage, above ground features were classified and removed using proprietary software to produce the bare-earth coverage.

## Aerial Triangulation

Aerial triangulation was performed to extend or densify the network of control points established by the ground control survey. Aerial triangulation provides the proper number and pattern of control points for

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each stereo model derived from the imagery strips. This data is necessary to orient the imagery to the ground for the QC of LiDAR data and the rectification of raster images. For a detailed overview of the aerial triangulation, refer to: Woolpert Aerial Triangulation Report, *SWFWMD Peace River Topography (P692) & Polk County DOI Mapping Project, for the Southwest Florida Water Management District in cooperation with the Polk County Property Appraiser, October 2005.*

## LiDAR QC

From the triangulated aerial imagery, stereomodels were derived over the project limits. The bare-earth LiDAR (DEM) data was then subdivided into the stereomodel units. These units were imported into a softcopy stereoplotter and superimposed over their respective stereomodels. The technician then verified stereoscopically that the LiDAR data was consistent with the ground.

The LiDAR DEM was delivered in the LAS format based on the DISTRICT's 5,000' x 5,000' tile system.

## Digital Orthophoto Imagery (DOI)

Color (RGB) and false color infrared (FCIR) DOI was developed by rectifying the digital aerial imagery to correct for aircraft tilt, terrain relief, and camera lens distortion. Overlapping nadir images were derived from the triangulated flight lines. Full differential rectification was then performed on each derived image using the Z/I Imaging Corporation Base Rectifier software. Image mosaicking was performed between adjacent rectified images using OrthoVista software, version 3.3.0, developed by Stellacore Corporation of Parker, Colorado, and distributed by Inpho of Estes Park, Colorado. Processing for orthorectification and image mosaicking was performed on Micron Dual Pentium III, 1000 MHz, photogrammetric workstations.

After rectifying all of the digital aerial imagery, a controlled mosaic was developed from the individual digital orthophotography images to create a continuous base map. Orthorectification and mosaicking were performed at a 1.0-foot pixel resolution. Two-thousand three hundred and ninety-five (2,395) individual image tiles were extracted from the mosaic based on the DISTRICT's 5,000' by 5,000' tile system. For each image tile, an ArcINFO world file was generated to georeference the DOI within the ArcINFO environment.

## Accuracy Checks

The horizontal accuracy of the DOI was independently field verified by the Polk County Property Appraiser. Results of those field verifications are included in Appendix F: DOI Accuracy Analysis.

## References

<http://rockyweb.cr.usgs.gov/nmpstds/nmas.htm> – UGSG Internet Site for National Map Accuracy Standards

Woolpert Photogrammetric Ground Control Survey Report

*Minimum Technical Standards*

*SWFWMD Peace River Topography (P692) & Polk County DOI Mapping Project*

*Southwest Florida Water Management District in Cooperation with the Polk County Property Appraiser*

*March 2005*

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Woolpert Aerial Triangulation Report  
SWFWMD Peace River Topography (P692) & Polk County DOI Mapping Project  
Southwest Florida Water Management District in Cooperation with the Polk County Property Appraiser  
October 2005

## General Notes

1. This report is not complete without the CD's of the DOI mapping, and vice versa.
2. Intended display scale – This mapping is intended to be displayed at a scale of 1:1,200 (1"=100') or smaller.
3. This map complies with National Standards for Spatial Data Accuracy.
4. This map complies with the National Map Accuracy Standards for 1"=100' scale horizontal accuracy.

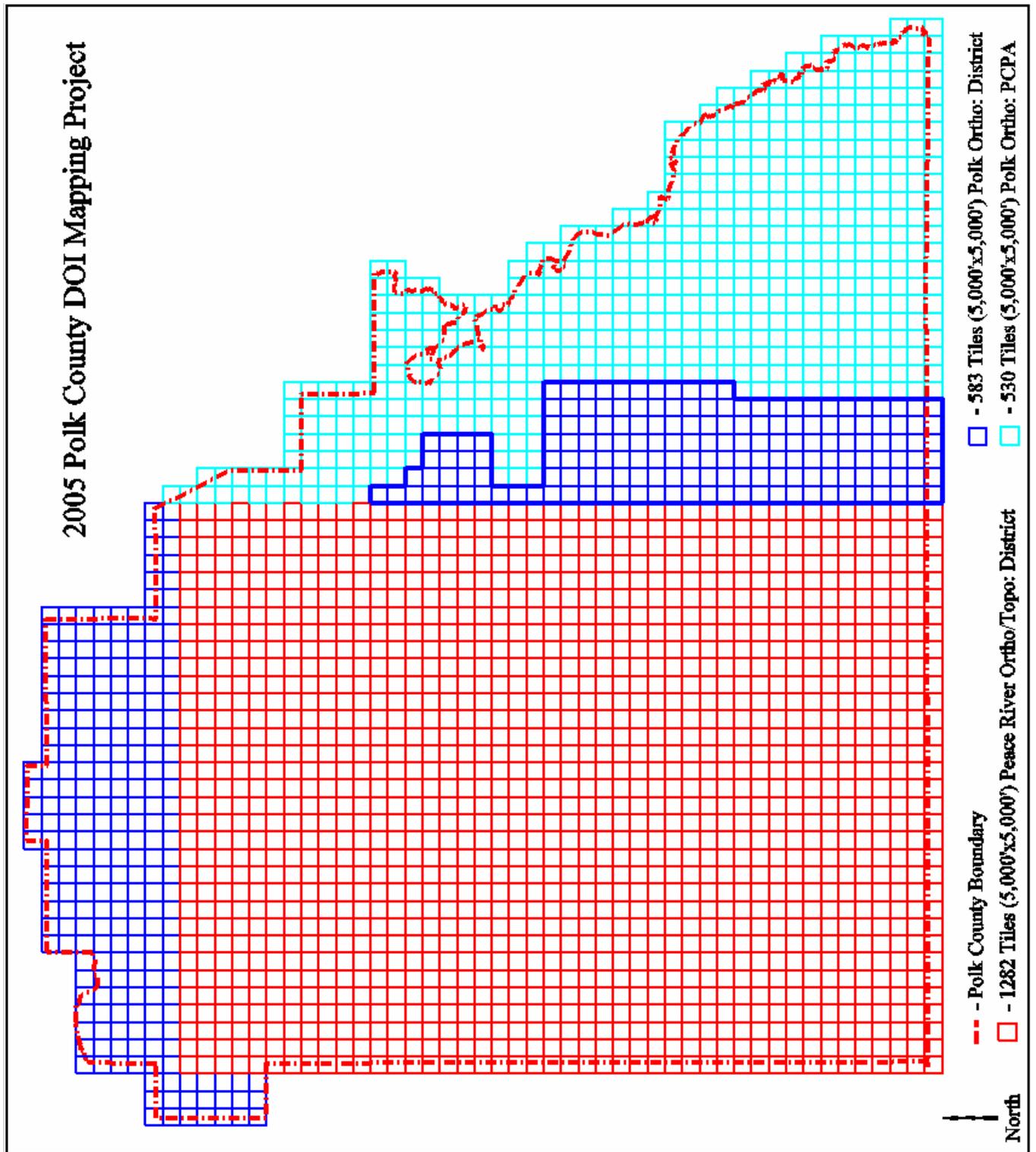
**THIS REPORT IS NOT VALID WITHOUT THE SIGNATURE AND RAISED SEAL OF A FLORIDA LICENSED SURVEYOR AND MAPPER IN RESPONSIBLE CHARGE.**

**Surveyor and Mapper in Responsible Charge:**

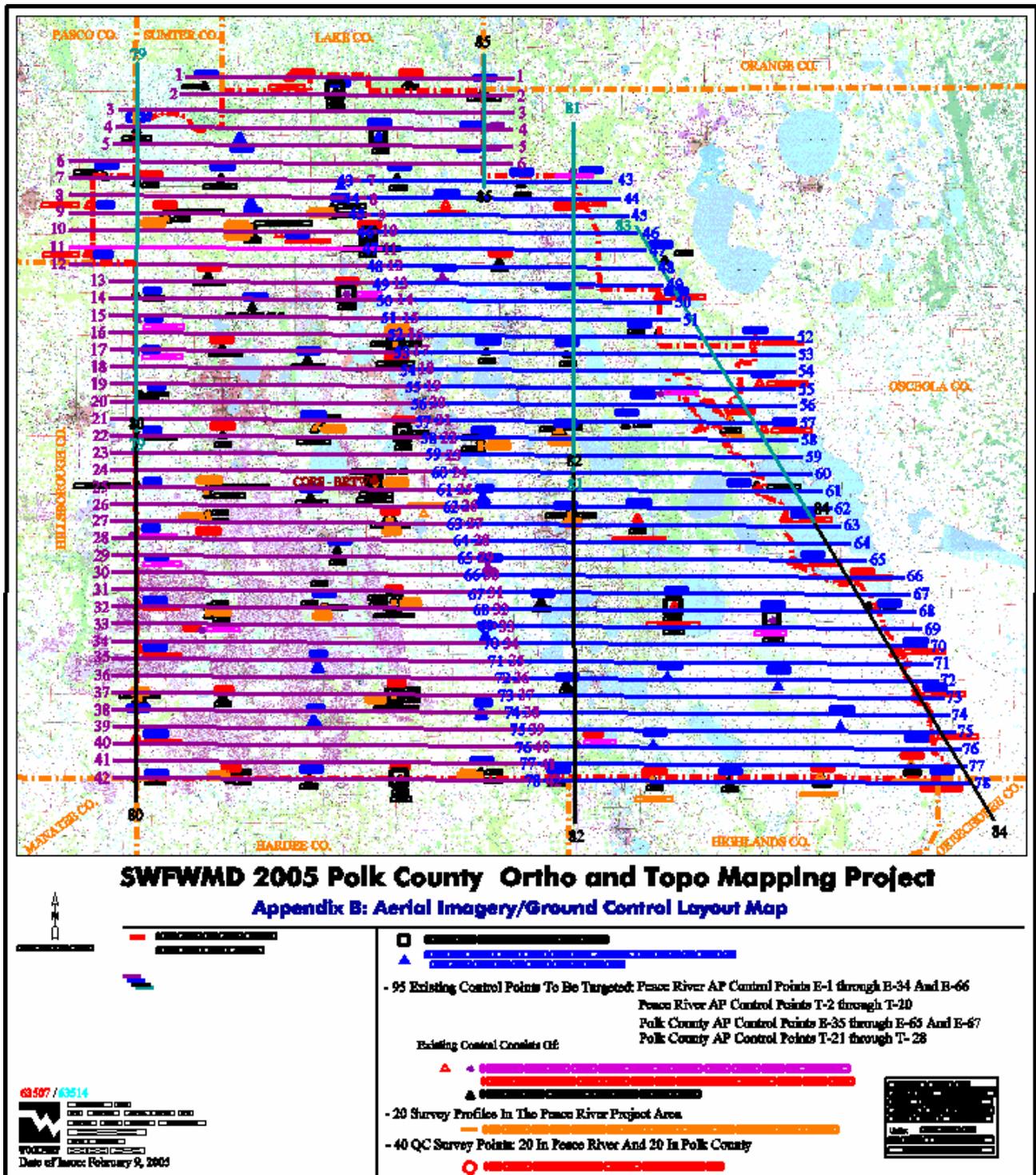
Savo Slijepcevic, CP, PSM  
Professional Surveyor and Mapper  
License #LS-0005438

Signed: Savo Slijepcevic Date: 10-14-05 Seal:

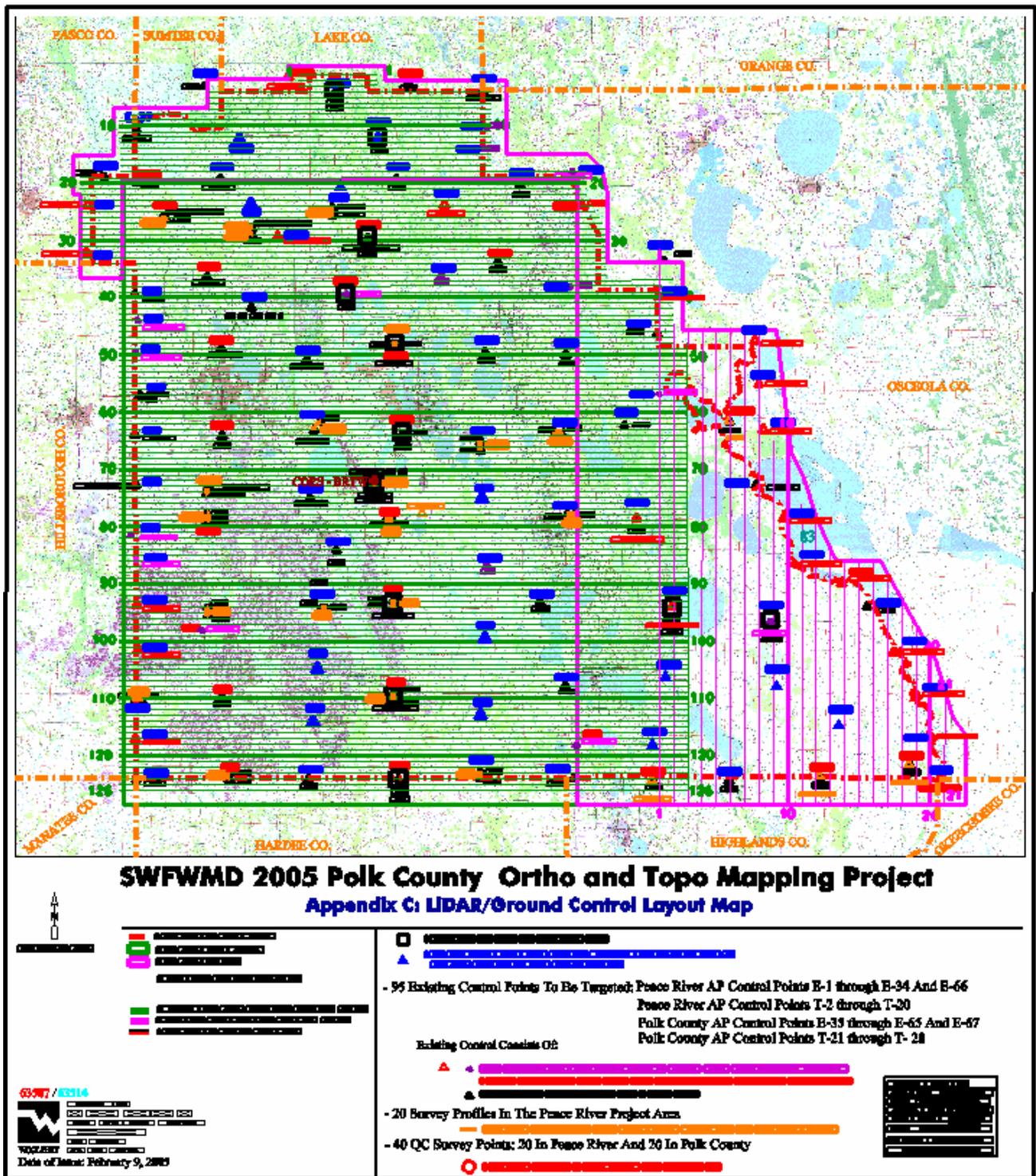
# APPENDIX A: SURVEY LIMITS/TILE LAYOUT



# APPENDIX B: AERIAL IMAGERY AND GROUND CONTROL LAYOUT

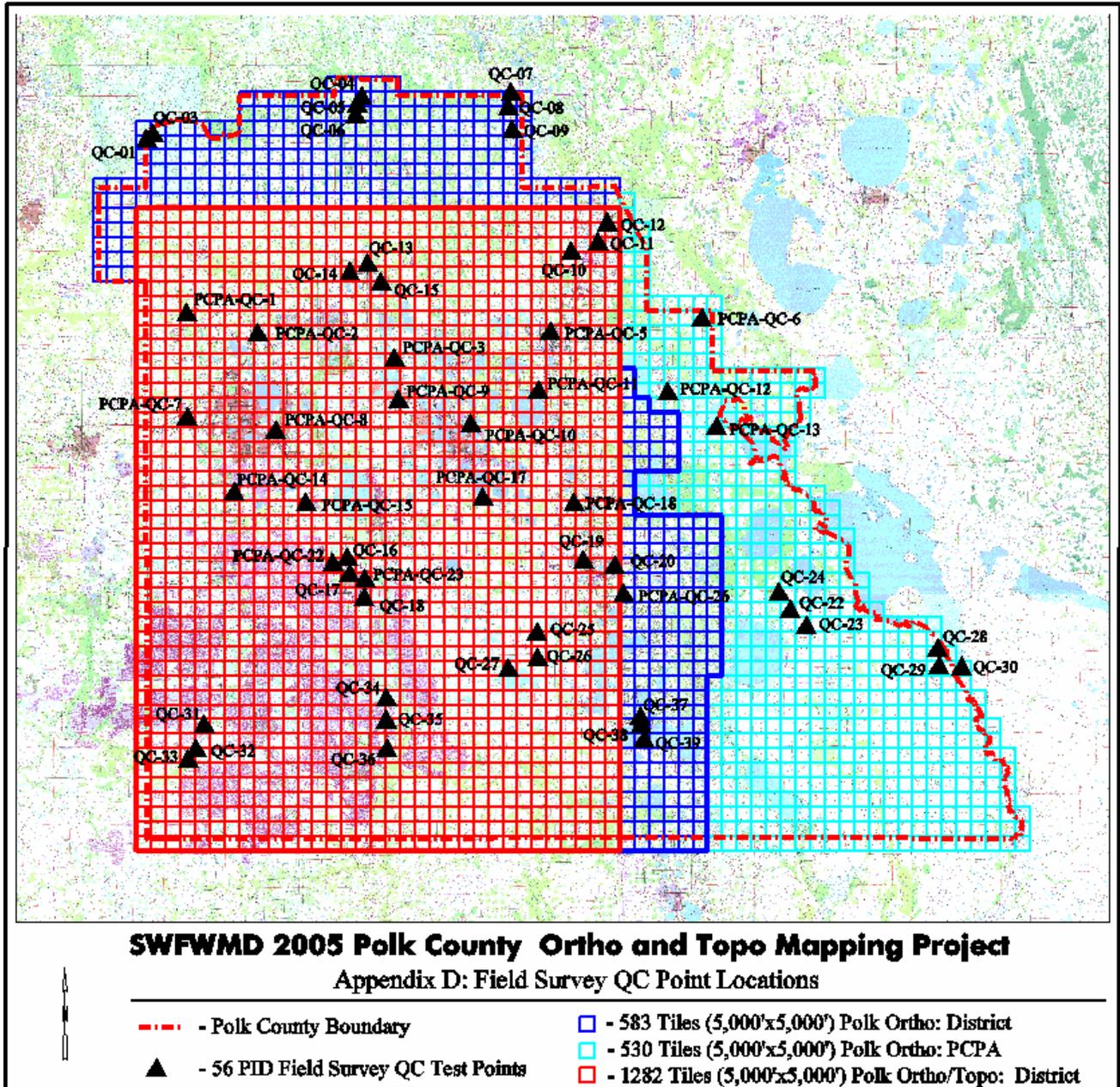


# APPENDIX C: LIDAR AND GROUND CONTROL LAYOUT



# APPENDIX D: FIELD SURVEY QUALITY CONTROL POINT LOCATIONS

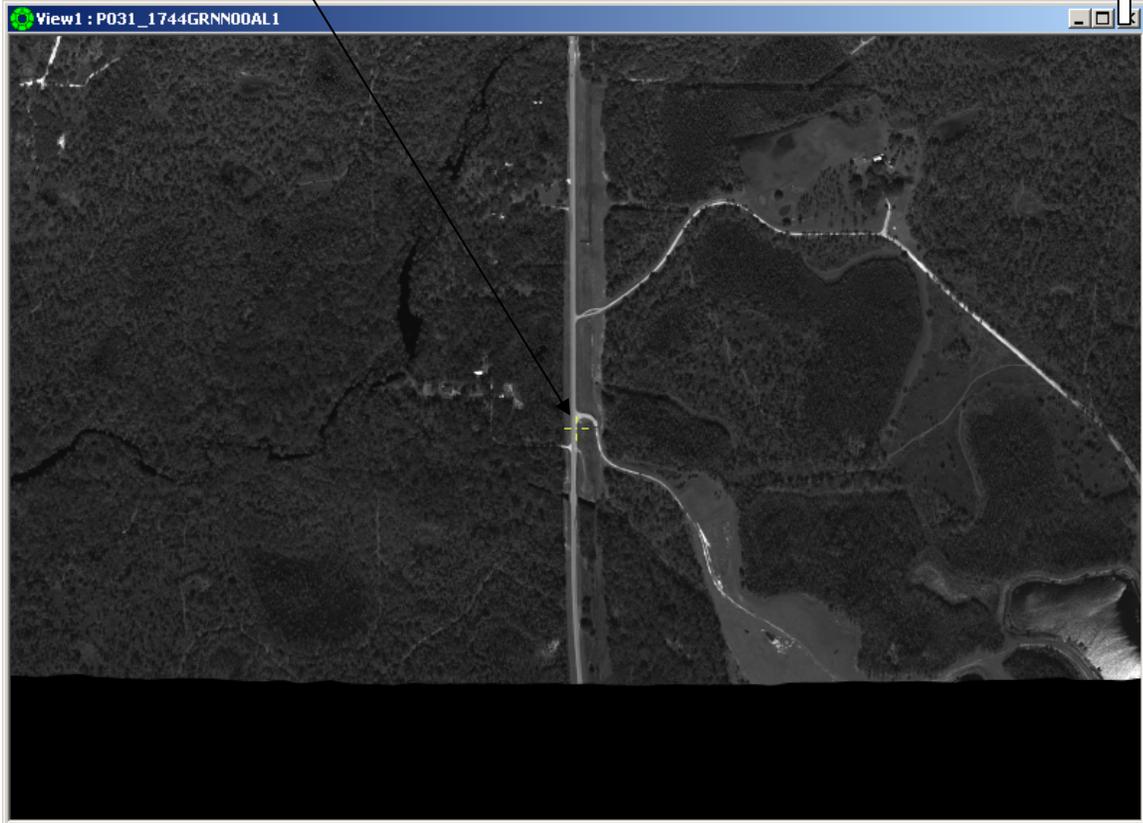
The horizontal accuracy of the DOI was verified by capturing field survey QC points on photo identifiable features. A total of 56 ground shots were captured randomly across the county by the Polk County Property Appraiser (see Appendix F: DOI Accuracy Analysis).





QC-1 Tip of turn arrow

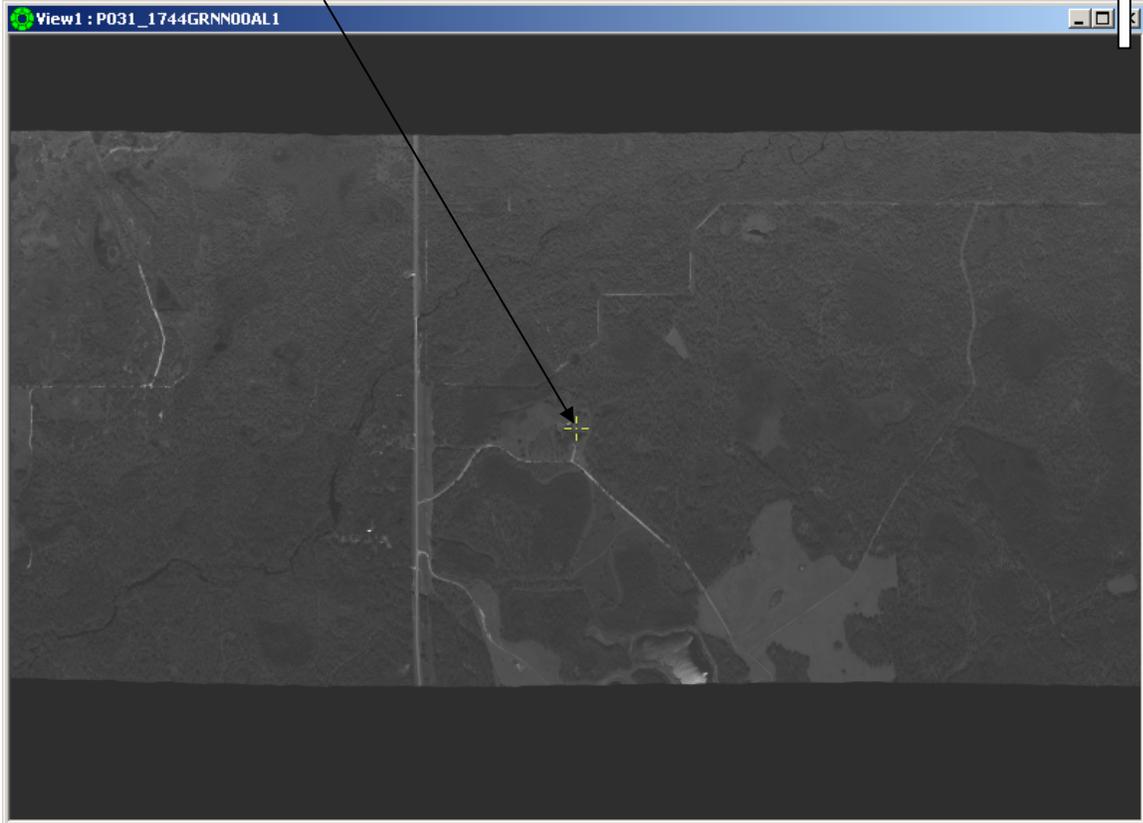
North

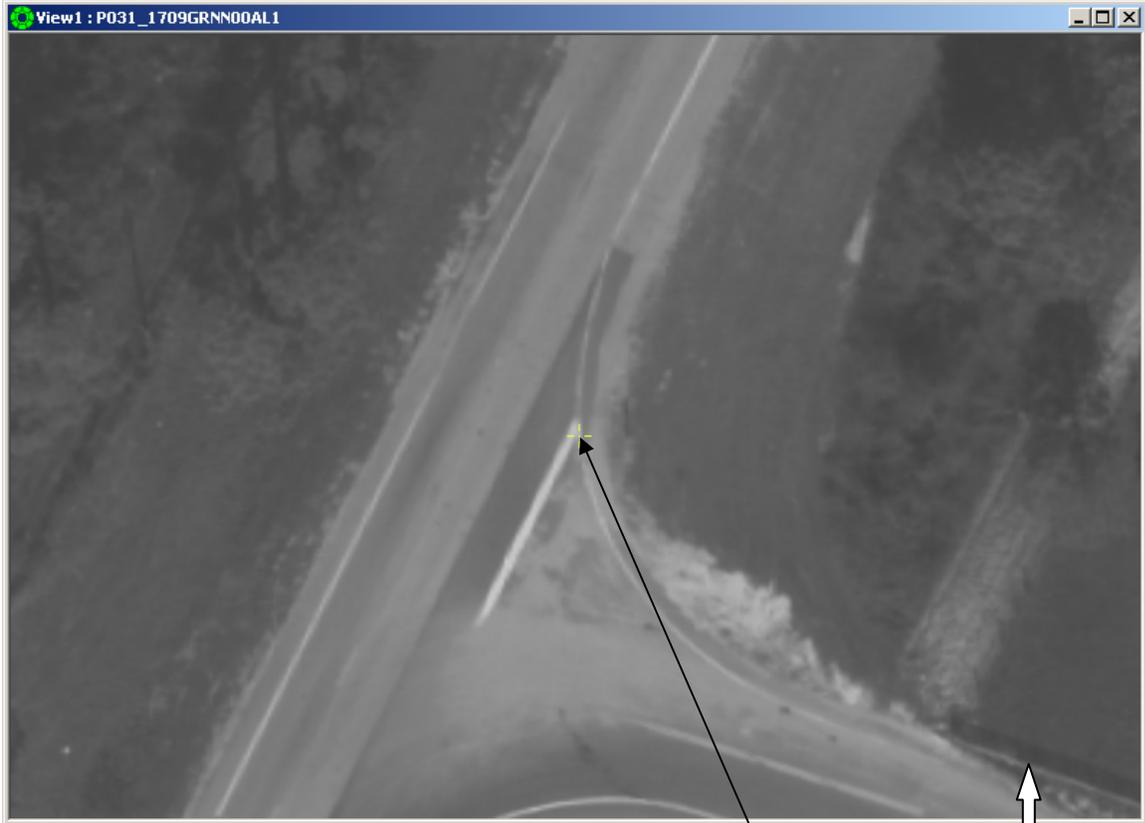




**QC-3 Corner of walks**

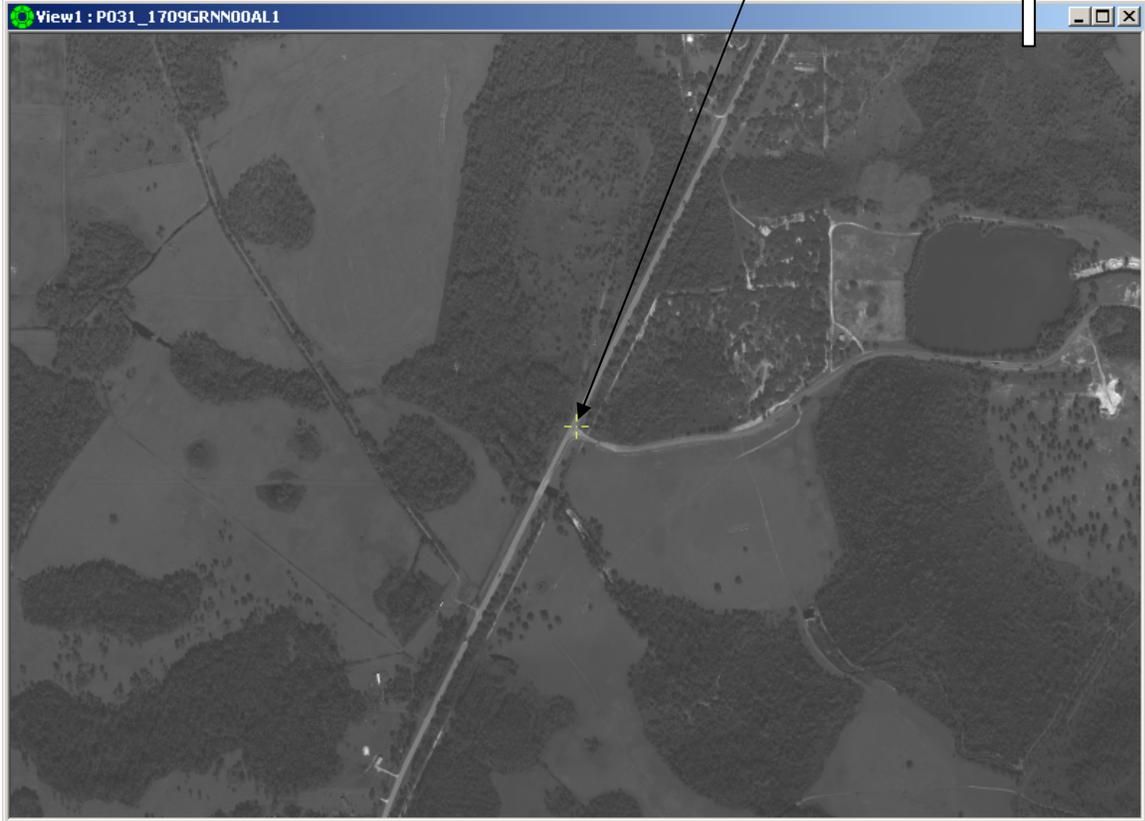
**North**

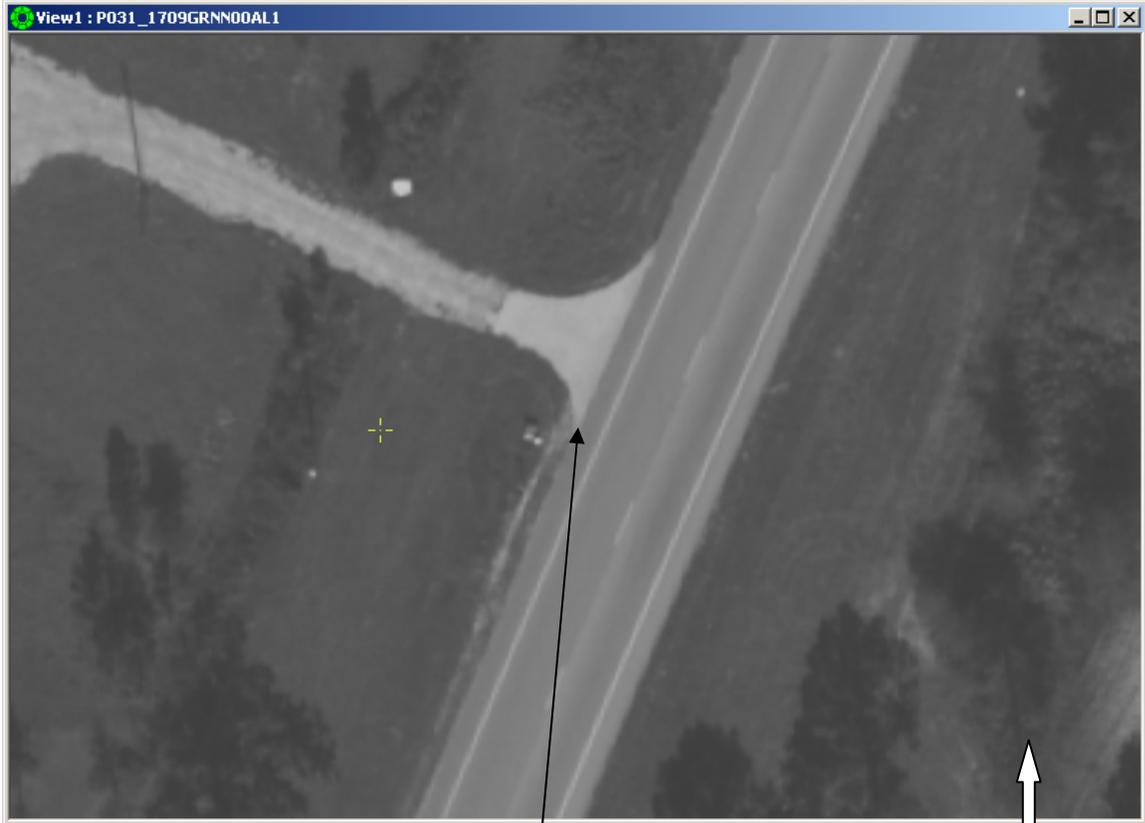




**QC-4 East edge of north end of stop bar at edge paint line**

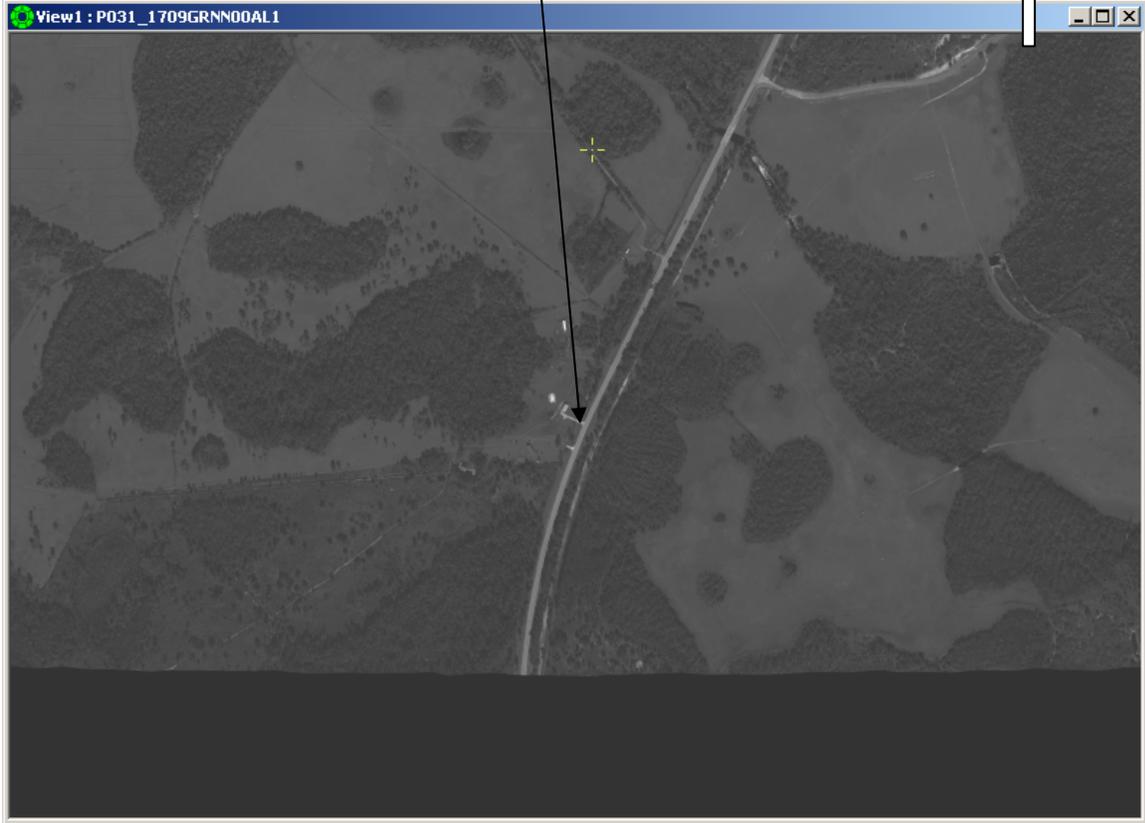
**North**





**QC-5 Edge of road at edge of drive apron**

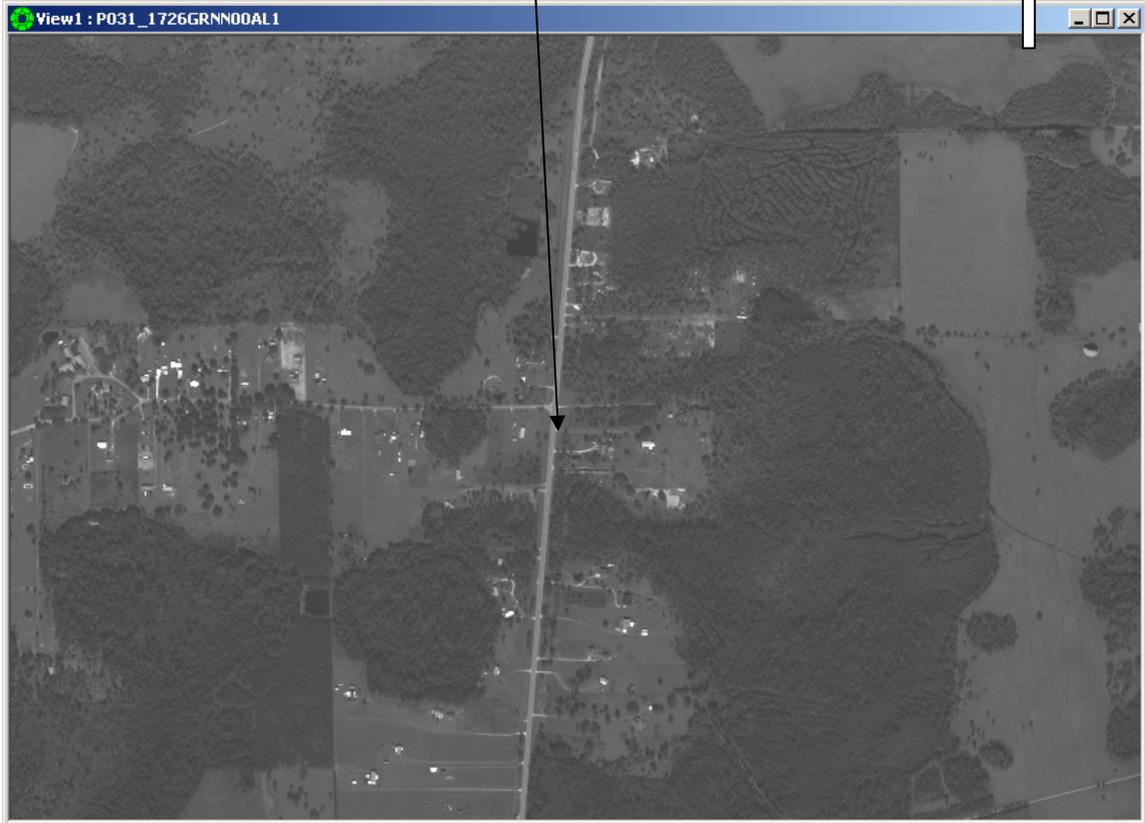
**North**





**QC-6 SE corner of concrete drive apron**

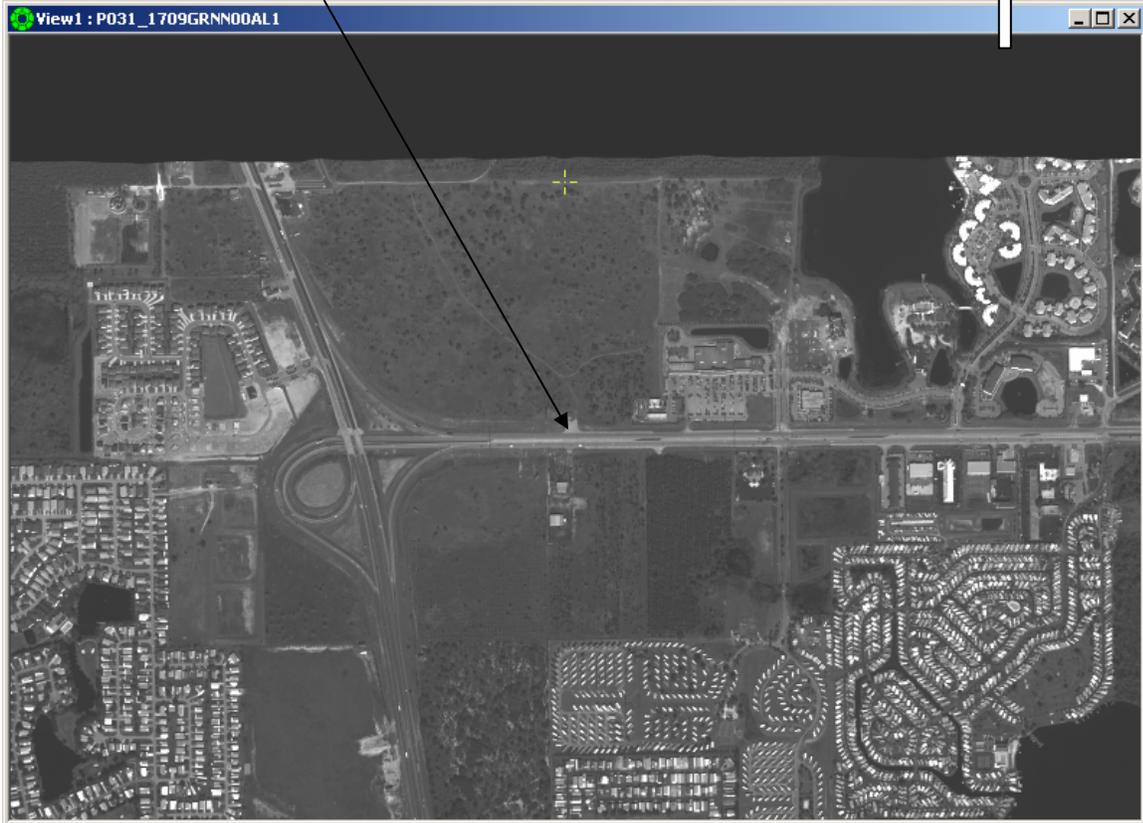
**North**





**QC-7 Tip of turn arrow**

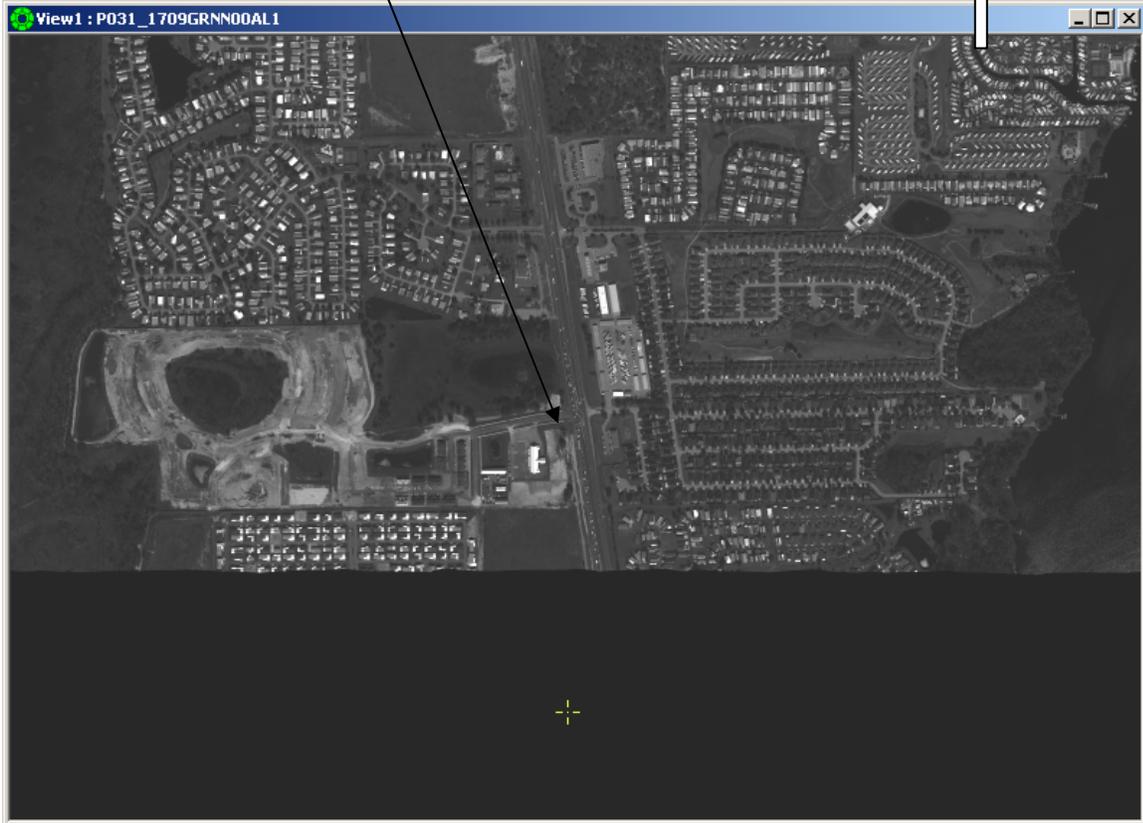
**North**





**QC-8 Northeast corner of walk**

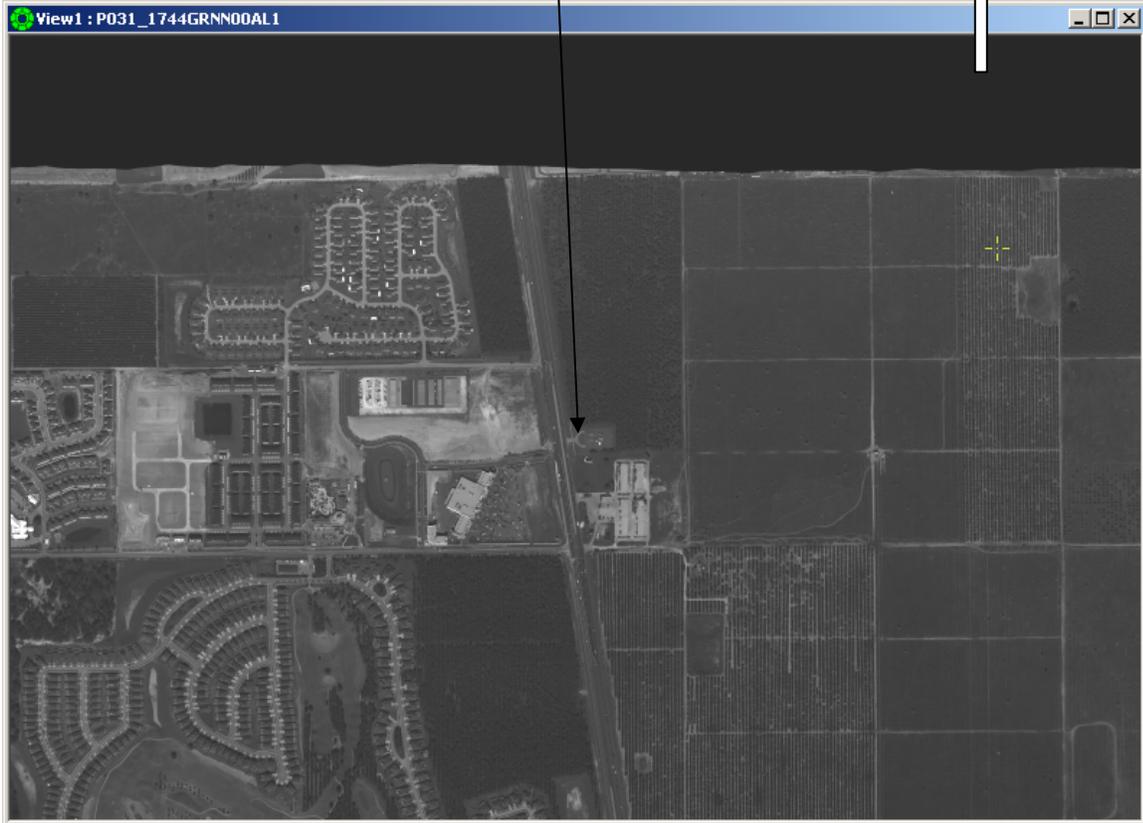
**North**





**QC-9 East edge of walk at north edge of drive**

**North**





**QC-10 East edge of road at change of pavement**

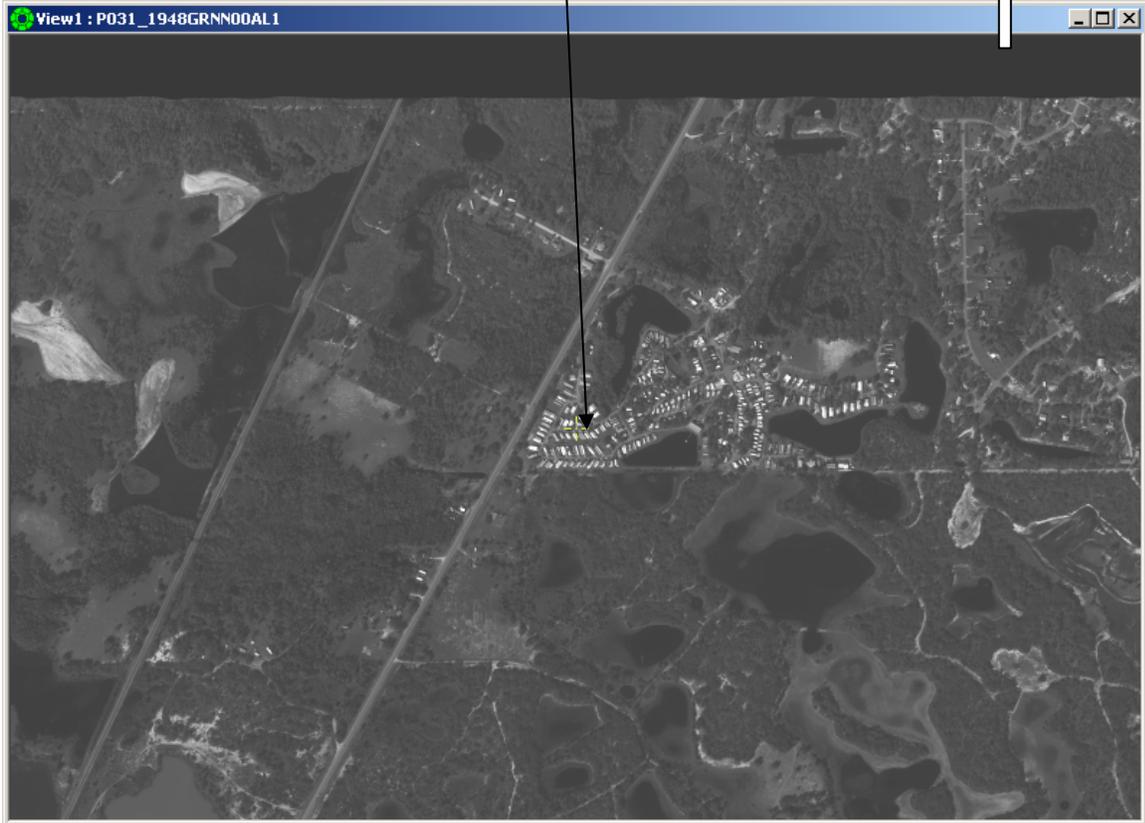
**North**





**QC-11 East edge of drive at north edge of road**

**North**





**QC-12 Tip of turn arrow**

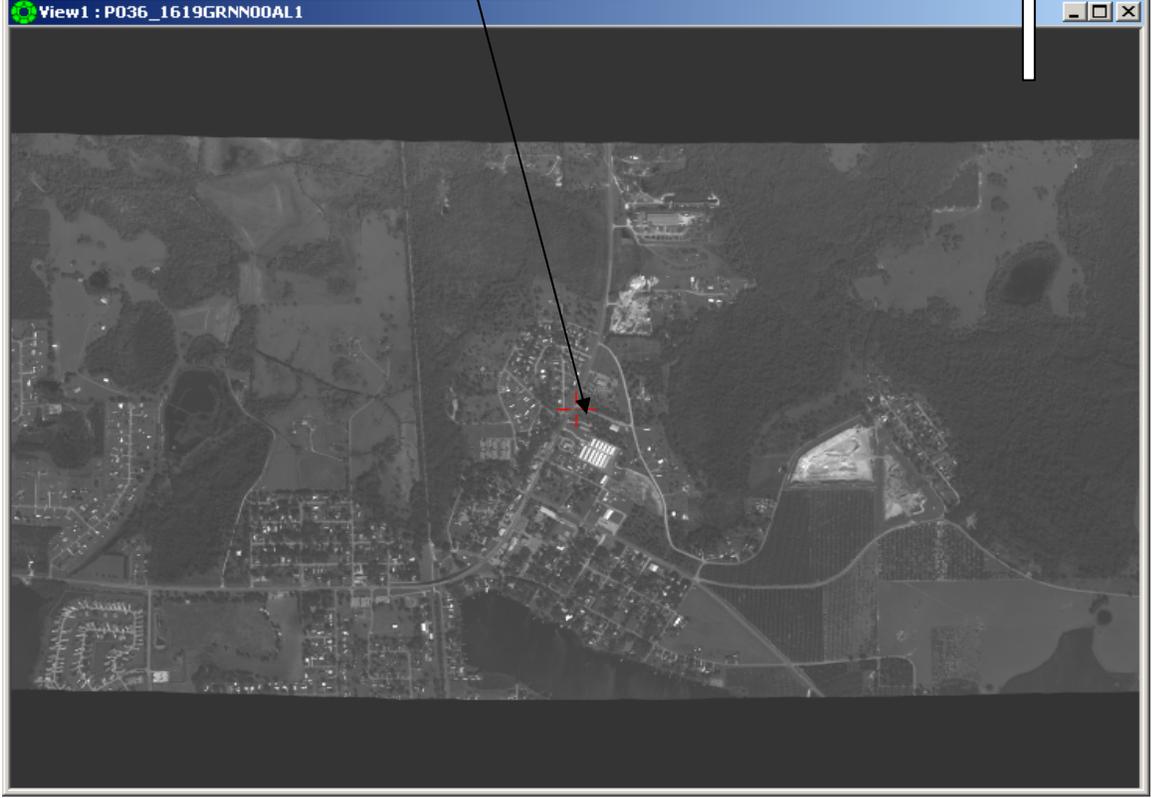
**North**





**QC-13 Northeast corner of stop bar**

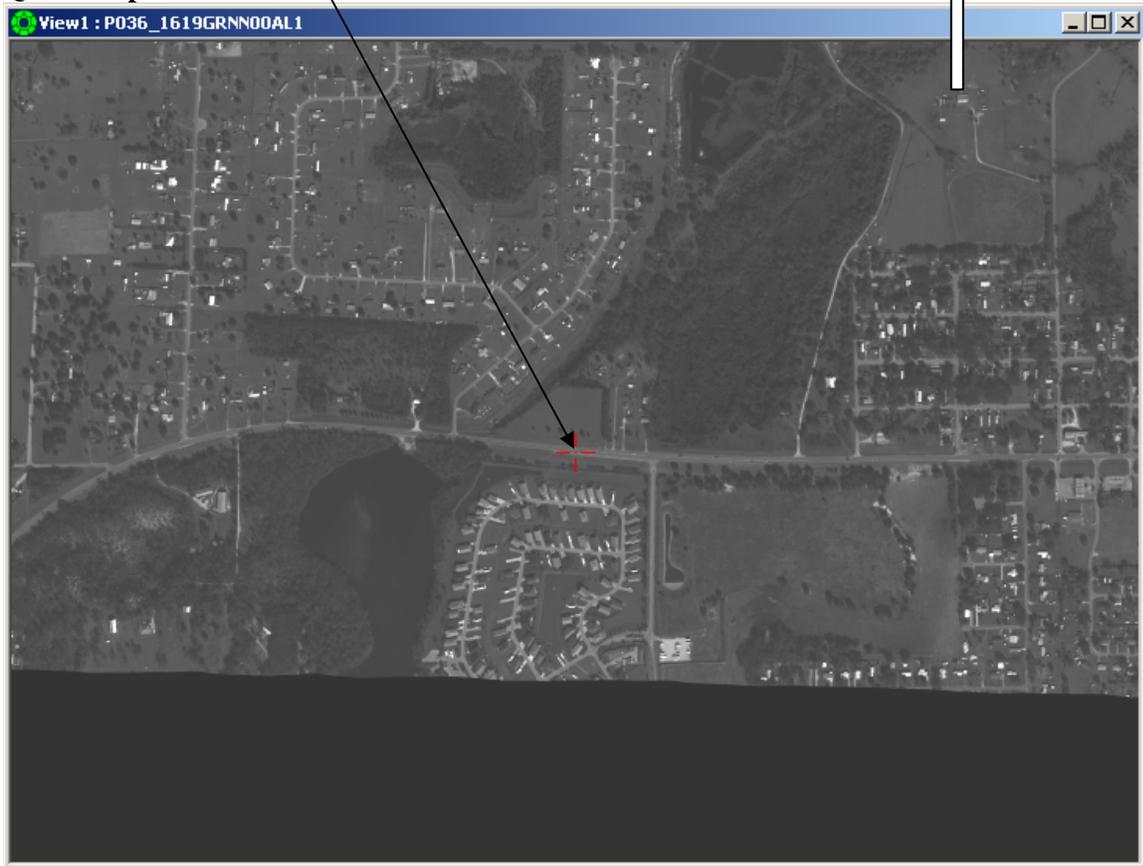
**North**





QC-14 Tip of turn arrow

North





**QC-15 Corner of concrete drive apron**

**North**





**QC-16 Tip of chevron**

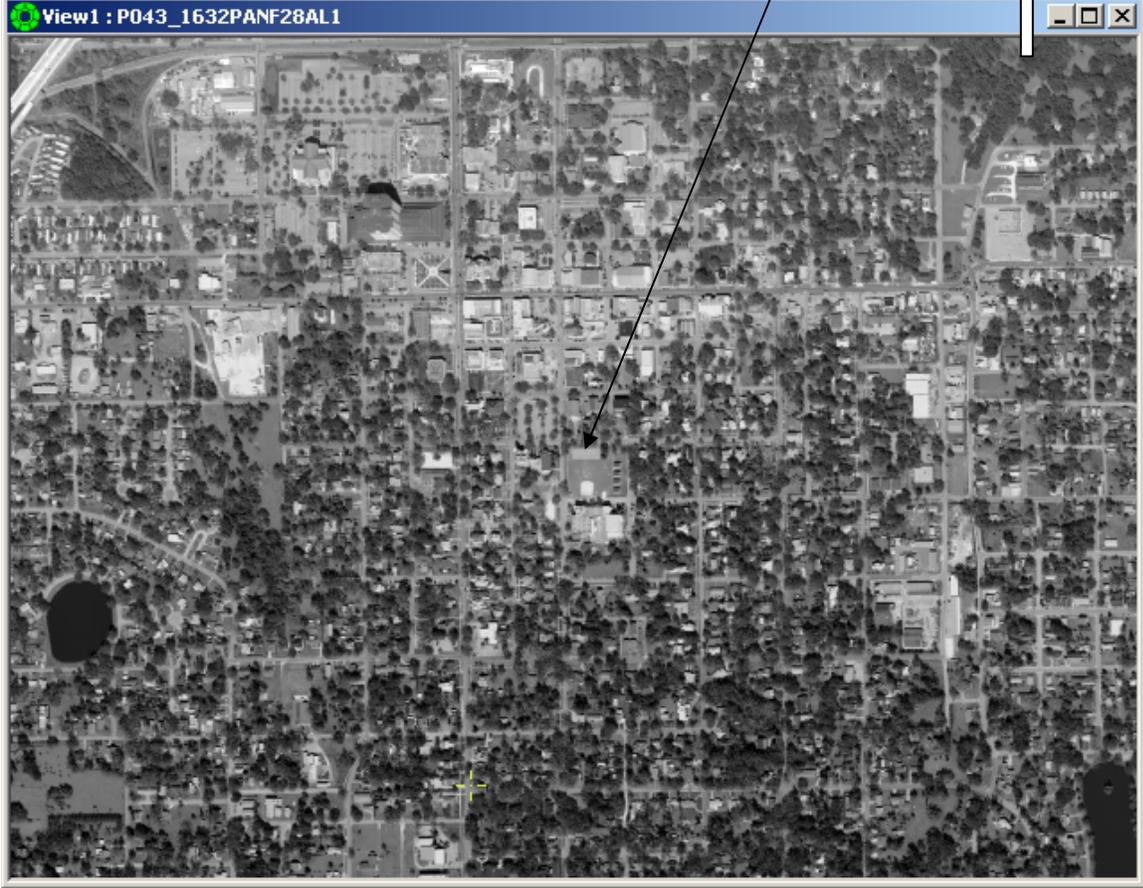
**North**





**QC-17 Intersection of paint lines at center of 4-square area**

**North**





QC-18 centerline intersection of parking lines

North





**QC-19 Inside corner of walk intersection**

**North**





QC-20 "T" target

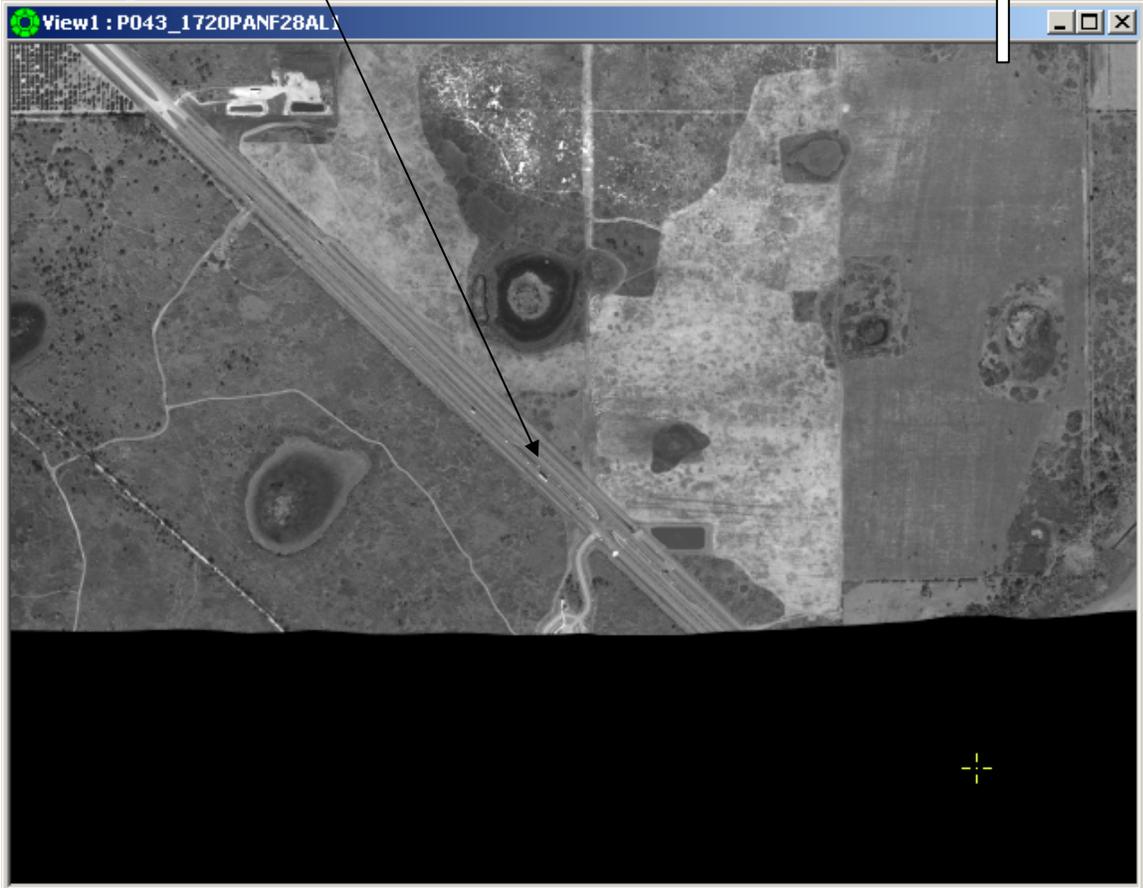
North





QC-22 Tip of turn arrow

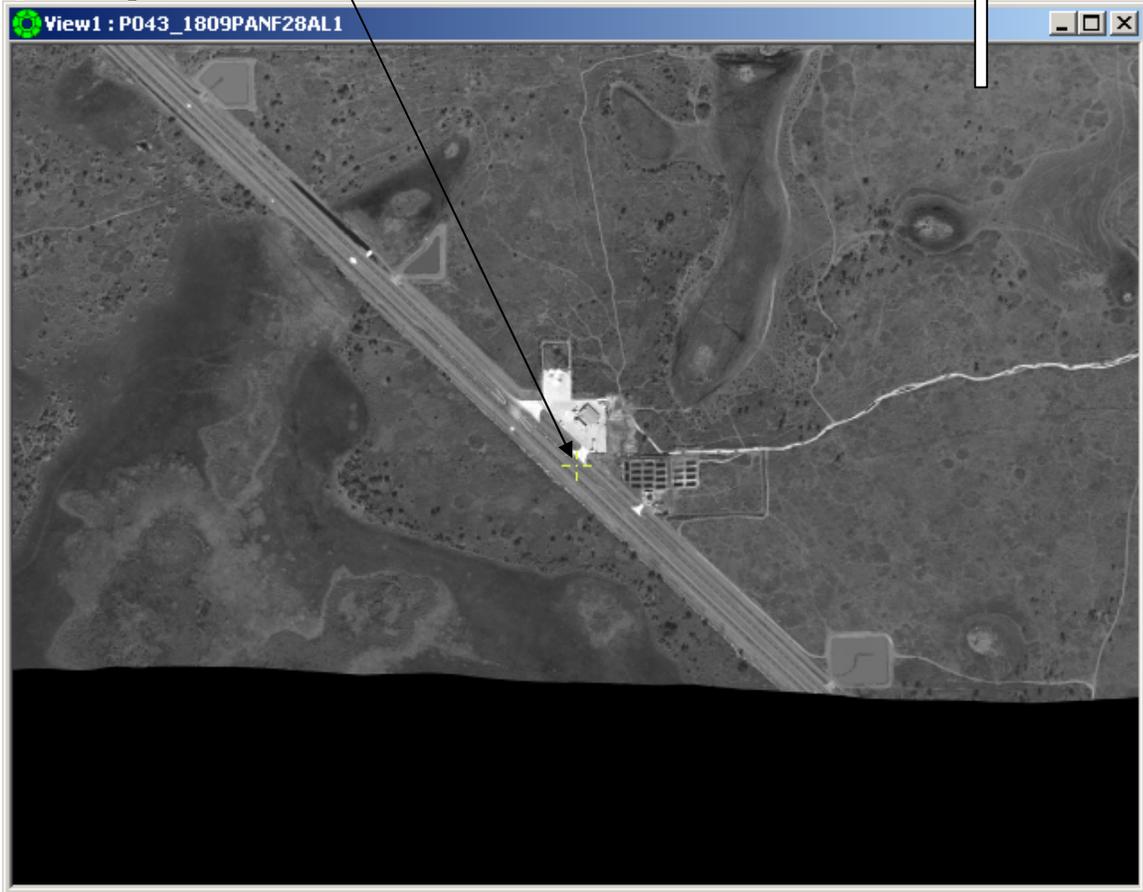
North





**QC-23 Tip of turn arrow**

North





QC-24 North edge of drive at paint stripe on west edge of road

North





QC-25 Northeast corner of stop bar at edge stripe

North





QC-26 Northwest corner of stop bar

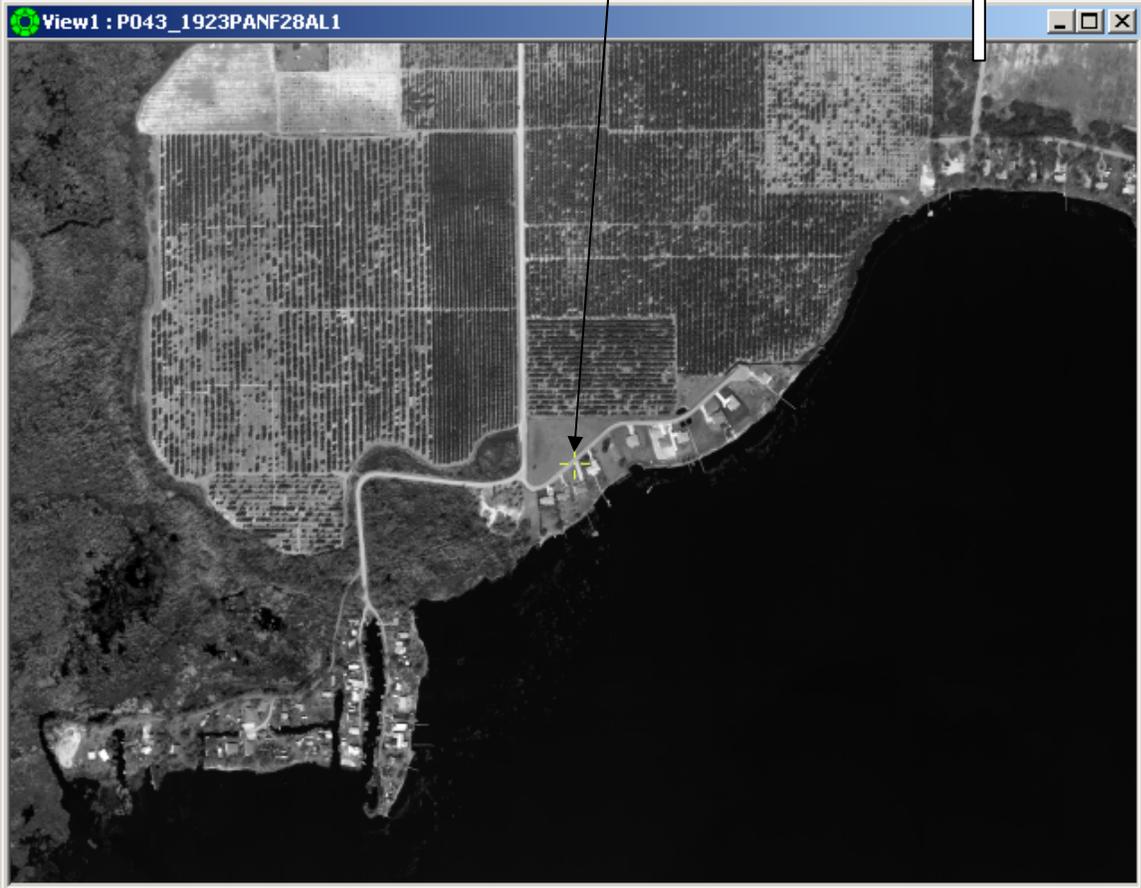
North





QC-27 Northwest corner of concrete drive

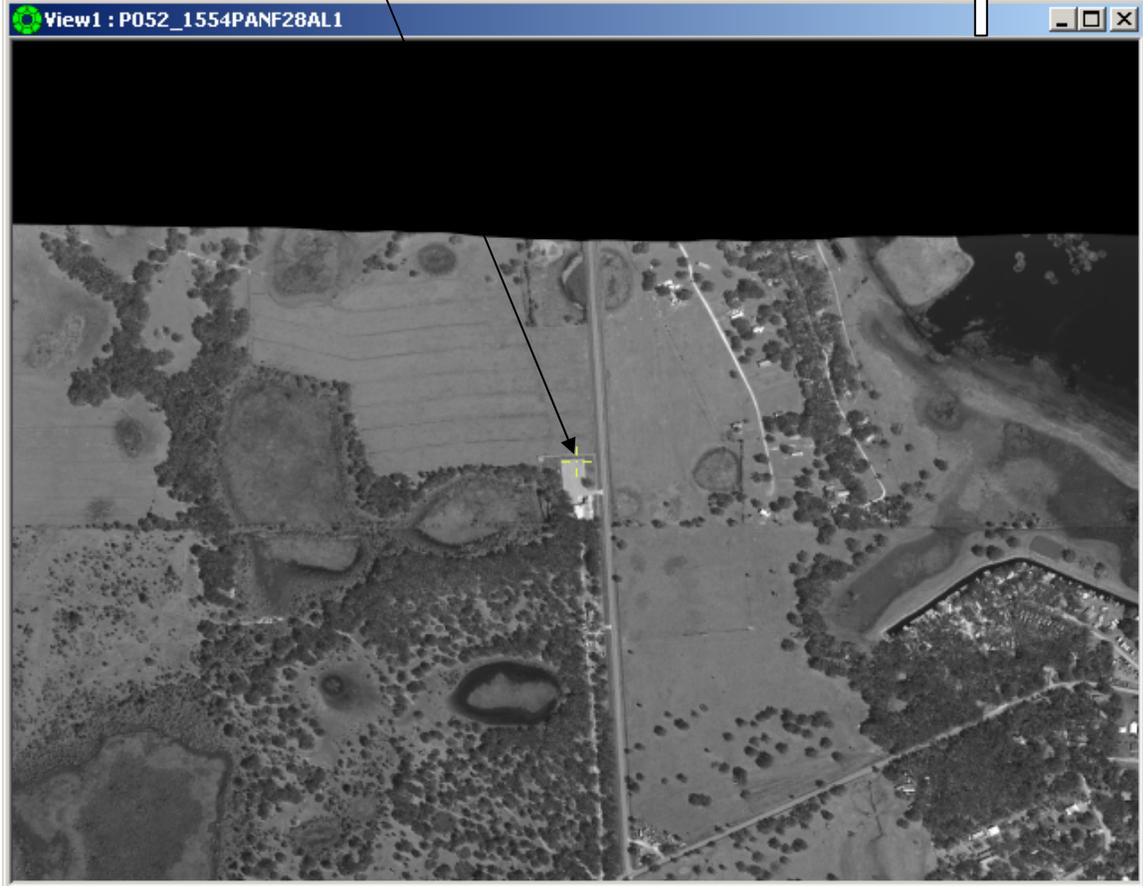
North





QC-28 Tip of parking lines

North





QC-29 Tip of chevron

North





QC-30 Southwest corner of stop bar

North





**QC-31 Northwest corner of stop bar**

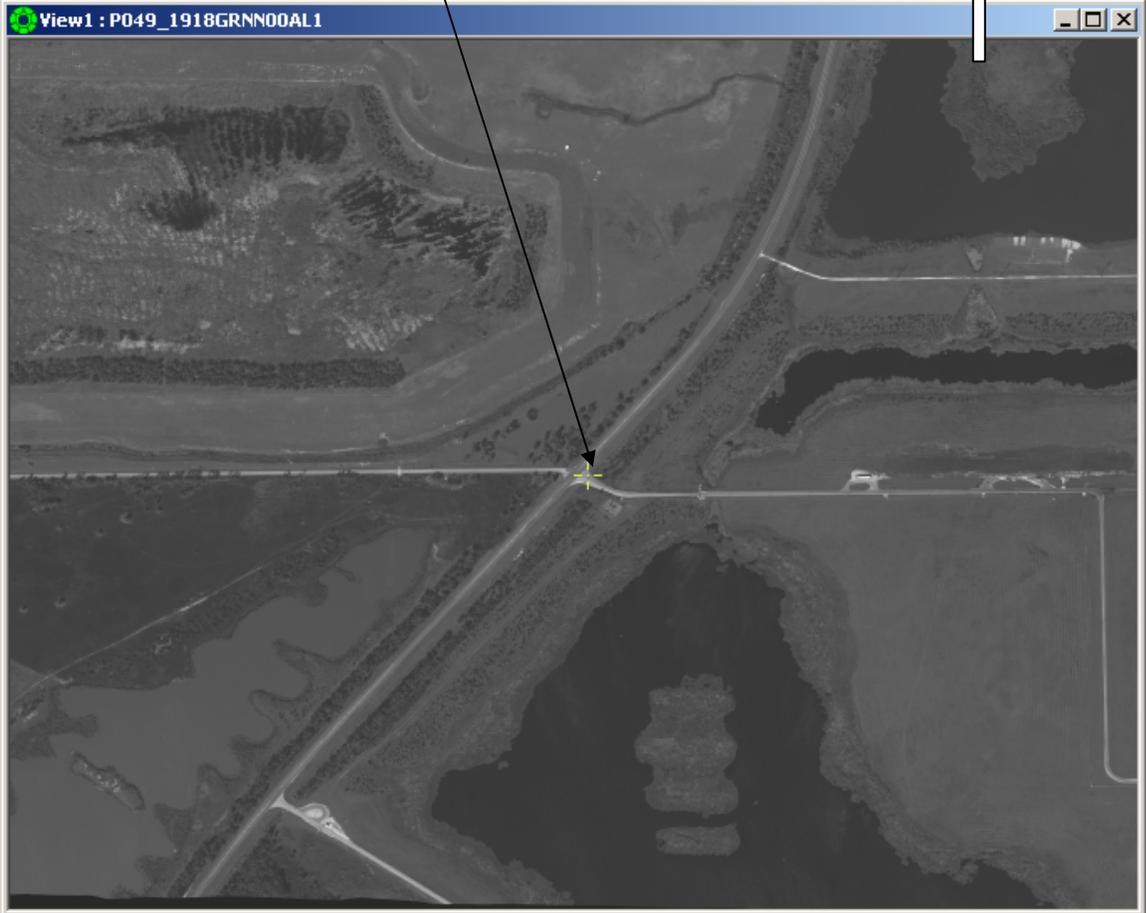
**North**





**QC-32 Intersection of paint stripes**

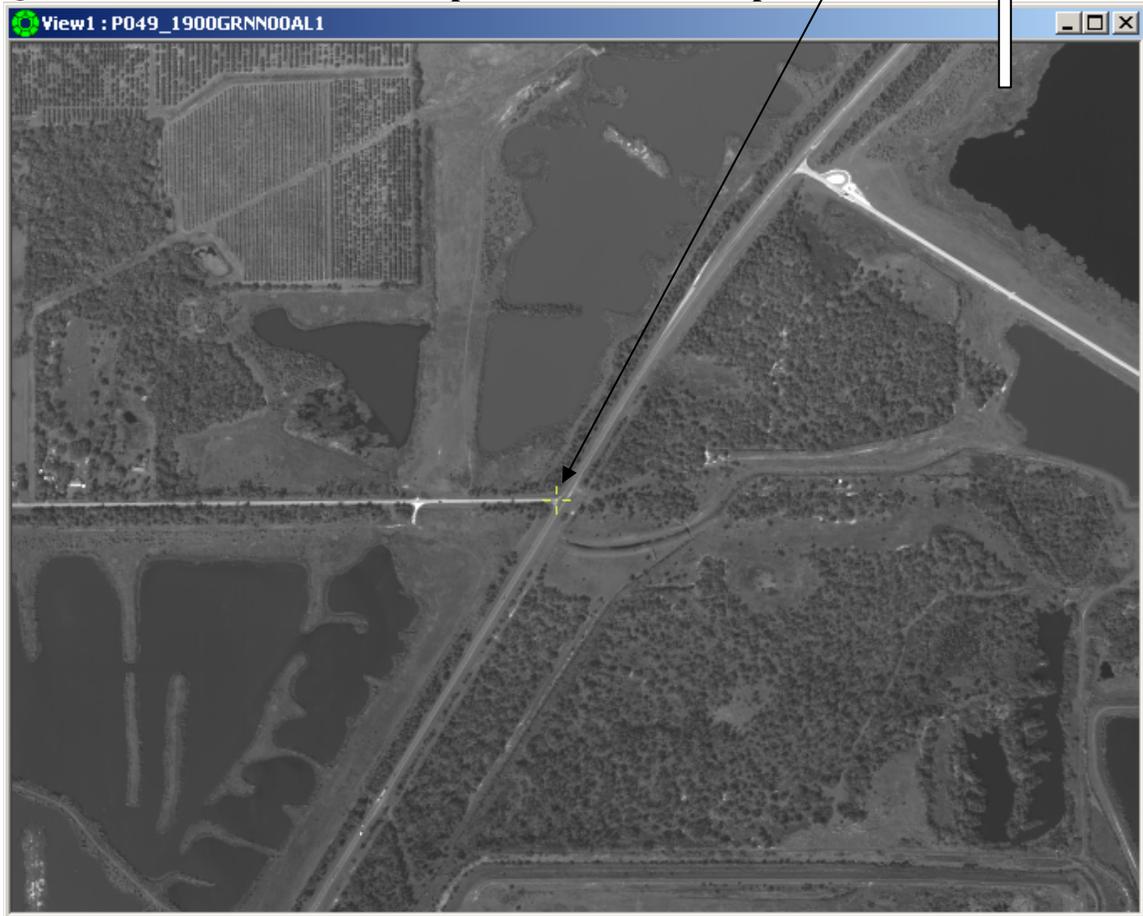
**North**





**QC-33 centerline intersection of stop bar and centerline stripe**

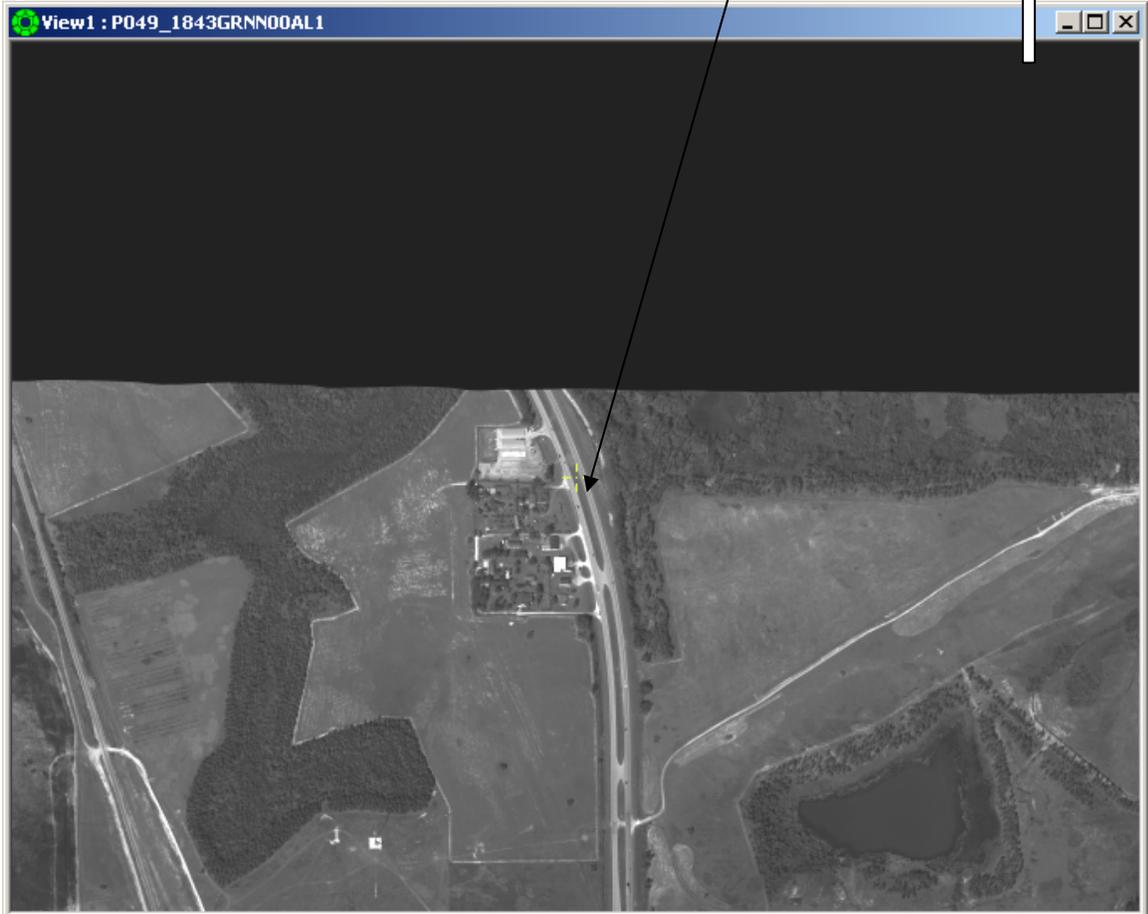
North





QC-34 North corner of concrete around catch basin

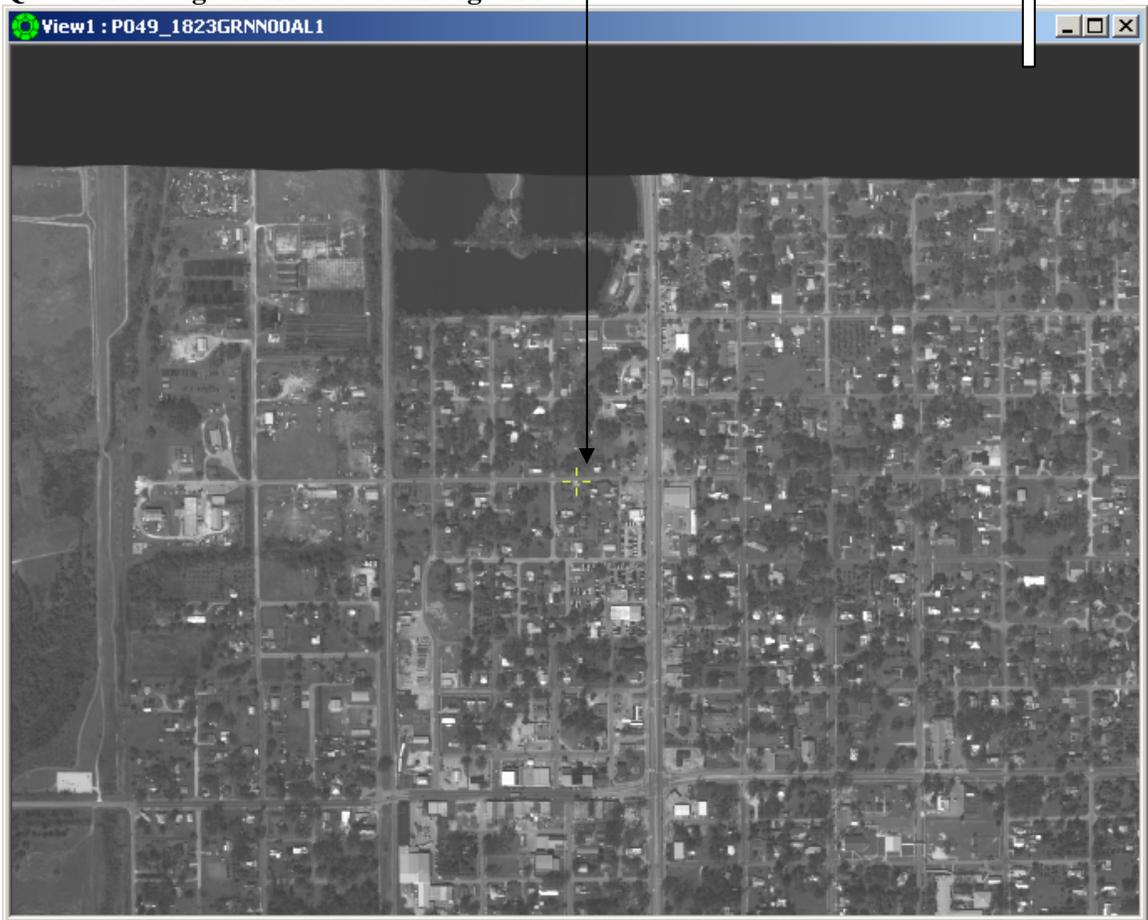
North





QC-35 East edge of drive at south edge of road

North

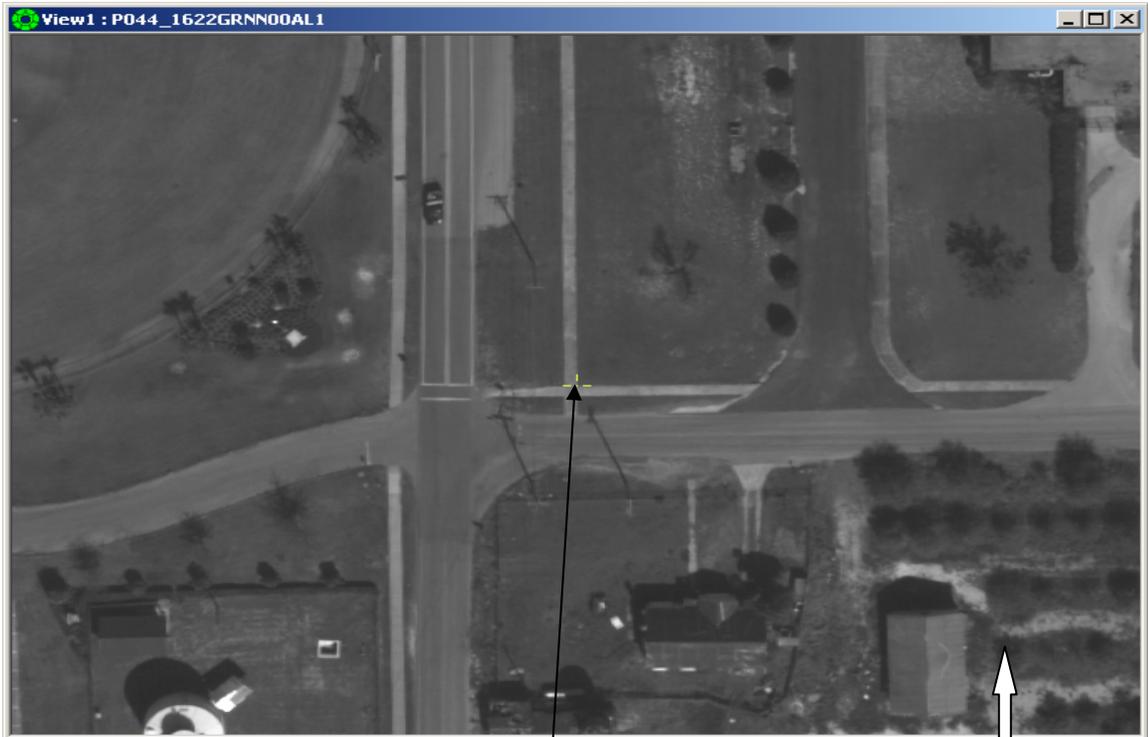




QC-36 Tip of turn arrow

North





**QC-37 Northeast corner of walk intersection**

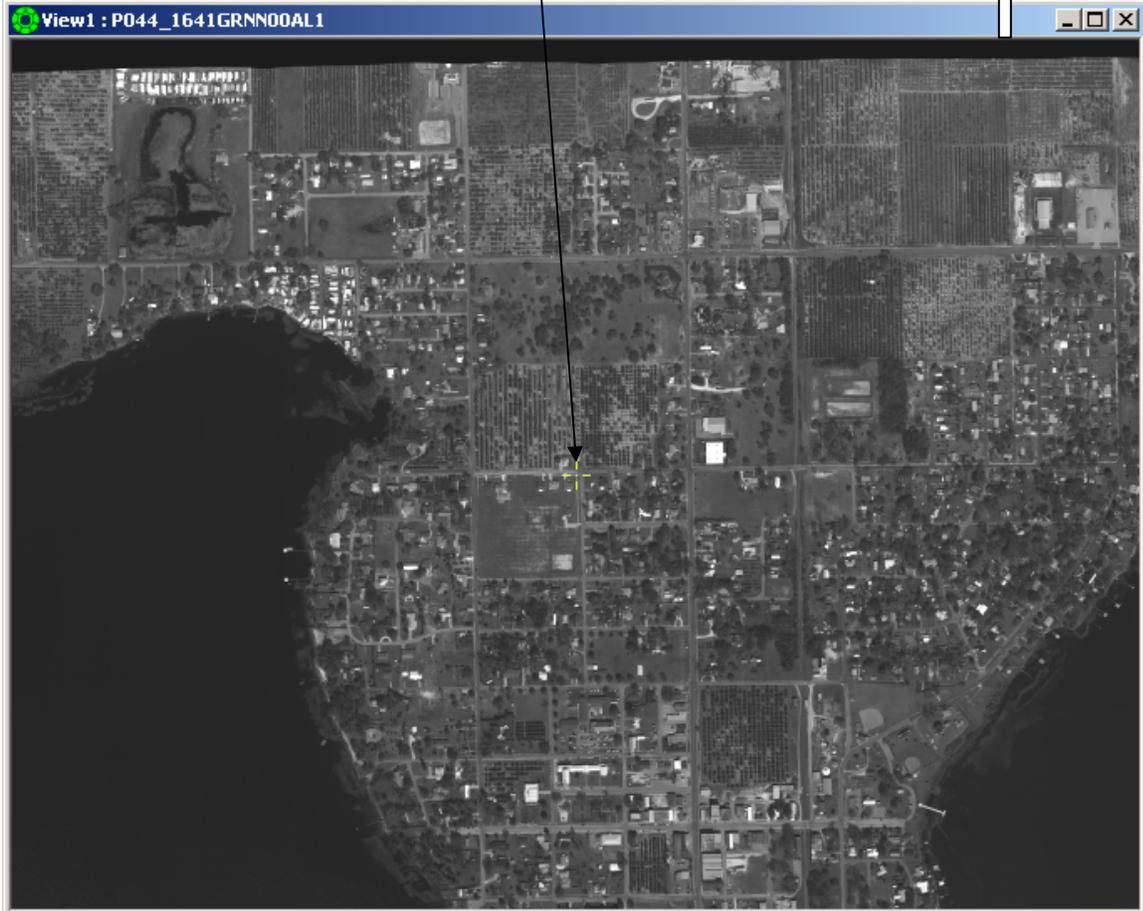
**North**





QC-38 Northeast corner of walk intersection

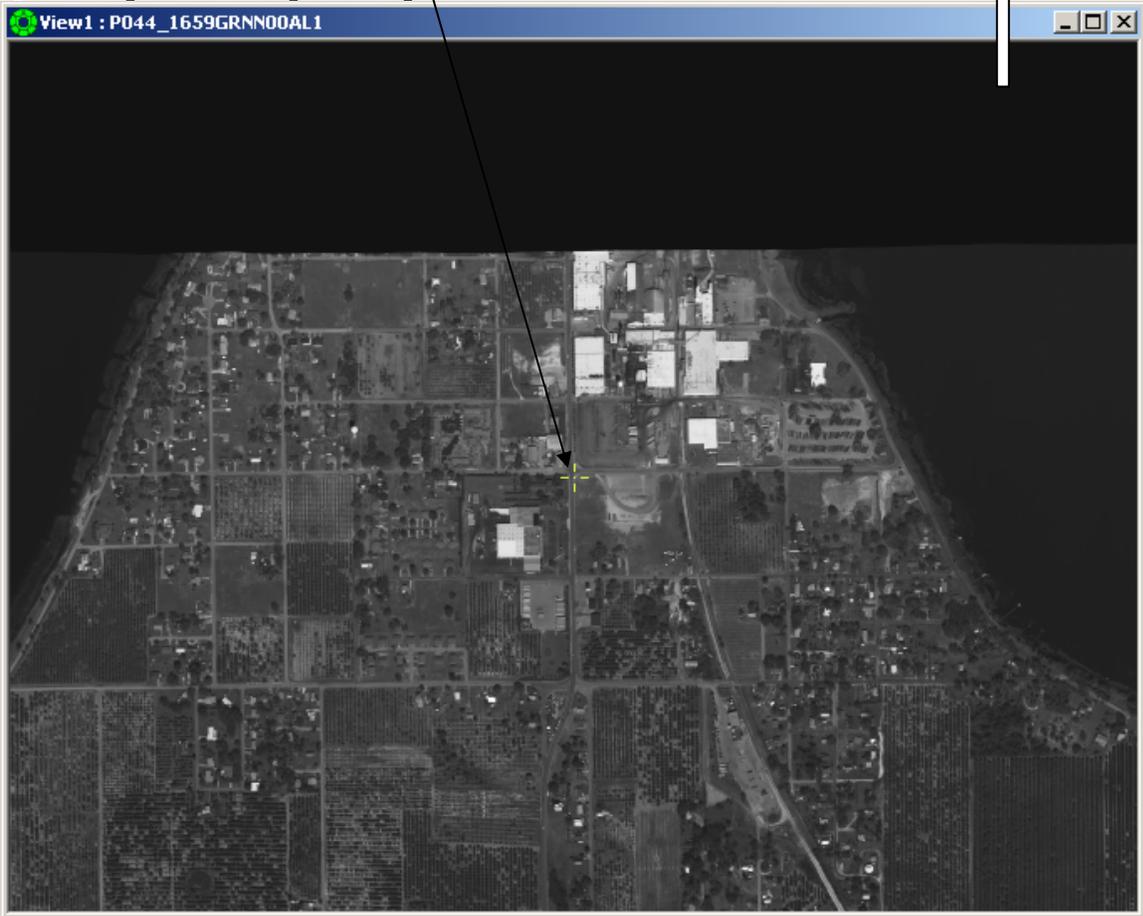
North





QC-39 Tip of chevron paint stripe

North





PCPA-QC-1

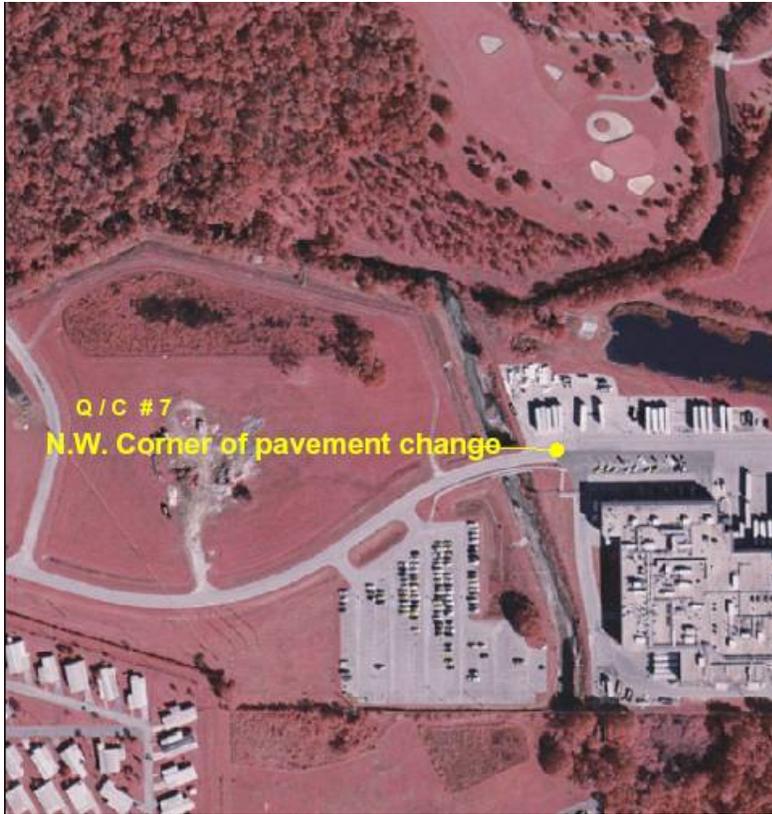
PCPA-QC-3: NE corner of drive at sidewalk





PCPA-QC-5: Southwest Corner of Driveway  
PCPA-QC-6





PCPA-QC-7  
PCPA-QC-8





PCPA-QC-10  
PCPA-QC-11





PCPA-QC-12

PCPA-QC-13: NE corner of driveway and road





PCPA-QC-14: Centerline tip of parking strip  
PCPA-QC-15





PCPA-QC-17  
PCPA-QC-18





PCPA-QC-22  
PCPA-QC-23





PCPA-QC-25:  
PCPA-QC-26



# APPENDIX E: GROUND CONTROL USED TO GEOREFERENCE DOI ANALYSIS

SWFWMD PEACE RIVER TOPO MAPPING & POLK COUNTY PROPERTY APPRAISER DOI MAPPING
POLK COUNTY, FLORIDA
HORIZONTAL DATUM: NAD 83 (1999) HARN
VERTICAL DATUM: NAVD 88
UNITS: US SURVEY FEET
STATE PLANE ZONE: FLORIDA WEST (FLW0902)
GEOID MODEL: GEOID 03
COORDINATE SYSTEM: GRID
FEBRUARY 2005

Station	Grid	Grid	Station	Comments
Name	Northing	Easting	Elevation	
	(US Feet)	(US Feet)	(US Feet)	
E-1	1416400.83	620497.18	77.56	Target Only - Existing Photo Control
E-2	1398840.15	619953.95	91.10	Target Only - Existing Photo Control
E-3	1383441.98	637948.38	112.83	Target Only - Existing Photo Control
E-4R	1373817.56	638868.08	109.88	GPS Surveyed - Photo Control
E-5R	1361948.35	637992.20	116.12	GPS Surveyed - Photo Control
E-6R	1346036.59	639543.51	124.18	GPS Surveyed - Photo Control
E-7	1331422.35	638019.31	129.33	GPS Surveyed - Photo Control
E-8	1312777.65	638319.50	109.15	Target Only - Existing Photo Control
E-9R	1293824.26	636079.27	95.63	GPS Surveyed - Photo Control
E-10R	1285208.38	638310.38	113.80	GPS Surveyed - Photo Control
E-11R	1268544.92	638766.72	157.23	GPS Surveyed - Photo Control
E-12	1252041.66	639054.85	122.65	GPS Surveyed - Photo Control
E-13	1233283.92	638156.56	102.86	Target Only - Existing Photo Control
E-14	1218931.16	637995.54	132.62	Target Only - Existing Photo Control
E-15	1204107.54	638468.01	135.72	Target Only - Existing Photo Control
E-16	1204103.85	701874.87	91.35	Target Only - Existing Photo Control
E-17	1267456.64	707061.48	158.83	GPS Surveyed - Photo Control
E-18	1288648.43	712368.94	126.65	Target Only - Existing Photo Control
E-19	1308360.16	702481.78	107.49	Target Only - Existing Photo Control
E-20	1333437.17	704066.38	100.85	Target Only - Existing Photo Control
E-21	1359414.06	701459.11	122.19	GPS Surveyed - Photo Control
E-22R	1405541.62	691010.72	130.27	GPS Surveyed - Photo Control
E-23R	1416419.98	752230.89	134.68	GPS Surveyed - Photo Control
E-24R	1390200.74	751191.70	139.01	GPS Surveyed - Photo Control
E-25	1362271.25	767398.08	144.68	Target Only - Existing Photo Control
E-26	1329078.41	765594.12	144.54	Target Only - Existing Photo Control
E-27R	1283475.34	768119.33	110.90	GPS Surveyed - Photo Control
E-28	1206800.76	765453.51	116.55	Target Only - Existing Photo Control

Station	Grid	Grid	Station	
Name	Northing	Easting	Elevation	Comments
	(US Feet))	(US Feet))	(US Feet))	
E-29	1204498.73	800243.35	123.48	Target Only - Existing Photo Control
E-30	1238775.39	797048.42	123.58	GPS Surveyed - Photo Control
E-31	1301702.39	797557.87	174.16	Target Only - Existing Photo Control
E-32	1331992.28	795495.91	119.46	GPS Surveyed - Photo Control
E-33	1361061.99	797151.74	92.69	Target Only - Existing Photo Control
E-34R	1386273.42	798739.02	72.76	GPS Surveyed - Photo Control
E-35R	1429126.81	799814.63	78.93	GPS Surveyed - Photo Control
E-36	1426952.62	626644.64	83.40	Target Only - Existing Photo Control
E-37	1444398.89	638308.03	86.95	Target Only - Existing Photo Control
E-38	1460649.55	663467.96	93.92	GPS Surveyed - Photo Control
E-39	1428165.09	670618.20	108.54	GPS Surveyed - Photo Control
E-40	1426462.93	734431.97	129.14	Target Only - Existing Photo Control
E-41	1458386.73	711875.04	117.11	Target Only - Existing Photo Control
E-42	1458959.35	766504.14	114.13	GPS Surveyed - Photo Control
E-43R	1437678.50	766543.51	201.93	GPS Surveyed - Photo Control
E-44	1424055.10	780291.39	120.62	GPS Surveyed - Photo Control
E-45R	1445663.43	767992.88	143.07	GPS Surveyed - Photo Control
E-46	1396095.25	833507.83	69.48	Target Only - Existing Photo Control
E-47	1383000.44	831217.41	65.50	Target Only - Existing Photo Control
E-48	1369171.89	830957.76	59.16	Target Only - Existing Photo Control
E-49	1366364.47	867043.92	59.10	Target Only - Existing Photo Control
E-50	1350305.73	868427.38	57.49	Target Only - Existing Photo Control
E-51	1333554.51	870167.89	61.10	Target Only - Existing Photo Control
E-52	1312949.92	867444.68	51.99	GPS Surveyed - Photo Control
E-53	1300712.12	877755.18	51.80	GPS Surveyed - Photo Control
E-54	1284727.18	880481.01	52.24	GPS Surveyed - Photo Control
E-55	1268247.36	908568.42	56.53	GPS Surveyed - Photo Control
E-56	1250884.84	918344.37	49.26	GPS Surveyed - Photo Control
E-57	1235089.10	926932.54	46.91	GPS Surveyed - Photo Control
E-58	1219348.94	932049.10	54.53	Target Only - Existing Photo Control
E-59	1203941.00	935513.60	56.80	Target Only - Existing Photo Control
E-60R	1203419.22	857443.99	80.46	GPS Surveyed - Photo Control
E-61R	1262612.50	873041.72	107.10	GPS Surveyed - Photo Control
E-62R	1346664.31	831862.92	57.01	GPS Surveyed - Photo Control
E-63R	1335266.82	818839.91	129.68	GPS Surveyed - Photo Control
E-64	1300484.93	823459.76	107.95	Target Only - Existing Photo Control
E-65	1268048.90	836860.45	74.82	GPS Surveyed - Photo Control
E-66R	1269435.62	787586.06	129.97	GPS Surveyed - Photo Control
E-67	1380783.22	682647.65	140.51	GPS Surveyed - Photo Control
N-1	1417107.58	680586.12	122.66	GPS Surveyed - Photo Control
N-3	1245221.30	705525.26	144.87	GPS Surveyed - Photo Control
N-4	1225130.79	704113.47	99.51	GPS Surveyed - Photo Control
N-5	1228206.23	765216.21	141.20	GPS Surveyed - Photo Control
N-6	1256729.88	767478.44	131.63	GPS Surveyed - Photo Control
N-7	1307809.25	765294.00	125.13	GPS Surveyed - Photo Control

Station	Grid	Grid	Station	
Name	Northing	Easting	Elevation	Comments
	(US Feet)	(US Feet)	(US Feet)	
N-9	1423371.93	713534.38	132.70	GPS Surveyed - Photo Control
N-10	1441139.25	727881.05	126.11	GPS Surveyed - Photo Control
N-11	1241509.72	834089.74	86.46	GPS Surveyed - Photo Control
N-12	1216779.72	829088.18	81.49	GPS Surveyed - Photo Control
N-13	1238021.94	871908.32	94.66	GPS Surveyed - Photo Control
N-14	1222989.31	897753.48	77.04	GPS Surveyed - Photo Control
N-15	1441407.02	676519.81	109.87	GPS Surveyed - Photo Control
T-2	1204083.37	672710.36	130.55	Target Only - Existing Photo Control
T-3	1204150.45	735402.85	123.08	Target Only - Existing Photo Control
T-4R	1216576.04	801267.91	105.23	GPS Surveyed - Photo Control
T-5	1235798.71	733607.26	132.09	GPS Surveyed - Photo Control
T-6	1234240.15	670115.65	147.16	GPS Surveyed - Photo Control
T-7R	1259225.42	662524.75	134.24	GPS Surveyed - Photo Control
T-8	1270238.75	733355.76	212.52	Target Only - Existing Photo Control
T-9	1299787.86	733202.14	114.18	Target Only - Existing Photo Control
T-10	1299660.80	664610.68	124.95	Target Only - Existing Photo Control
T-11R	1331357.99	669663.87	179.35	GPS Surveyed - Photo Control
T-12	1331600.39	736749.04	143.34	Target Only - Existing Photo Control
T-13	1364836.24	734641.52	149.31	Target Only - Existing Photo Control
T-14	1363450.52	669912.30	161.43	Target Only - Existing Photo Control
T-15R	1383616.62	715999.55	171.80	GPS Surveyed - Photo Control
T-16	1390293.73	664628.45	155.44	GPS Surveyed - Photo Control
T-17	1395531.43	772220.09	147.38	Target Only - Existing Photo Control
T-18R	1412536.92	800066.61	98.36	GPS Surveyed - Photo Control
T-19	1404414.91	723998.18	143.31	GPS Surveyed - Photo Control
T-20	1412711.63	648470.88	107.80	Target Only - Existing Photo Control
T-21	1424953.56	638406.10	92.16	Target Only - Existing Photo Control
T-22	1463925.35	694522.32	108.15	Target Only - Existing Photo Control
T-23	1461951.12	739046.92	119.30	Target Only - Existing Photo Control
T-24	1336421.21	857701.45	51.44	Target Only - Existing Photo Control
T-25	1276822.86	899259.43	52.58	GPS Surveyed - Photo Control
T-26	1209469.56	924421.23	55.79	GPS Surveyed - Photo Control
T-27R	1199583.96	892684.03	124.66	GPS Surveyed - Photo Control
T-28	1203449.91	829254.06	136.99	Target Only - Existing Photo Control

**Additional Control:**

Station	Grid	Grid	Station	
Name	Northing	Easting	Elevation	Comments
	(US Feet)	(US Feet)	(US Feet)	
X460	1252976.51	912498.21	55.47	GPS Surveyed - Existing Control
BRTW	1314451.27	726276.70	131.09	GPS Surveyed - Existing Control
K103	1288744.09	870736.36	62.44	GPS Surveyed - Existing Control
K112	1262786.38	890459.24	60.83	GPS Surveyed - Existing Control

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## APPENDIX F: DOI ACCURACY ANALYSIS

The horizontal accuracy of the digital orthophoto image maps (DOI) was independently verified by the Polk County Property Appraiser. Fifty-six (56) photo identifiable field survey quality control (QC) test points were randomly captured across the project area using real-time kinematic survey methods.

For each field survey QC test point, a comparison was made against the corresponding measured coordinates in the digital orthophoto image map to derive a residual error in the X and Y directions. Based on the residual error, the RMSE was calculated for X, Y, and the resultant XY. The RMSE was then translated to an equivalent NMAS, or circular map accuracy standard, and compared against the project requirements for horizontal accuracy.

**The actual DOI accuracy for this project exceeds expectations for 1"=100' scale mapping by 1.8-feet.**

The accuracy analysis was based on methods outlined in the Geospatial Positioning Accuracy Standards, Part 3, National Standards for Spatial Data Accuracy (NSSDA), developed by the Federal Geodetic Data Committee (FGDC-STD-007.3-1998).

**6350763514 SVFVMD/Polk County Orthophoto**

Target Accuracy is NMAS for 1"=100' Mapping (circular map accuracy standard at the 90% confidence level)

Calculated Accuracy is the circular map accuracy calculated from the residual error at the 90% confidence level (NMAS)

Coordinates in State Plane, Florida West, NAD83/HARN, NAVD88, US Survey Ft

**Overall Statistics, All Points**

RMSE X	0.5 ft	Ave Error	0.8 ft
RMSE Y	1.0 ft	Min Error	-0.1 ft
RMSE XY	1.0 ft	Max Error	2.1 ft
Count	56	Calc. Accurac	1.5 ft
		Trgt Accuracy	3.3 ft

Point #	Tile No.	Ortho X	Ortho Y	PCPA X	PCPA Y	d X	d Y	d XY	DESCRIPTION
QC-01	18112	638217.08	1443063.30	638217.18	1443064.16	-0.10	-0.86	0.86	TIP OF TURN ARROW
QC-03	18113	640462.46	1444927.98	640462.71	1444928.39	-0.25	-0.41	0.48	SW COR OF SW
QC-04	17638	711506.50	1457859.85	711506.23	1457861.24	0.27	-1.39	1.41	NE COR STOP BAR
QC-05	17638	710230.68	1455164.13	710230.59	1455163.99	0.09	0.14	0.17	SE COR OF DR EOP
QC-06	17800	709653.95	1451280.90	709652.82	1451281.35	1.13	-0.45	1.21	SE COR OF CONC DR
QC-07	17648	762638.73	1459088.42	762638.25	1459088.91	0.48	-0.49	0.69	TIP OF TURN ARROW
QC-08	17811	761775.77	1454184.52	761775.12	1454184.73	0.65	-0.21	0.68	NE COR OF SW
QC-09	17974	763111.03	1446424.36	763110.69	1446424.66	0.34	-0.29	0.45	NE COR BS
QC-10	19187	783237.17	1404807.07	783238.04	1404807.68	-0.87	-0.61	1.07	NE COR PAV CHANGE
QC-11	19026	792417.85	1407791.48	792417.58	1407791.76	0.27	-0.28	0.39	SE COR OF DRIVE
QC-12	18950	795682.10	1414500.84	795681.97	1414500.17	0.14	0.67	0.69	TIP OF TURN ARROW
QC-13	19173	713568.97	1400412.58	713569.15	1400412.83	-0.18	-0.24	0.30	NE COR OF STOP BAR
QC-14	19335	707594.36	1397921.71	707594.31	1397922.28	0.05	-0.57	0.57	TIP OF TURN ARROW
QC-15	19500	718167.46	1394224.37	718166.94	1394225.18	0.52	-0.81	0.97	SE COR CONC APRON
QC-16	22509	706701.74	1299635.98	706701.34	1299634.70	0.40	1.28	1.34	TIP OF CHEVRON
QC-17	22672	707425.54	1294158.38	707425.33	1294160.37	0.21	-1.99	2.00	INTERSECTION OF PAINT LINES
QC-18	22836	712595.51	1285965.45	712594.69	1285966.62	0.82	-1.17	1.43	CENTER INTERSECTION OF PARKING LINES
QC-19	22525	787428.24	1298951.69	787428.66	1298950.51	-0.42	1.18	1.25	SE COR OF SW INTERSECTION
QC-20	22527	798040.13	1297069.16	798039.79	1297068.42	0.34	0.74	0.82	SE COR
QC-22	23028	857948.71	1282100.08	857948.10	1282100.83	0.61	-0.75	0.97	TIP OF TURN ARROW
QC-23	23192	863556.27	1276436.29	863556.20	1276436.97	0.08	-0.68	0.69	TIP OF TURN ARROW
QC-24	22864	854165.47	1287825.32	854165.31	1287827.08	0.16	-1.76	1.77	N EDGE DR @ EDGE OF PAINT LINE
QC-25	23423	771506.31	1274298.49	771505.20	1274298.54	1.11	-0.05	1.11	NE COR STOPBAR INSIDE PAINT LINE
QC-26	23586	771722.61	1265309.06	771722.02	1265307.31	0.59	1.76	1.85	NW COR OF STOP BAR
QC-27	14201	761618.33	1261823.33	761618.52	1261821.24	-0.19	2.09	2.10	NW COR CONC DRIVEWAY
QC-28	23613	908390.11	1268668.68	908390.13	1268669.62	-0.02	-0.94	0.94	TIP OF PARKING LINES NE COR
QC-29	14230	908790.24	1262589.73	908789.85	1262590.29	0.39	-0.56	0.68	TIP OF CHEVRON
QC-30	14232	916550.19	1262542.09	916550.42	1262543.15	-0.23	-1.06	1.09	SW COR STOP BAR
QC-31	24206	657777.68	1242673.13	657778.05	1242673.33	-0.37	-0.20	0.42	NW COR SB
QC-32	24532	655204.63	1234537.06	655204.71	1234536.82	-0.08	0.24	0.25	CIL PAINT STRIPES
QC-33	24531	652326.24	1230594.05	652324.85	1230595.09	1.39	-1.04	1.74	CIL PS CIL SB
QC-34	23893	720165.56	1251755.16	720165.59	1251754.74	-0.02	0.42	0.42	NE COR CATCH BASIN
QC-35	24218	719986.16	1244221.95	719986.34	1244221.81	-0.18	0.14	0.23	NE COR OF DRIVE
QC-36	24545	720393.36	1234542.42	720392.50	1234541.49	0.86	0.93	1.27	TIP OF TURN ARROW
QC-37	24073	806692.10	1245567.35	806692.09	1245567.09	0.01	0.26	0.26	NE COR OF WALK INT
QC-38	24236	807303.58	1242854.40	807303.59	1242854.20	-0.01	0.20	0.21	NE COR OF WALK INT
QC-39	24399	808074.38	1237533.75	808074.19	1237534.00	0.19	-0.25	0.31	TIP OF CHEVRON
PCPA-QC-1	19813	651842.55	1383414.04	651842.98	1383414.32	-0.43	-0.28	0.52	NW COR DRIVE BOC
PCPA-QC-2	19981	676223.04	1376652.42	676222.77	1376652.43	0.27	-0.01	0.27	NW COR DRIVE BOC
PCPA-QC-3	20316	722909.90	1368195.63	722909.41	1368195.44	0.49	0.19	0.53	NE COR OF D&SW
PCPA-QC-5	20001	776046.15	1377035.14	776046.26	1377035.46	-0.11	-0.32	0.34	SE COR OF DRIVE
PCPA-QC-6	19848	827898.27	1381928.39	827898.50	1381928.66	-0.23	-0.27	0.35	SE COR OF DRIVE
PCPA-QC-7	20868	652052.82	1347920.00	652052.09	1347920.05	0.73	-0.05	0.73	NW COR PAV CHANGE
PCPA-QC-8	21037	682422.16	1343377.27	682421.68	1343377.37	0.48	-0.10	0.49	SE COR SW BOC
PCPA-QC-9	20805	724221.50	1354052.51	724221.20	1354053.19	0.30	-0.68	0.74	N INT PARK LINES
PCPA-QC-10	20887	748840.02	1345547.99	748840.03	1345547.89	-0.01	0.10	0.10	NW COR OF DRIVE
PCPA-QC-11	20652	772072.89	1357178.08	772072.92	1357178.71	-0.03	-0.63	0.63	NW COR OF DR AT RD
PCPA-QC-12	20661	816273.80	1356740.64	816273.13	1356740.49	0.68	0.15	0.69	NE COR OF DRIVE
PCPA-QC-13	21067	832945.05	1344546.67	832944.72	1344547.76	0.33	-1.09	1.14	NE CR OF DRIVE
PCPA-QC-14	21686	668093.15	1322288.06	668093.73	1322288.94	-0.58	-0.88	1.06	TIP OF PARK STRIPE
PCPA-QC-15	21854	692671.40	1318654.29	692671.89	1318653.74	-0.49	0.55	0.74	SE COR DRIVE
PCPA-QC-17	21703	752936.99	1320592.90	752937.10	1320592.94	-0.11	-0.04	0.12	SE COR OF DRIVE
PCPA-QC-18	21872	784054.41	1318430.09	784054.32	1318430.28	0.09	-0.19	0.21	SE COR OF DRIVE
PCPA-QC-22	22508	701839.48	1297893.14	701838.73	1297891.51	0.75	1.63	1.79	SE COR DRIVE BOW
PCPA-QC-23	22673	712677.39	1292457.01	712676.87	1292458.61	0.52	-1.60	1.68	SE COR OF DRIVE
PCPA-QC-26	22854	801058.48	1287544.31	801058.65	1287546.17	-0.17	-1.86	1.87	NW COR OF DRIVE