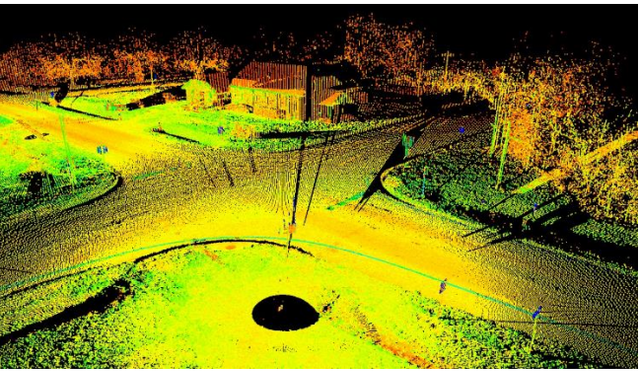
GDOT Automated Survey Manual



2/4/2022
Revision 11.1
Atlanta, GA 30308

Georgia Department of Transportation

This document was developed as part of the continuing effort to provide guidance within the Georgia Department of Transportation in fulfilling its mission to provide a safe, efficient, and sustainable transportation system through dedicated teamwork and responsible leadership supporting economic development, environmental sensitivity and improved quality of life. This document is not intended to establish policy within the Department, but to provide guidance in adhering to the policies of the Department.

Your comments, suggestions, and ideas for improvements are welcomed.

Please send comments to:

State Design Policy Engineer

Georgia Department of Transportation

One Georgia Center

600 W. Peachtree Street, 26th Floor

Atlanta, Georgia 30308

DISCLAIMER

The Georgia Department of Transportation maintains this printable document and is solely responsible for ensuring that it is equivalent to the approved Department guidelines.

The mission of Geodetic Surveys and Mapping Control is to provide accurate horizontal and vertical control on photogrammetric mapping projects. It is with the knowledge that this control will be propagated throughout the entire life of the project, that low, tolerances are set, high accuracy is achieved, and a QUALITY product produced. The primary horizontal and vertical control traverses established for the project are to be used as the principle control for all field and photogrammetric survey activities.

Some verbiage expressed within this document is Georgia Department of Transportation application software specific.

Revision Summary

Revision Number	Revision Date	Revision Summary
Original	7/8/13	Original Release Date
N/A	N/A	N/A
10.0	12/17/14	Updated manual to new standard template
10.1	1/7/15	Chapter 2 – Corrected typo on page 2-30. Policy should be 4465-1 instead of 4420-1.
10.2	5/29/15	Chapter 1 – Updated traverse adjustment info; added new section Relocation of Endangered Survey Control Chapter 2 – Updated hyperlinks. Updated field survey procedures. Updated feature codes. Inserted Survey Manpower to Meet Project Schedule policy Chapter 4 - Updated minor info in Upstream and Downstream Structures Chapter 6 – Added 4465-8 policy Chapter 7 – Added new section regarding Photogrammetric Services; and added policies 4451, 4452, 4452-a, 4452-b and updated hyperlinks
10.3	6/30/15	Chapter 2 – Updated Feature Codes Chapter 7 – Deleted section 7.3 Notice to Consultants from chapter
10.4	9/18/15	Chapter 4 – Added Section 4.6, titled Low Impact Bridge Projects. Included new diagram and note that limits may be changed based on geography and field meetings.
10.5	3/30/16	Chapter 4 - Hyperlink was changed for location of railroad mileposts Chapter 7 - Added line item under “Field Procedures
10.6	4/15/16	Chapter 2 – Added info regarding Trimble FXL link Chapter 7 – Added info regarding how deeds, plats and property cards should be scanned into a PDF file
10.7	6/9/16	Survey Checklist - In Section III the “Pavement” section was edited. Chapter 2 – Added new section regarding property resolution. In Section ‘Additional Topo” subsection D.2 the “Pavement” section was edited. Chapter 7 - Added new section regarding property resolution
10.8	8/16/16	Chapter 7 – Added criteria to InRoads Data set
10.9	10/20/16	Chapter 2 – Updated 2.23 GDOT Feature Codes (InRoads) table

10.10	11/28/16	Chapter 2 – Added info regarding Corps of Engineers property on projects Chapter 4 – Updated Hydraulic Field Report hyperlink
10.11	1/19/17	Chapter 2 – Added new section 2.5 regarding Health Department Research for Septic Tanks and Drain Fields Added Septic tanks and drain lines to additional topo
10.12	2/2/17	Chapter 3 - Section 3.4 has been added to the in order to change the way Catch Basins, Headwalls, and Wingwalls or collected in the field
10.13	2/13/17	Chapter 3 – Section 3.5 Culvert/Pipe Condition Surveys added
10.14	5/23/17	Chapter 2: Added new codes to InRoads Codes for collection of headwall and wing walls. Chapter 3: Edited codes in section 3.4 to reflect headwall and wing wall changes. Chapter 4: Added section 4-7 which is an example of survey requirements for bridges.
10.15	6/7/17	Chapter 2 – Updated the Trimble FXL library link
10.16	7/25/17	Chapter 2 Section 2.15 added Monitoring Wells info and changed page number references in the “Note” section at the bottom of the page. Section 2.24 - Updated descriptions of feature codes. Chapter 4: Updated Bridge Survey Requirements picture Appendix A – Added new section regarding Monitoring Wells
10.17	8/11/17	Chapter 4 – Added info regarding Bridge Surveys: Collection of center of columns on all bridges is now required.
10.18	9/7/17	Chapter 4 - Added collection of bridge columns on all bridge surveys. Added update to low impact bridge requirements.
10.19	1/18/18	Checklist, Chapter 3 and 4 - Changes reflect that Bridge Sketches are no longer required
10.20	3/1/18	Chapter 2: Added section 2.26 describing 3D data collection / Changed InRoads code list to match processing guidelines Chapter 3: Added section 3.6 “MS4 Storm Water System Surveys” Chapter 4: Added section 4.3.B “Railroad Update / Verification Survey” / Added note to section 4.5 concerning hydraulic field reports Chapter 7: Added section 7.5 “Consultant Ownership of Existing Survey Database”

10.21	3/29/18	Chapter 8 - Updates of safety policies and guidelines concerning vehicles, signage and personnel.
10.22	9/10/18	Chapter 2 - Section 2.5 “Septic and Drain Field Survey Guidelines” - This section has been edited to reflect changes in survey policy concerning septic collection.
10.23	2/12/19	Chapter 2 - The CAICE and InRoads Feature Code lists have been removed and now have links where they will be updated as needed. (Sections 2.23 and 2.24). A new cell symbol library is shown as a reference on page 2-33 of the manual. Buildings will no longer be triangulated in InRoads databases (Section 2.26) Chapter 6: Added guidelines for utilizing LIDAR technology to include the use of UAS/Drone LIDAR technology on state projects. (Sections 6.5 and 6.6) Chapter 7: Section 7.2 has added the addition of a .csv file in excel format deliverable in the following format: **Pt. I.D., Northing, Easting, Elevation, Feature Code, Description 1, and Description 2**. (In that order) This is reflected on Page 7-3 and 7-5. Added Survey Database QA Checklist and review guide links on Page 7-4.
10.24	3/8/19	Chapter 3 - Section 3.6 at the bottom of page 3-10 has been edited at the bottom of the page. Verbiage was changed and the link to MS4 areas was changed.
10.25	4/9/19	Chapter 6 – Section 6.5 and 6.6 have been updated with new deliverables for LIDAR projects.
10.26	3/20/20	Chapter 2 – Section 2.3 Changes were made concerning Easements. (Number 8). Chapter 4 – Section 4.1 Added for guidance on additional structures and culvert surveys. Chapter 5 – Section 5.1 a note was added to be sure to check for underwater foliage before sonar is used for underwater surveys. Chapter 6 – Section 6.5 added info regarding LIDAR info. Section 6.6 number A.5 for the department’s requirement for a GDOT test site for drone use. Chapter 7- Section 7.2 removed the csv deliverable. Added a new 7.3 section for contractor certified cross sections.
11.0	12/16/20	Updated template to comply with corporate branding guidelines Chapter 4 – Updated 4.4 Bridge Stakeout section
11.1	2/4/22	Chapter 4 – 4.3 Added Right of Entry should be obtained from Railroad company to perform survey

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List of Effective Chapters

Document	Revision Number	Revision Date
List of Effective Chapters	11.1	2/4/22
Table of Contents	11.1	2/4/22
Sequence of Operations	11.0	12/16/20
Survey Check List	11.0	12/16/20
Chapter 1. Survey and Mapping Control	11.0	12/16/20
Chapter 2. Automated Surveying	11.0	12/16/20
Chapter 3. Drainage	11.0	12/16/20
Chapter 4. Bridge Surveys	11.1	2/4/22
Chapter 5. Lake Surveys	11.0	12/16/20
Chapter 6. GPS Survey Guidelines	11.0	12/16/20
Chapter 7. Consultant Checks and Notices	11.0	12/16/20
Chapter 8. Safety	11.0	12/16/20
Appendix A. Monitoring Wells	2.0	12/16/20

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Table of Contents

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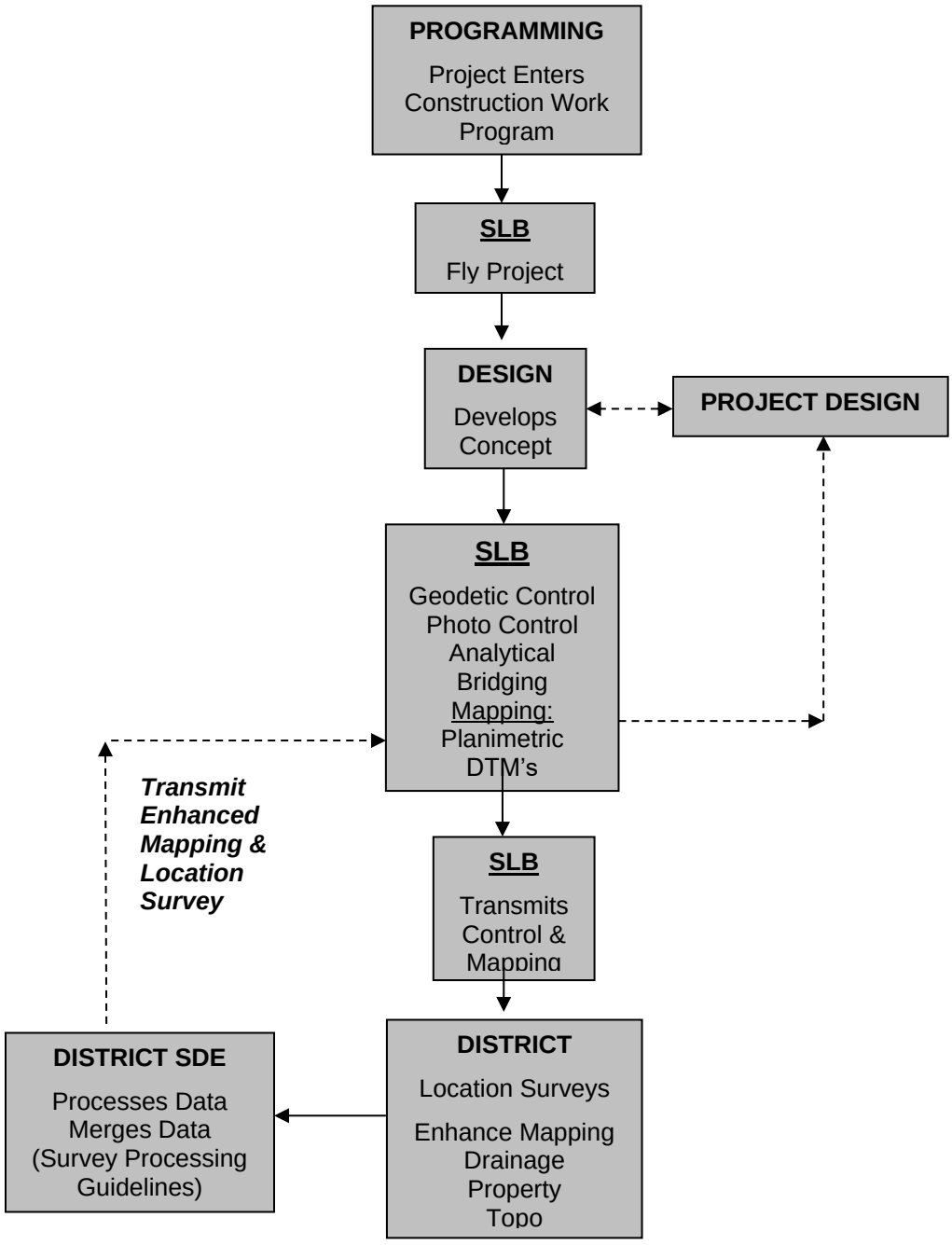
Sequence of Operations for Data Collection on Internal Projects

***SLB = Statewide Location Bureau (Formerly OEL)**



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Survey Checklist

PROJECT NO._____**P.I. NO.**_____

SURVEYED BY_____**DATE**_____

DATA COLLECTOR FILE NAME_____

COMPUTER FILE NAME_____

I. PRE-SURVEY

[ ] Survey letters to property owners
[ ] Pre-survey field review with designer
[ ] Review of property data with Property Research Specialist
[ ] Check all field equipment used to compile information i.e. ***(levels, rods, electronics)***

II. PROPERTY

[ ] Tax Maps
[ ] Property Owner Names
[ ] Deeds and Plats of Property
[ ] Record Right- of- Way Plans
[ ] Easements
[ ] Property corners located and positioned
[ ] Existing Right- of- Way shown
[ ] Prescriptive Right- of- Way shown
[ ] Land Lot lines shown
[ ] Boundary lines shown

III. TOPO AND MAPPING ENHANCEMENT

[ ] Pavement: All Mainline Pavement including curb/gutter and sidewalk will be collected on Mainline and 100 feet on all side roads. Pavement type shown
[ ] Driveway type shown ***(include pipe type and size)***
[ ] Building structure type and use shown
[ ] Drainage structure size and type shown ***(culverts, x-drain pipes, storm sewers, etc.)***
[ ] Culverts without wing wall noted
[ ] Additional topo plotted
[ ] Obscured areas enhanced
[ ] Obscured areas noted as enhanced or not enhanced
[ ] Limit lines shown where required
[ ] Major transmission utilities shown
[ ] Designers special request completed
[ ] Active construction areas noted
[ ] Completed construction enhanced
[ ] Storage tanks shown
[ ] Landfills and hazardous waste sites shown
[ ] Highway and Railroad milepost shown
[ ] Railroad surveys completed
[ ] New location alignment staked
[ ] Crossroads flagged on new location alignment
[ ] Private signs located

IV. LOCAL CONTROL SET

[ ] Control deltas scaled and adjusted
[ ] Control deltas described
[ ] Control deltas elevated
[ ] Benchmarks set at all flowing streams
[ ] Benchmarks described

V. DRAINAGE

[ ] All culverts elevated
[ ] All cross drain pipes elevated
[ ] All storm sewers elevated
[ ] Alignment, topo, and elevations on all flowing streams
[ ] Alignment, topo, and elevations on all outfall ditches

VI. BRIDGE SURVEYS

A. REQUIRED FOR ALL SURVEYS

[ ] Alignment and topo of existing bridge and roadway
[ ] Property survey completed
[ ] 3 control points / benchmarks set and described
[ ] Cross sections or DTM survey completed
[ ] Bridge deck elevations
[ ] Highway mile post

B. BRIDGES OVER STREAMS

[ ] High water elevation established and noted
[ ] Floodplain cross sections or DTM coverage completed to **2 feet** above high water
[ ] Located structures in floodplain that might be flooded (location and floor elevation)
[ ] All drainage structures within floodplain shown and elevated
[ ] Profiles on crossroads within floodplain
[ ] Stream traverse at bridge site completed
[ ] 3 top of water elevations on stream
[ ] Stream traverse on all other streams within floodplain
[ ] Hydraulic Report completed

C. BRIDGES OVER RAILROADS

[ ] **1000 feet** railroad survey
[ ] All drainage structures shown
[ ] Cross sections or DTM data to include 5 Cross sections within Right-of-Way boundaries
[ ] Railroad milepost shown

D. BRIDGES OVER ROADWAYS

[ ] **300 feet** roadway survey on road beneath bridge
[ ] All drainage structures shown

VII. FILE DATA TRANSFER

[ ] Survey file transferred from data collector to personal computer
[ ] *.CSV and JOB File transferred from personal computer to the **SDE**
[ ] Property files (kcm) or sketches (tax maps with points) transferred to the **SDE**

Chapter 1. Survey and Mapping Control - Contents

Chapter 1. Survey and Mapping Control

1.1 Project Coordinate Datum

There are still projects the Department is currently designing and constructing that are based on a variety of different datum. In fact, since 1993 all mapping and location survey submittals as well as design plans have contained a statement to indicate which horizontal and vertical datum was used. However, since then there has been an official adoption of yet another set of datum which needs to be noted for you, the surveyor. So, this will serve as an updated guide for you to distinguish between the various datum the Department currently uses.

A. **Horizontal Datum:**

The following datum are noted, as you would see them on any set of plans or control package. Even though there are five different sets of coordinates listed, there are actually just three with six different names. The North American Datum of 1983 and the Georgia Coordinate System of 1985 are one in the same. However, the most accurate of this list is known as the H.A.R.N. or otherwise noted as NAD83/(94) datum. This is a nationwide adjustment that was collected with Global Positioning System (GPS) technology. Please note that the newest NAD 83/(94) HARN coordinate system is very similar to the NAD 83 and /or GCS 85 system, but it cannot be substituted or used interchangeably with it. If you compare published coordinates from the two systems for a control station, you will see a difference that exceeds 0.6 feet. **No assumed coordinate values should be used except for emergency situations.**

(a) North American Datum of 1927 [NAD 27]

(b) North American Datum of 1983 [NAD 83 or GCS 85]

(c) Georgia Coordinate system of 1985 [NAD83 or GCS 85]

(d) High Accuracy Reference Network or H.A.R.N. [NAD 83/(94) HARN]

(e) High Accuracy Reference Network [NAD83/(2007)HARN]

(f) High Accuracy Reference Network [NAD83/(2011)HARN]

Note: GDOT will accept the most up to date datum adjustments as long as they are based on the coordinate system of 85. Systems and datums must be displayed on control packages.

B. **Vertical Datum:**

In 1998, the Department decided to switch back to using the U.S. Survey foot (English units) for the development of design plans and construction. However, this version will have no affect on the current use of the North American Vertical Datum of 1988 (NAVD 88). The following two sets of datum are the only ones currently being used by the Department:

(a) National Geodetic Vertical Datum of 1929 [NGVD 29]

(b) North American Vertical Datum of 1988 [NAVD 88]

GEORGIA STATE PLANE COORDINATE SYSTEM

Georgia Department of Transportation

Georgia Department of Transportation

GDOT Publications
Policies & Procedures

Policy: 4420-2- Georgia Coordinate System of 1985
Section: State Plane Coordinate System
Office/Department: Statewide Location Bureau

Reports To: Office of Design Policy and Support
Contact: 404-699-4401

In 1985, Chapter 4 of Title 44 of the Official Code of Georgia Annotated was amended. This Act changes the provisions relating to the horizontal coordinate system currently being used by the State of Georgia by adopting a new system.

This new and official coordinate system, which is to be used for designating the geographic position of points on the surface of the earth within the State, shall be known as the **Georgia Coordinate System of 1985**.

This new coordinate system is based upon recomputation of the coordinates for the monumented points of the North American Horizontal Geodetic Control Network by the National Geodetic Survey (NGS) office. The Georgia Coordinate System of 1985 uses the data as provided by the North American Datum of 1983 as the basis for computation.

The horizontal coordinates of survey stations which were computed by using the 1927 Datum, as authorized in the Act of 1945, were recomputed using the North American Datum of 1983. This recomputation will result in significantly different coordinate values. The new coordinates can easily be differentiated from the old by the large increase in the size of the easting (X) coordinate (see example).

Example:

Station	System	Northing (Y)	Easting (X)
BV-011-103	1927	1,033,939.112	688,445.275
BV-001-103	1985	1,034,023,919	2,485,053.668

As specified in the Act, beginning January 1, 1990, the Georgia Coordinate System of 1985 will be the sole coordinate system for the
State.

In order to comply with Georgia law, the Statewide Location Bureau has obtained a master listing of the coordinates of all monumented NGS points in Georgia which have been recomputed by the NGS to the 1985 Datum. This coordinate listing will be kept on file at the Office of Environment/Location and is available to governmental agencies and the public.

The Statewide Location Bureau will soon begin mapping projects with the 1985 coordinate system and by January 1, 1990, all future projects will be mapped and surveyed with the new coordinates.

If additional data is required after January 1, 1990, it will be provided in the same datum as the original mapping or survey.

For Reference Only

It will be the policy of the Statewide Location Bureau to convert survey control stations (monuments and deltas) which have been set by this office to the 1985 Datum only upon request. All future stations set by this office will be coordinated using the Georgia Coordinate System of 1985.

The Georgia Coordinate System of 1985 does not affect the State's vertical datum. This coordinate system will not change any
survey computation based upon centerline station and offset. This coordinate system will not affect area computations or bearing and distance computations. These will all be carried out exactly as before.

If there are any questions, contact the Statewide Location Bureau.

References: None.

History:

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added to Manual of Guidance: 06/28/89 revised: 09/01/95 added to TOPPS: 05/01/96 reviewed: 11/10/06
Revised: 08/14/13
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Georgia Department of Transportation

GDOT Publications
Policies & Procedures

Policy: 4420-1- Georgia State Plane Coordinate System
Section: State Plane Coordinate System
Office/Department: Statewide Location Bureau

Reports To: Office of Design Policy and Support
Contact: 404-699-4401

The necessity of relating the horizontal positions of points in one survey to those in another by means of a common system of coordinates has become unquestionably more important in recent years. Modern civil engineering projects have increased greatly in complexity and extent of area covered. The need for higher accuracy and greater precision of surveys has demanded more rigid geometric control. It has been very rare for any one survey to remain independent and isolated from another. This trend has underlined the need of converting existing geodetic positions to plane rectangular coordinates and of computing and expressing the results of horizontal surveys in terms of some standard plane coordinate system.

In the early 1930's, the U.S. Coast and Geodetic Survey (the predecessor of the National Ocean Survey) established a coordinate system for each state in the United States. In designing the state plane coordinate systems, they elected to use the transverse Mercator mapping projection for states whose major dimensions extended north to south and the Lambert conformal projection for states extending primarily east to west. They chose to hold the distortion between the sea level curved surface of the earth and the projected plane to less than 1 part in 10000. Due to the curvature of the earth, this meant that the maximum width of area which could be projected on a single plane surface would be about 158 miles. Thus, the state plane coordinate system of Georgia consists of two zones, and uses the transverse Mercator projection. The datum for the system is the North American Datum of 1927 which is based on the Clarke spheroid of 1866.

The two zones of the Georgia State Plane Coordinate System are the West Zone and the East Zone. In order to minimize scale and angular distortions in the projections to the plane surface, central meridians were chosen as 84° 10' West Longitude and 82° 10' West Longitude for the West and East Zones respectively. The boundary between the two zones was made to follow county lines in order that only one zone would be needed in any one county (see Figure 1).

The planes for the system were defined as being one ten-thousandth of the radius of the earth below the sea level curved surface of the earth at each of the two central meridians. The easting or x coordinate values increase from west to east and the central meridian of each zone was arbitrarily assigned a value of 500,000 feet. The northing or y coordinate values increase from south to north and the intersection of the central meridian for each zone with the 30 North Latitude parallel was given a value of 0 feet. All coordinates for both zones are, therefore, positive.

Both true or geodetic azimuths and plane azimuths were defined as the clockwise angle from the south. Plane azimuths are referred to the central meridian of each plane as the north and south line. Unlike geodetic lines, lines in a single plane coordinate zone having the same plane azimuths are parallel. As the distance of a line from the central meridian increases, the difference between the plane azimuth and the true or geodetic azimuth increases due to the convergence of the true or geodetic azimuth toward the central meridian. In computation involving only plane coordinates, no account need be made of this convergence.

In order to use the Georgia State Plane Coordinate System measured distances must be reduced to grid distances before they are used in traverse computations. After slope distances have been reduced to horizontal distances, a sea level factor must be applied for reduction to sea level and a scale factor must be applied for reduction to grid. The sea level factor depends on the elevation of the area and the scale factor depends on the distance of the area east or west of the central meridian of the zone. (For an explanation on how to determine and apply these factors, see Figure 2. Tables of Sea Level Factors and Scale Factors are provided in Figure 3.)

The reference library of any surveyor or engineer who performs control surveys or employs the State Coordinate Systems should contain the following NGS and ACSM publications and papers.

1. Coast and Geodetic Survey, : **Plane Coordinate Projection Tables, Special Publication Series.** For states where projects will be undertaken.
2. Mitchell, H.C., and Simmons, L.G., 1945, revised 1974, reprinted 1975: **The State Coordinate Systems (A Manual for Surveyors), Special Publication No. 235.**
3. Dracup, J.F., and Kelley, C.F., 1973, reprinted 1975: **Horizontal Control as Applied to Local Surveying Needs.**
4. Simmons, L.G., 1968, reprinted 1975: **Geodetic and Grid Angles - State Coordinate Systems, ESSA Technical Report C&GS 36.**
5. Federal Geodetic Control Committee, 1974, reprinted 1975/1976: **Classification, Standards of Accuracy, and General Specifications of Geodetic Control Surveys.**
6. Federal Geodetic Control Committee, 1975/1976: **Specifications to Support Classification, Standards of Accuracy, and General Specifications of Geodetic Control Surveys.**
7. Dracup, J.F., 1969, revised 1973: **Suggested Specifications for Local Horizontal Control Surveys, Technical Monograph No. CS-1.**
8. Dracup, J.F., 1970: **Standards and Specifications for Supplemental Horizontal Control Surveys.**
9. Mitchell, H.C., 1948, reprinted 1974/1976: **Definitions of Terms used in Geodetic and Other Surveys, Special Publication No. 242.**
10. Tomlinson, R.W., and Burger, T.C., 1971, revised 1975: **Electronic Distance Measuring Instruments, Technical Monograph No. CS-2.**

Some surveyors and engineers contend the State systems are not adaptable to their projects because ground distances are required in laying out structures, etc. This problem, of course, can be generally overcome by projecting the State plane coordinates to the average elevation and correcting for the average scale factor of the site.

Why employ the state plane coordinate systems?

1. No point can ever be considered legally lost since it can be repositioned to original accuracy.
2. All surveys correlated to a single reference framework.

3. Bordering and overlapping mapping project s are consistent.
4. Few blunders will go undetected if two or more coordinated points are used to control a survey.
5. The accuracy of a survey has nothing to do with whether or not the state plane coordinate system should be used.
6. Computational time-negligible! Additional costs are due to field operations necessary to connect survey to points of known coordinates.
7. Provides supplemental identification for property descriptions.

Figure 1-- Georgia East & West Zone map
Figure 2-- Cross-section diagram and explanations of factors
Figure 3-- Tables of Sea Level Factors and Scale Factors

References:

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History:

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added to Manual of Guidance: 1976 revised: 09/01/95 added to TOPPS: 04/30/96 Figures 1, 2, and 3 made available: 04/28/97 reviewed: 11/10/06 revised: 08/14/13
Created at 9/15/2008 4:18:06 PM by Helene Nickey

1.2 Horizontal Control

A. Control Location

A control packet will be compiled at the Statewide Location Bureau with all control in the project vicinity to include:

1. National Geodetic Survey (NGS) Monuments

   These are the most accurate controls available and should be used if economically feasible. In April 1994, Global Positioning System (GPS) observations were conducted in Georgia as part of the nationwide High Accuracy Reference Network (HARN). There are five “A order points” with an accuracy of 1: 10,000,000, one hundred twenty nine “B order points” with an accuracy of 1: 1,000,000, and sixty one “C order points” with an accuracy of 1: 100,000. Many of these marks were existing, BV stations. Future plans include a readjustment of all NGS control and many BV marks, which are tied to the NGS network established in the early 1970’s. The readjusted coordinates will carry the designation of NAD-83(94). The existing NAD-83 coordinates have an accuracy of 1:100,000

2. **Department of Transportation Brownie Verniers (BV) Monuments**

   Each monument will have a county code identifying the county followed by an identification number. There are three distinct groups of BV monuments, which are:

   a. **200’s** – Concrete monuments which have an identification number in the 200 range were tied directly to the NGS Network and are excellent control.

   b. **300’s** – Monuments (Rebar with aluminum caps) which have an identification number in the 300 range were set using the Global Positioning System and were tied to the NGS Network and are excellent control. This will hold true in every county **EXCEPT FULTON**. The Fulton County GPS Monuments begin at 320

   c. **1-2-3’s** – Concrete monuments which were set on a traverse between published control were numbered in a range from 1 to 199. These monuments should be used with **CAUTION** and only if other more accurate forms of control are not available.

3. **Existing Project Control**

   Control location deltas from previous jobs should be used only if a more accurate control is not available. Before using these points an investigation should be made of the existing traverse to determine what control was used and the precision obtained. Any traverse which had a precision after angle adjustment of less than **1/20,000** should **NOT** be used. However, the existing project traverse should be tied and noted to verify the relationship between it and the new project.

B. Control Location Deltas

A **horizontal mainline control traverse** should originate from published NGS control and tie to published NGS control. Accurate **Control Location Deltas (CLD’s)** shall be established over the entire project length, and described for future reference. The maximum distance between CLD’s should be **2000 feet** and a minimum distance of **1000 feet** where possible or as terrain allows. The CLD’s should be set near the outside of the right-of-way of

the road if possible. A **CLD SHALL NEVER** be located within three feet of the edge of a travel lane. CLD's should be 3/4 inch diameter iron pin a minimum of **30 inches** long and having a punch hole or survey cap. These should be driven to a minimum depth of **3 to 6 inches** below natural ground. CLD's can be set in a **FIXED STABLE** concrete slab, such as approach slabs to bridges, sidewalks, or parking lots, only if other suitable locations are not available. These CLD's should be a punch hole **0.01 feet** in diameter, **0.02 feet** in depth, with three identification lines beginning **0.02 feet** from the punch hole and extending for **0.20 feet**. CLD's located in asphalt should be a railroad spike driven flush with paving, with job number, delta number, and a punch hole in the head of the spike. This should be done with regard to private property to avoid future conflicts. A **mainline control traverse** should not have over twelve deltas. All subsequent survey data shall be collected from the adjusted primary traverse values.

C. **Secondary Control**

Secondary control, if needed, will be established from the primary horizontal control. A secondary traverse will have to be performed if more than 2 deltas are considered necessary to collect project design data. These two deltas are not to exceed a combined total of 1600 U. S. survey feet. If more than two deltas are required a return tie line will have to be run. The return tie line must be adjusted and meet current Department guidelines for traverse closures.

D. **Traverse Adjustment**

The traverse shall have an azimuth closure of no more than **1.5"** per angle. The traverse shall be scaled to the state plane and angle adjusted have a precision no less than **1/20,000 for rural and 1/25,000 for urban areas**. The traverse shall be **Compass Rule Adjusted** to complete the adjustment.

1.3 Vertical Control

A. **Control Location**

A control packet will be compiled at the Statewide Location Bureau with all control in the project vicinity to include:

1. **National Geodetic Survey (NGS) Monuments**

   This is the most accurate control available and should be used if economically feasible. These guidelines are considered first order, which have a precision of 0.01' * square root of miles ran.

2. **United States Geological Survey (USGS) Monuments**

   These monuments are considered third order, which have a precision of 0.04' * square root of miles ran. These monuments are good for control surveys.

3. **Georgia Geodetic Survey (GGS) Monuments**

   Experience has shown that these monuments have a varying degree of accuracy and should be used only as a last resort and with **EXTREME CAUTION** and only after verification from other known vertical control.

4. **Department of Transportation Brownie Vernier's (BV) Monuments**

   These monuments have a varying degree of accuracy and should be used with CAUTION. Often times these monuments were elevated from third order control, or on loop traverses.

5. **Existing Project Control**

   Benchmarks from previous jobs should be used only if a more accurate control is not available. However, the existing project should be tied and noted to verify the relationship between it and the new project. If problems exist, notify SLB in writing concerning the discrepancies.

6. **Others**

   There are many other sources of vertical control which should be used with **EXTREME CAUTION** and only after verification from other known vertical control. Some of these include the Corps of Engineers, City of Atlanta and MARTA.

B. **Traverse Staking**

A **vertical mainline control traverse** should originate from published control and tie to another published control. Accurate Benchmarks (**BM's**) shall be established over the entire project length and be described for future reference. The maximum distance between BM's should be 1000 feet. BM's should be set in culverts and at road intersections. It should be a definitely identifiable mark, such as a square cut or stamped nail and washer. BM's such as top of fire plugs, center of steps, or manholes should **NEVER** be set or used.

C. **Field Observations**

Either a conventional level or electronic level may be used to establish mainline vertical control, provided the following guidelines are adhered to.

1. **Conventional Level**

   A conventional level should be peg checked and adjusted to an accuracy of **0.003 feet**. The level rods should be 13 foot wooden rods, calibrated prior to each run before being considered for use in establishing vertical mainline control. A second run of the mainline is **REQUIRED**. Third order accuracy is defined as 0.049' times the square root of the miles ran.

2. **Electronic Level**

   An electronic level should be peg checked and adjusted to an accuracy of 5 arc seconds (**0.02'/100'**). A second run of the mainline is **NOT REQUIRED** if third order accuracy is achieved. Third order accuracy is defined as **0.049'** times the square root of the miles ran.

D. **Vertical Traverse Adjustment**

The traverse(s) shall meet third order accuracy. If not, the Control Survey Supervisor should be consulted to determine if further ties should be made. All subsequent survey data shall be collected from the adjusted primary traverse values.

1. **Conventional Level**

The two runs of the mainline should be adjusted using the number of turn's method (error ÷ # of turns = correction per turn) and the two runs meaned together. All control location deltas located in the project vicinity and benchmarks **WILL** have two runs through them.

2. **Electronic Level**

The mainline runs should be adjusted using the least squared method if support software is available, or the number of turn's method if unavailable.

1.4 Survey Control Package Guidelines

A Survey Control Package shall be provided to the Statewide Location Bureau for all Department and Consultant performed surveys. All control packages should be submitted to the Consultant Compliance Supervisor (CCS) headquartered at SLB for a quality assurance review. This control package should be submitted to the CCS as soon as the control has been verified and all to reaches as well as descriptions have been checked and the control pack meets Department guidelines and is known to be accurate. The control files will be stored in the repository located at SLB.

A copy of an approved survey control package will be provided in this section later as a convenience. Please note that where the provided reference copy has Statewide Location Bureau Control you will need to replace this with the appropriate District Number, company letterhead, company logo or company name.

Remember, the survey control package is the baseline information in which the data was gathered and designed. It will also eventually be the same information that the project will be constructed from. The entire project life, which consists of survey, design and construction disciplines may take ten years or more to complete. That is why it is so important that the control and control package be as accurate, enduring and comprehensive as possible. You must complete the package as if you were the individual who will be looking for this much needed information at a later date and also has never been to the project location.

The Survey Control Packet shall be assembled from the adjusted primary horizontal and vertical control traverses established for the project. The data contained in the packet shall consist of the primary horizontal and vertical control points which will be used for all photogrammetric and field survey activities, project design, right-of-way staking and project construction. The project Survey Control Packet shall contain the following information and in the order listed:

a) Cover sheet showing the project number, P.I. number and project description, DATE of project, COUNTY or COUNTIES in which project is located, horizontal and vertical DATUM USED and LENGTH of project.

b) Area map showing location of project.

c) Copy of a quadrangle map with approximate location of all primary adjusted horizontal control deltas and published horizontal monuments that were used for the project plotted on the map.

d) Control file listing showing the following information in order listed:

1. Project No., P.I. No. and description of project and date of project.
2. County or counties in which project is located.
3. Horizontal datum used.
4. State Plane Zone.
5. Scale factor computed and used for each traverse.
6. Published horizontal control monuments used.
7. Vertical datum used.
8. Published vertical control monuments used.
9. Units of measurement.
10. Point number, east coordinate, north coordinate, elevation and the name or number of all published monuments used and primary control deltas set.

e) Description sketches for each primary survey control delta set. The following shall be noted on the sketch:

1. The Name of the CONSULTANT or DISTRICT.
2. Control delta number.
3. Brief note describing the delta (i.e., ¾ " diameter iron pin set 0.4 foot below ground surface, punch-hole in concrete sidewalk, etc.).
4. DATE and COUNTY.
5. Elevation.
6. North and East Coordinate Values.
7. State Plane Zone.
8. Horizontal and vertical datum.
9. Units of measure.
10. North Arrow.
11. Distances and directions from a minimum of three local features.
12. A "to reach" description from a permanent feature such as a major road intersection, county line, bridge over a named stream, etc.

f) Copy of a quadrangle map with approximate location of all primary adjusted vertical benchmarks established and published vertical monuments that were used for the project, plotted on the map.

g) Vertical control file listing all published monuments used and all primary vertical benchmarks set and described, along with their adjusted elevation.

h) Description sketches for each primary benchmark set. The following shall be noted on the sketch:

1. The Name of the CONSULTANT or DISTRICT.
2. Benchmark number.
3. Brief note describing the benchmark (i.e., R/R spike set a base of Power Pole, square cut in concrete bridge abutment, etc.).
4. DATE and COUNTY.
5. Elevation.
6. North and East Coordinate Values, only if a publishable coordinate value is placed on the benchmark.
7. State Plane Zone.
8. Vertical datum, and Horizontal datum, if applicable.
9. Units of measure.
10. North Arrow.
11. Distances and directions from a minimum of three local features.
12. A “to reach” description from a permanent feature such as a major road intersection, county line, bridge over a named stream, etc.

A map shall be included showing the coordinate zones GA EAST or GA WEST. The state plane coordinate zone will be determined by the zone percentages within the project area. Whichever zone covers 55% or more of the project area will be the dominating zone for that project. If the project appears to be evenly divided between the two zones then written permission from the Statewide Cadastral Engineering Supervisor (SCES) or the CCS will be required to determine the projects state plane coordinate zone. A zone map has been provided in this section for your convenience. You may also find this map on the Departments website at: http://mygdot.dot.ga.gov/info/gdotpubs/Publications/4420-1m.pdf

EXAMPLE: If a project is 60% in the GEORGIA WEST state plane coordinate zone and 40% in the GEORGIA EAST state plane coordinate zone then the project would be controlled using GEORGIA WEST state plane coordinate zone values.

It is requested as a tool for future reference, but not required, that if the description provided to a National Geodetic Survey (NGS) horizontal and/or vertical control monument, United States Geological Survey (USGS) benchmark, or any other approved monument, marker, delta or benchmark the Department provides a description for is outdated then please update the description with a new sketch, new local distances with bearing directions as well as a new to

reach. These can be submitted to the Computations Engineering Technician (CET) at SLB for filing and need not be a part of the survey control package. The CET contact number is 404-699-4471.

1.5 Mapping Crew Photo Checklist

PI # _____PROJECT #_____COUNTY_____ JOB #_____

PROJECT DESCRIPTION _____

_____

BELOW ITEMS ARE TO BE MARKED AND LABELED ON HORIZONTAL PHOTOS BEFORE RETURN TO OFFICE

☐ PIPE AND CULVERT CROSSDRAINS

☐ ELECTRICAL SUB STATIONS, OVERHEAD TRANSMISSION LINES, UNDERGROUND PIPE OR UTILITY LINE CROSSINGS (LABEL TYPE OF CROSSING)

☐ MILEPOST MARKERS ON ROAD

☐ SCHOOLS, CHURCH'S AND CEMETERY'S (LIST NAMES IF KNOWN)

☐ COURT HOUSES AND OTHER FEDERAL, STATE, COUNTY, OR CITY GOVERNMENT BUILDINGS

☐ NAMES OF ALL CITY STREETS, AND RAILROADS

☐ STATE AND FEDERAL ROAD ROUTE NUMBERS,

☐ COUNTY ROAD NAMES AND/OR NUMBERS (IF KNOWN)

☐ NAMES OF ALL RIVERS, CREEKS AND LAKES

☐ ALL LANDFILLS (ACTIVE OR INACTIVE)

☐ ANY ABANDONED UNDERGROUND TANKS DISCOVERED (PROPANE OR GASOLINE)

☐ STATE, COUNTY AND CITY BOUNDARY LINES AS WELL AS HISTORIC SIGNS AND MARKERS

☐ NEW ACTIVITY ALONG ROADWAY SUCH AS INTERSECTION IMPROVEMENTS, PASSING LANES, NEW PAVEMENT (BEGINNING AND ENDING POINTS), NEW HOUSING, NEW BUSINESS STRUCTURES, ETC…

✓ IF SOME WERE FOUND AND IDENTIFIED ✗ IF NONE WERE LOCATED

ADDITIONAL CHECK

☐ ALL PRIMARY HORIZONTAL DELTA AND PRIMARY VERTICAL BENCH MARK DESCRIPTIONS HAVE BEEN CHECKED AND VERIFIED BY PARTY AND CREW CHIEFS

HORIZONTAL PC_____ VERTICAL PC_____
SIGNATURE SIGNATURE

CREW CHIEF_____
SIGNATURE

1.6 Relocation of Endangered Survey Control

Georgia Department of Transportation

GDOT Publications
Policies & Procedures

Policy: 4465-2- Relocation of Endangered Survey Control Marks
Section: Surveys
Office/Department: Office of Design Policy and Support
Reports To: Division of Engineering
Contact: 404-699-4401

The Statewide Location Bureau will serve as a clearinghouse for all vertical and horizontal control monuments that are in jeopardy of being destroyed by DOT construction. These procedures are set up to provide an orderly and efficient method to re-set the monuments when required.

All control monuments along a proposed project will be marked on the topographic maps which are produced by this office. The Project Designer can then determine if the control marks are in danger of being destroyed. The Designer will furnish the Statewide Location Bureau, a cover sheet and marked plan sheets showing the particular survey marks that need to be relocated. At that time, the Field Control Section of the Statewide Location Bureau will determine if the control marks should be relocated.

The resurveying and relocation of the survey control marks will be coordinated through the Statewide Cadastral Engineering Supervisor (404)699-4442. This work will only be done by survey parties which are assigned to this office and have been trained in monument relocation procedures.

References:

None.

History:

Copied to GDOT Publications v.02.00.00 on 2/21/2012
added to Manual of Guidance: 04/17/86 revised: 09/01/95 added to TOPPS: 05/01/96 reviewed: 11/10/06
Created at 9/15/2008 4:31:20 PM by Helene Nickey

Georgia Department of Transportation

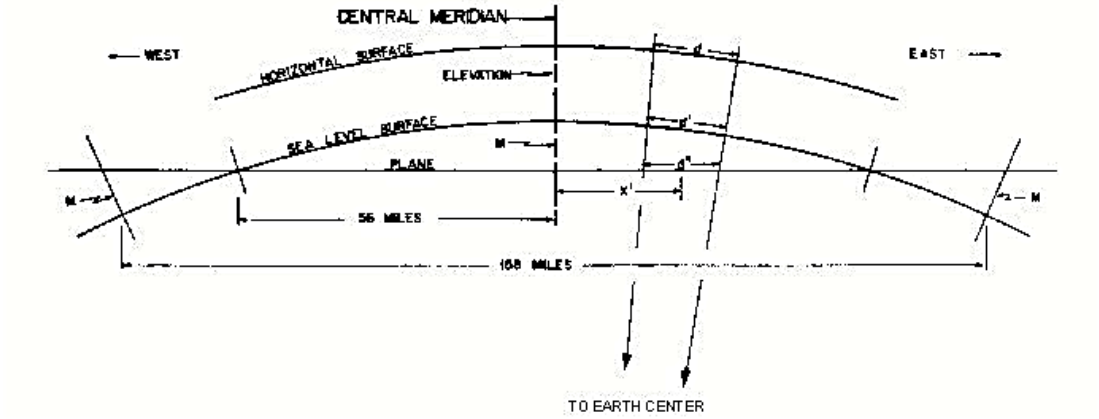
GDOT Publications
Policies & Procedures

Form Word: 4420-1c - Policy 4420-1 Georgia State Plane - Cross-sectional View - South to North
Section: Plane Coordinate System **Reports To:** Division of Engineering
Office/Department: Office of Design Policy & Support **Contact:** 404-631-1000

See below

GEORGIA STATE PLANE

CROSS-SECTIONAL VIEW LOOKING FROM SOUTH TO NORTH



SAME FOR BOTH ZONES

R = APPX EARTH RADIUS (20,900,000 FT)

M = R/10000

d = HORIZONTAL DISTANCE

d' = SEA LEVEL DISTANCE

d" = PLANE OR GRID DISTANCE

E = ELEVATION

X = EASTING PLANE COORDINATE

X' = MEAN DISTANCE FROM CENTRAL MERIDIAN

SL = SEA LEVEL FACTOR

SF = SCALE OR GRID FACTOR

CF = COMBINED FACTOR

SL = I E/R

SF = ((R M)/COS(ARCTAN(X' / (R M)))) / R

d' = d x SL

CF = SL × S F or SL + SF 1

d' = d' × SF

OR

d' = d × CF

Form Word: 4420-1c- Policy 4420-1 Georgia State Plane - Cross-sectional View - South to North
Date Last Reviewed: [Date Last Reviewed] Page **2** of **4**

EXAMPLE DISTANCE REDUCTION

GIVEN: MEAN X = 458265.83 Ft.
MEAN E = 1127.56 Ft.
d = 526.934 Ft.

SL = 0.9999460
X' = 41734.17 Ft.
SF = 0.9999020
CF = 0.9998480
d' = d × SL = 526.906 Ft.
d'' = d' × SF = d × CF = 526.854 Ft.

References:

None.

History:

copied to GDOT Publications v.02.00.00: 03/21/12

Georgia Department of Transportation

GDOT Publications
Policies & Procedures

Form Word: 4420-1m - Georgia State Plane Coordinate System
Section: Plane Coordinate System
Office/Department: Office of Design Policy & Support
Reports To: Division of Engineering
Contact: 404-631-1000

See Below

References:

None.

History:

Form Word: 4420-1m- Georgia State Plane Coordinate System
Date Last Reviewed: [Date Last Reviewed]

copied to GDOT Publications v.02.00.00: 03/21/12.

Georgia Department of Transportation

GDOT Publications
Policies & Procedures

Form Word: 4420-1t - Policy 4420-1 Sea-Level Factors
Section: Plane Coordinate System
Office/Department: Office of Design Policy & Support

Reports To: Division of Engineering
Contact: 404-631-1000

TABLES OF SEA LEVEL FACTORS AND SCALE FACTORS

SEA-LEVEL FACTORS							
Elevation (feet)	Sea-level factor (SL)	Elevation (feet)	Sea-level factor (SL)	Elevation (feet)	Sea-level factor (SL)	Elevation (feet)	Sea-level factor (SL)
0	1.000 0000	1,000	0.999 9522	2,000	0.999 9043	3,000	0.999 8565
100	0.999 9952	1,100	0.999 9474	2,100	0.999 8995	3,100	0.999 8517
200	0.999 9904	1,200	0.999 9426	2,200	0.999 8947	3,200	0.999 8469
300	0.999 9856	1,300	0.999 9378	2,300	0.999 8899	3,300	0.999 8421
400	0.999 9809	1,400	0.999 9330	2,400	0.999 8852	3,400	0.999 8373
500	0.999 9761	1,500	0.999 9282	2,500	0.999 8804	3,500	0.999 8325
600	0.999 9713	1,600	0.999 9234	2,600	0.999 8756	3,600	0.999 8277
700	0.999 9665	1,700	0.999 9187	2,700	0.999 8708	3,700	0.999 8229
800	0.999 9617	1,800	0.999 9139	2,800	0.999 8660	3,800	0.999 8181
900	0.999 9569	1,900	0.999 9091	2,900	0.999 8612	3,900	0.999 8134
1000	0.999 9522	2,000	0.999 9043	3,000	0.999 8565	4,000	0.999 8086

SCALE FACTORS								
x' (feet)	Scale Factor (SF)	Tabular Difference	x' (feet)	Scale Factor (SF)	Tabular Difference	x' (feet)	Scale Factor (SF)	Tabular Difference
0	0.999 9000	1	150,000	0.999 9258	35	300,000	1.000 0031	69
10,000	0.999 9001	4	160,000	0.999 9293	38	310,000	1.000 0100	72
20,000	0.999 9005	5	170,000	0.999 9331	40	320,000	1.000 0172	75
30,000	0.999 9010	8	180,000	0.999 9371	42	330,000	1.000 0247	77
40,000	0.999 9018	11	190,000	0.999 9413	45	340,000	1.000 0324	79
50,000	0.999 9029	12	200,000	0.999 9458	47	350,000	1.000 0403	81
60,000	0.999 9041	15	210,000	0.999 9505	49	360,000	1.000 0484	84
70,000	0.999 9056	17	220,000	0.999 9554	52	370,000	1.000 0568	85
80,000	0.999 9073	20	230,000	0.999 9606	53	380,000	1.000 0653	89
90,000	0.999 9093	21	240,000	0.999 9659	57	390,000	1.000 0742	90
100,000	0.999 9114	25	250,000	0.999 9716	58	400,000	1.000 0832	93
110,000	0.999 9139	26	260,000	0.999 9774	61	410,000	1.000 0925	95
120,000	0.999 9165	28	270,000	0.999 9835	63	420,000	1.000 1020	97
130,000	0.999 9193	31	280,000	0.999 9898	65	430,000	1.000 1117	100
140,000	0.999 9224	34	290,000	0.999 9963	68	440,000	1.000 1217	102
150,000	0.999 9258	35	300,000	1.000 0031	69	450,000	1.000 1319	

Form Word: 4420-1t- Policy 4420-1 Sea-Level Factors
Date Last Reviewed: [Date Last Reviewed]

References:

None.

History:

copied to GDOT Publications v.02.00.00: 03/21/12

Form Word: 4420-1t- Policy 4420-1 Sea-Level Factors
Date Last Reviewed: [Date Last Reviewed]

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Chapter 2. Automated Surveying - Contents

Chapter 2. Automated Surveying

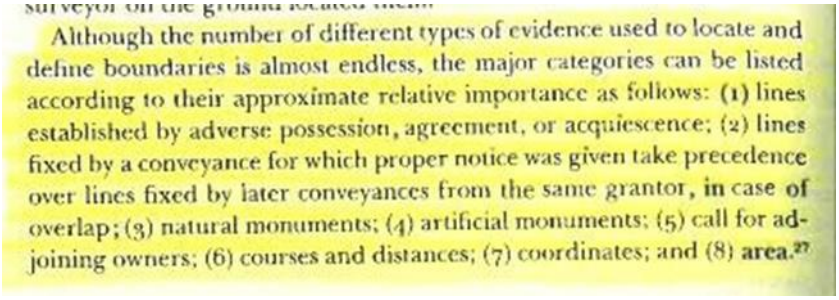
2.1 Property Resolution on GDOT Projects and GDOT Sponsored Projects

GDOT's practice to prevent conflicts, disputes and to insure accurate property databases is to hold to property pins in the resolution.

This section applies to consultants and GDOT in-house personnel who perform property and right of way resolution on GDOT sponsored projects. It has always been GDOT's in-house procedure to hold to field located monumentation that reasonably fits the deeds, plats and ROW information of the corridor parcels unless senior rights or another contrary intent indicated by a deed dictates it should not. The term "reasonably fits" would be the tolerance that a competent Georgia Registered Land Surveyor would use based on his experience and professional judgment.

With this in mind, most property owners can point out their property corners or other monumentation as it relates to their property. Neighbors often agree that a monument is their dividing corner even though it may be off 2 tenths of a foot from the deed measurement.

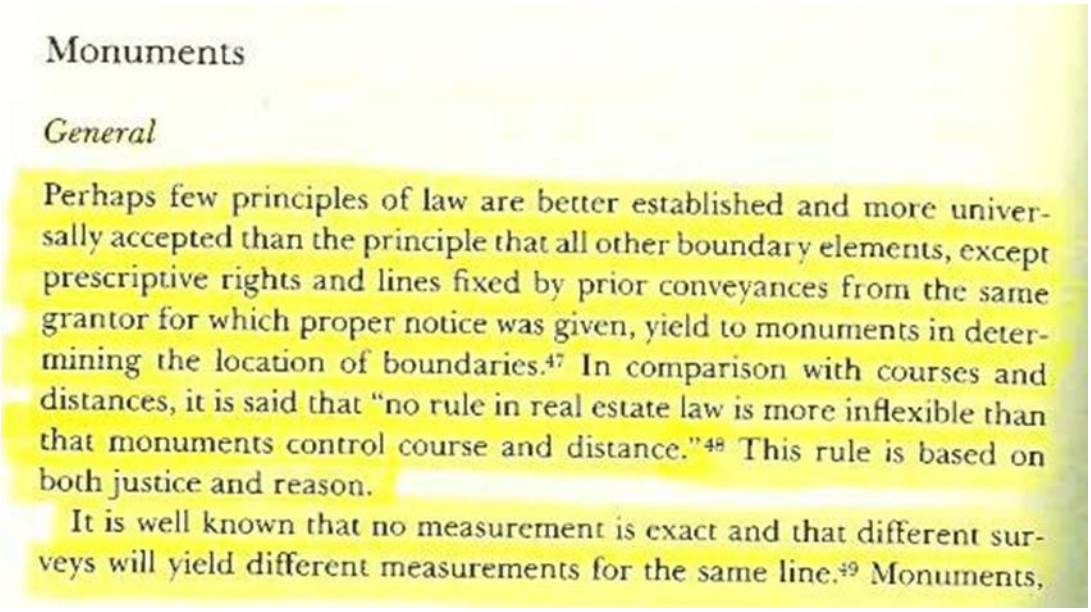
Below are excerpts from the *Georgia Land Surveying History and Law* publication written by Farris W. Cadle. Be mindful these excerpts are not ***law***, but principles for good surveys.



surveyor on the ground locates them.

Although the number of different types of evidence used to locate and define boundaries is almost endless, the major categories can be listed according to their approximate relative importance as follows: (1) lines established by adverse possession, agreement, or acquiescence; (2) lines fixed by a conveyance for which proper notice was given take precedence over lines fixed by later conveyances from the same grantor, in case of overlap; (3) natural monuments; (4) artificial monuments; (5) call for adjoining owners; (6) courses and distances; (7) coordinates; and (8) area.[27]

(Page 398- Georgia Land Surveying History and Law, Farris W. Cadle, 1991 University of Georgia Press)

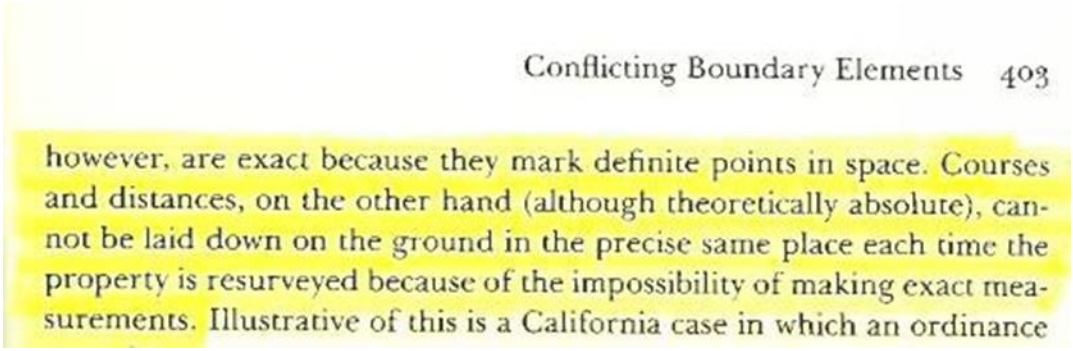


Monuments

General

Perhaps few principles of law are better established and more universally accepted than the principle that all other boundary elements, except prescriptive rights and lines fixed by prior conveyances from the same grantor for which proper notice was given, yield to monuments in determining the location of boundaries.[47] In comparison with courses and distances, it is said that "no rule in real estate law is more inflexible than that monuments control course and distance."[48] This rule is based on both justice and reason.

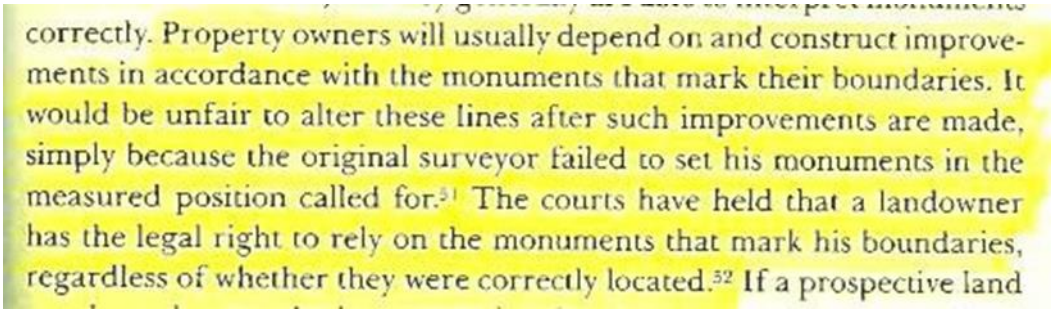
It is well known that no measurement is exact and that different surveys will yield different measurements for the same line.[49] Monuments,



Conflicting Boundary Elements 403

however, are exact because they mark definite points in space. Courses and distances, on the other hand (although theoretically absolute), cannot be laid down on the ground in the precise same place each time the property is resurveyed because of the impossibility of making exact measurements. Illustrative of this is a California case in which an ordinance

(Page 402-403 Georgia Land Surveying History and Law, Farris W. Cadle, 1991 University of Georgia Press)



correctly. Property owners will usually depend on and construct improvements in accordance with the monuments that mark their boundaries. It would be unfair to alter these lines after such improvements are made, simply because the original surveyor failed to set his monuments in the measured position called for.[51] The courts have held that a landowner has the legal right to rely on the monuments that mark his boundaries, regardless of whether they were correctly located.[52] If a prospective land

(Page 403- Georgia Land Surveying History and Law, Farris W. Cadle, 1991 University of Georgia Press)

Rotated Property Geometry

All GDOT projects are surveyed on the state plane coordinate system. With this in mind, all parcels should be individually rotated from magnetic north to grid north for the best possible property resolution.

For future in-house and consultant database checks, GDOT will be assessing if field located monuments are being held in property resolution. If a marker is not held to, GDOT may require an explanation. Checks will also be made to verify if the parcels have been rotated.

If you have any questions on this matter please contact:

GDOT Statewide Consultant Compliance Supervisor 404-699-4449

GDOT Statewide Survey Data Specialist 404-699-4446

2.2 Pre-Survey Field Review

Before field survey work begins the Party Leader should:

a. Hold a Pre-Survey Field meeting with the Project Designer and a representative from the local Area Engineer's Office.

b. Make sure you discuss with the designer the following: survey coverage limits on slopes, drainage, and tie-ins for crossroads. Also, be sure to note any unique topo items that need to be collected such as number of parking spaces that may be impacted. The coverage limits should be agreed upon by the designer and the surveyor.

c. Discuss with designer if any high risk septics will need to be collected on projects with a ROW phase.

2.3 Courthouse Research

A. A proficient courthouse research person is essential for a successful property study/survey. This person is usually a research specialist or a surveyor who will be involved in preparing the property database.

B. The research specialist conducts a thorough research for property owner's names, plats, deeds and easements attached to the property.

C. The research specialist furnishes the following listed items to the survey crew for them to conduct their property survey:

1. Tax Maps.
2. Property Owners Names and Addresses.
3. Deeds and Plats of Property, Right-of –way and Easements.
4. Names written on Tax Maps.
5. Tax Map and Parcel Number written on Deeds plus Deed and Plat Book Number and Page.
6. If no Plat is found, a sketch of the property from the deed.
7. Plot Properties on Tax Maps that have not been recorded due to recent sales.

8. All easements that can be reasonably discovered during routine property research will be shown and collected (Consultant not expected to perform full title search.)
9. Tax Maps in sequence of the survey.
10. Plats and Deeds in sequence of the survey.

*****Please notify the Project Manager IMMEDIATELY of any US Army Corps of Engineers properties on a Project!!!**

DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA

INTERDEPARTMENT CORRESPONDENCE

DATE October 26, 2010

FROM Brent A. Story, PE, State Design Policy Engineer

TO Chief Engineer/Deputy Commissioner's Executive Technical Staff, Division of Engineering, Division of Permits and Operations, Division of Construction, Division of Local Grants & Field Districts, Division of P3

SUBJECT **Standardized Property Access Letter**

As part of the plan development process, access to private property must be obtained for surveying, geotechnical investigations, right of way staking, environmental studies, and many other project related activities. When access is required, it is extremely important that we communicate information accurately and professionally with the public, give reasonable notice prior to accessing private property, and take extreme care not to inconvenience the property owners during these activities. In an effort to improve consistency a new standard access letter has been developed by this office.

The standard letter was developed as an Adobe Form and can be accessed by selecting the *Property Access Standard Letter* link from the R.O.A.D.S. web page under the *Design Related Links and Resources* section. The letter is to be used in place of all existing letters throughout the Department and can be linked from existing manuals using the ROADS page link as follows:
http://www.dot.ga.gov/PartnerSmart/DesignManuals/OtherResources/PropertyLetter.pdf

The letter type is selected by clicking on one of the buttons at the top of the form which will result in standard text being inserted into the form based on the type of letter selected. All fields designated with the symbols < > indicate text that can be manually edited.

Please ensure that all appropriate personnel in your office are aware of the availability of the new letter. If you have further questions about the new letter or issues in using it, please contact Glenn Williams at 404-631-1532 or at glwilliams@dot.ga.gov.

BAS:GDW

2.4 Right-of-Way Research (Courthouse Research Person)

A. The research specialist conducts thorough research for deeded right-of-way and easements at the following listed locations:

1. County Courthouse.
2. Office of Clerk of the Superior Court.
3. D.O.T. Right-of-Way Office in Atlanta.
4. District Right-of-Way Office.
5. County Tax Assessors Office.
6. County and City Commissioners Office.
7. Probate Court record for wills.

B. The research specialist does the following:

1. Obtains record plans of existing roadway.
2. Compiles all data into a job folder.
3. Review the property and right-of-way data with the survey crew.
4. Insure that a notification of survey letter is sent to each property owner along the proposed project two weeks prior to the beginning of the survey.
5. Compile and maintain an electronic listing of all current property owners' names and addresses. This listing is to be known as the Property Statistics Report (PSR).

2.5 Septic Tanks and Drain Field Survey Guidelines

A. For projects with a ROW phase and consultant survey

1. Septic Research will be added to Task order 1 and will include research to identify if project corridor is septic/sewer or both.
2. Septic collection will be added into Task Order 2. During scoping for task order 2, High risk parcels should have been identified in task order 1 (concept) and should be relayed to survey sub during scoping.
3. Consultant survey will collect any identified high risk septics and any convenient septics that are obvious to locate.

B. For projects with a ROW Phase In-House Survey and Concept already exists

1. Designer will relay the high risk parcels to Survey at the pre-survey field meeting.
2. Survey will perform research for records following the steps below at the end of this section.
3. Survey will collect all high risk septics and any convenient septics that are obvious to locate.

C. For projects where concept will be created from the survey

1. Survey will collect any obvious and **convenient** septics on the corridor.
2. Once survey is complete and concept complete, the designer will send an additional survey request to Location Bureau Chief with identified high risk septics.
3. Survey will perform research following steps below at the end of this section.
4. Survey will collect and merge the high risk septics and deliver to PM/Design.

Follow the steps below to ensure all septic tanks and drain fields are collected in the field correctly:

1. Use due diligence in locating septic tanks and septic lines by visual inspection if possible.
2. If septic is not obvious or easily located, ask the property owner for the location.
3. Use a probing rod if necessary to locate septic.
4. Contact the local county Health Department for the sketch records if necessary.
5. When collecting the septic tank and drain lines utilize the INROADS feature codes DSTC (Septic Tank) and DDL (Drain Line).

2.6 Beginning the Field Survey Effort

A. **FIELD SURVEYS**

The surveyor should have the following items before beginning the field survey effort:

1. Project Concept.
2. Tax Maps.
3. Deeds and Plats of Property, Right-of-Way and Easements.
4. Record Plans.
5. Survey Control Packet.
6. Mapping (2 Copies).
7. Existing Survey Control loaded in the data collector.
8. Environmental Impact Study.

NOTE: Before performing any instrument work in the field, the instrument should be checked for correct calibration by using the published **GUIDELINES FOR INSTRUMENT CALIBRATION CHECKS IN SECTION 2.22.**

If you are carrying elevations, the published guidelines for trigonometric leveling (**Section 2.19**) and carrying elevations with the Side-shot Program (**Section 2.20**) should be strictly followed.

B. **JOB FILES, TRAVERSE AND ADJUSTMENT**

1. When district survey control deltas are set for use in collecting survey data, there should be the following three data collector files for the job:
   a) **Survey File** (Main File for collecting survey data). The existing survey control should be located in this file.
   b) **Traverse File** (For running the district control delta traverse).
   c) **Adjust File** (For adjusting the district control delta traverse).

Note: Allegro users will have ".asc" and ".raw" files
Trimble users will have ".job" and ".csv" files

2. Determine the best locations to set the district control deltas for collecting the property and topo.
3. Always turn district control deltas traverse in the Traverse File. Before performing any survey operation, always check for the correct scale factor.
4. After completing the field traverse, if a scale factor was not used, the traverse should be scaled to state plane. Next, angle adjust the traverse and have a precision of no less than **1/20,000** in rural areas and **1/25,000** in urban areas, then the traverse should be compass ruled to complete the adjustment.
5. After checking to ensure that the control points were adjusted and scaled correctly, transfer the adjusted control deltas back into a **Survey File**.

6. Repeat the above process for each traverse run.
7. Before collecting property and topo field data, always check to insure that the correct scale factor for the job is stored in the data collector work file.
8. Remember, a traverse adjustment sheet needs to be filled out for each traverse (Found on the next 2 pages) and kept on file for future reference.

TRAVERSE ADJUSTMENT FORM:

JOB NAME: _____

DESCRIPTION: _____

HORIZONTAL DATUM:_____ ZONE: _____

VERTICAL DATUM: _____ UNITS: _____

PRELIMINARY CHECKS:

PUBLISHED CLOSING AZIMUTH __ INVERSE OF FOLLOWING POINTS:

_____ TO _____ **AZIMUTH = ____° ____' ____"**

FIELD CLOSING AZIMUTH __ INVERSE OF FOLLOWING POINTS:

_____ TO _____ **AZIMUTH = _____° ____' ____" AZ ERROR = _____° ____' ____"**

LAST FIELD OCCUPIED INVERSE TO PUBLISHED CLOSING POINT

_____ TO _____ **DISTANCE ERROR = _____**

ORIGINAL FILE NAME: _____

BACKUP FILE NAME: _____ USE **ADJ** ON END OF ORIGINAL FILE FOR **ADJUST**.

GRID FACTOR: _____

NOTE ON GRID FACTOR: IT IS BEST TO SURVEY WITH SCALE FACTOR ON WHEN YOU TRAVERSE IF YOU ARE USING STATE PLANE COORDINATES. IT ONLY SCALES THE COORDINATE FILE AND NOT THE RAW DATA. IF YOU ARE USING ASSUMED COORDINATES YOU CAN SCALE WHEN YOU PERFORM YOUR TRANSFORMATION OF COORDINATES.

SCALE to STATEPLANE: (If needed) Hit RPTS (the S Key)

First Delta thru Field Azi. Tie First Side Shot Thru Last

Then softkey CX, then softkey ΔNEZ, then softkey OLDPT (enter published beginning point), then softkey NEWP (enter published beginning point should be same as old point) then softkey EXIT, then softkey SCALE and type in the grid factor then hit the ENTER key, then softkey RUN. This will scale all points entered into the Random Points File.

PRECISION ONE: Hit RPTS (RANDOM POINTS FILE "S Key"):

First Field Occupied Traverse & Side shots Last Field Occupied Published Occupied (Tie Point)

Example, 2 space 3 or 1.3 **for traverse points.** 2 -3.50 51 52 -53.75 76 77 78 **for traverse with side shots.**

Then Hit Soft Key PREC = PRECISION ONE (Raw Precision): 1/_____ DIST ERROR=_____

ANGLE ADJUSTMENT: Hit RPTS (RANDOM POINTS FILE "S Key"):

BS OCC Traverse & Side Shots Field OCC Field AZ PT Pub PT PUB AZ PT

Then hit T key (more menus), soft key next, and then soft keys AA/CR, Then AERR. Record data as follows:

Total Angle Error: ____° ____' ____" # Angle Points:_____ Seconds Per Angle Point: _____"

Then hit soft key AA to adjust angles. DIST ERROR=_____

PRECISION TWO: Hit RPTS (RANDOM POINTS FILE "S Key"):

First OCC Traverse & Side Shots Field Closing PT Pub Closing PT

Hit Soft Key PREC = PRECISION TWO (After Angle Adjust): 1/_____

COMPASS RULE ADJUSTMENT: Hit RPTS (RANDON POINTS FILE "S Key"):

First OCC Traverse & Side Shots Last Field Occupied Published Occupied (Tie Point)

Then hit T key (more menus), soft key next, and then soft keys AA/CR, Then CRERR. Record data as follows:

Distance Adjust: _____

Then hit soft key CR to perform Compass Rule Adjustment.

TRAVERSE ADJUSTMENT FORM:

(INVERSE FROM LAST OCCUPIED TO PUBLISHED OR FIRST OCCUPIED, SHOULD BE O.OO'.)

ELEVATION ADJUSTMENT: (Perform the following steps for adjusting trig elevations that are within tolerance)

Hit RPTS (RANDON POINTS FILE "S Key"):

OCC Traverse & Side Shots Field TIE PUB TIE

Enter same points as Compass Rule & Hit Soft Key NEXT, NEXT , then Hit Soft Key ELADJ , this will distribute your elevation error equally along each leg of your traverse. ELEVATION SHOULD BE SAME AS TIE POINT.

Trimble TSC 3 Traverse Adjustment

Before adjusting a traverse in the TSC 3 data collector, make sure the following steps are performed:

1. Be sure to copy the .job file into the same folder and rename it to the job number with an “A” on the end of it and work strictly in that file.(Leave the original .job file alone)

2. In the “A” .job file make sure your field ties and published ties are called the same point numbers. Example: If a loop traverse was turned,(closing on the same known coordinates), call your tie points in the field the same. If the points were not called the same in the field, go to “key in points” and type the point number measured in the field, click “ok” when it gives the “point name already exists”, and type in the published coordinates and elevation for the tie points. Then select “store another” from the drop down list and click store.

   It would be best to call the points turned in the field the same as the published points originally keyed in or imported from the .csv file. The traverse program reads the raw data and knows what was turned and what’s published with the same point numbers!

3. Double check and make sure the job properties are correct. Example: Correct zone, units,etc.

From the General Survey Screen, click “**Cogo**”, go to page 2 and click “**Traverse**”.

Figure 1

Name the traverse. (Use the job name with an “A” on the end for adjusted.)

Select the start station. (Click on the arrow and “select from list” and select the station of your first occupied setup.)

Click “**Next**”.

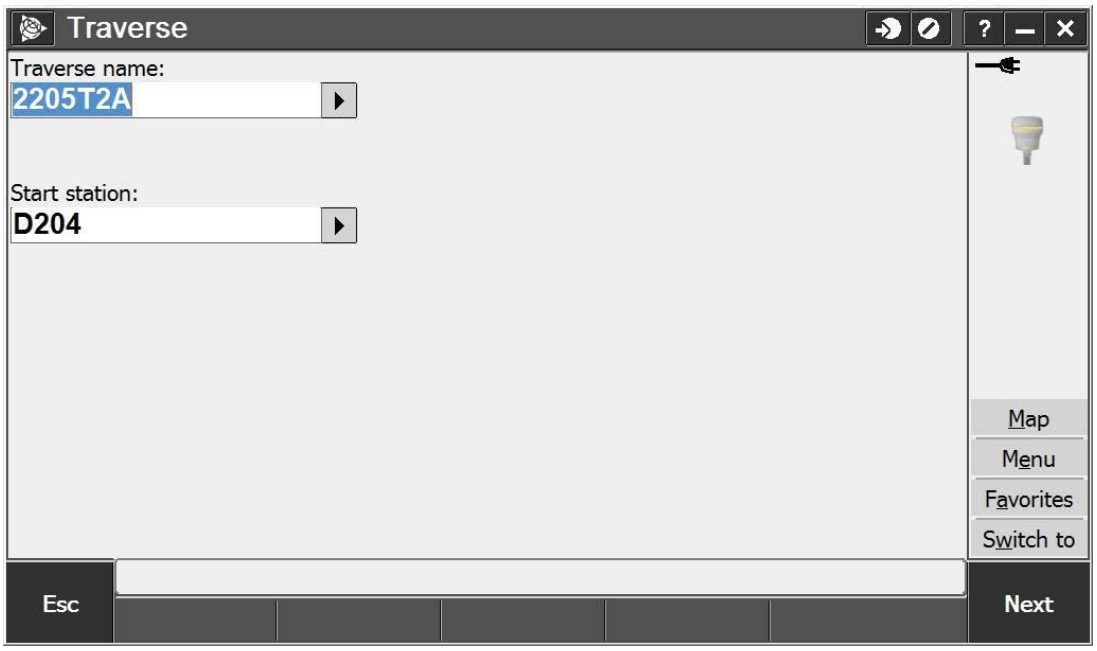


Figure 2

From this screen select “**Options**” at the bottom.

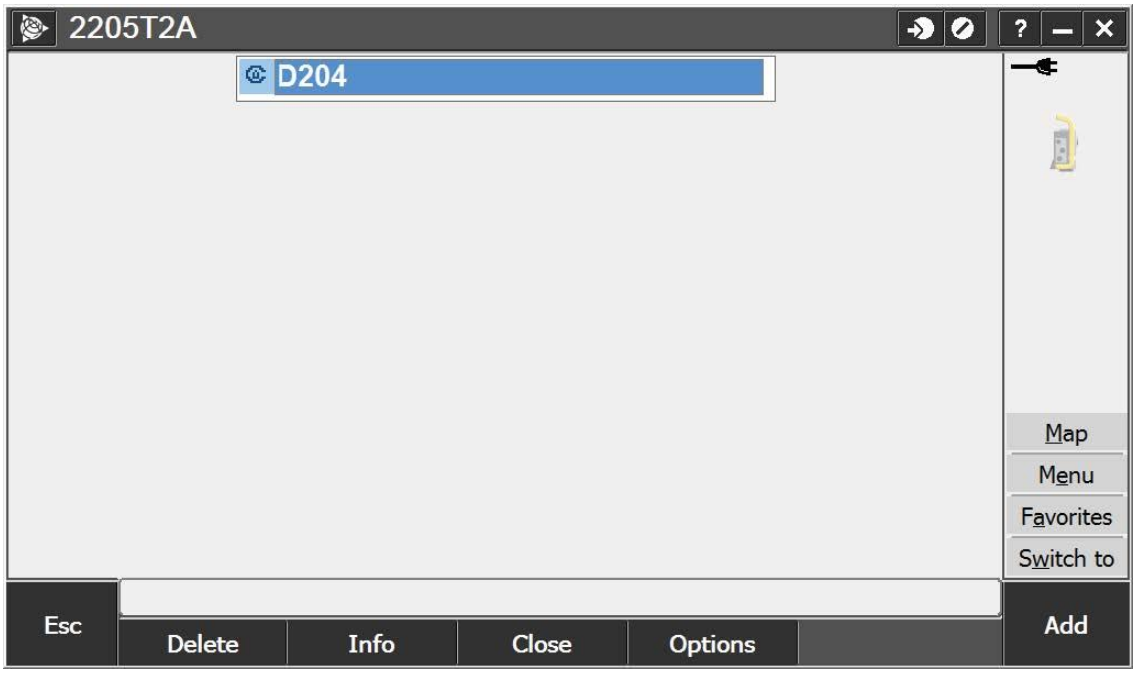


Figure 3

Make sure the adjustment method is set to "**Compass**" and the Error distribution is set to "**Equal proportions**".

Click "**Accept**".

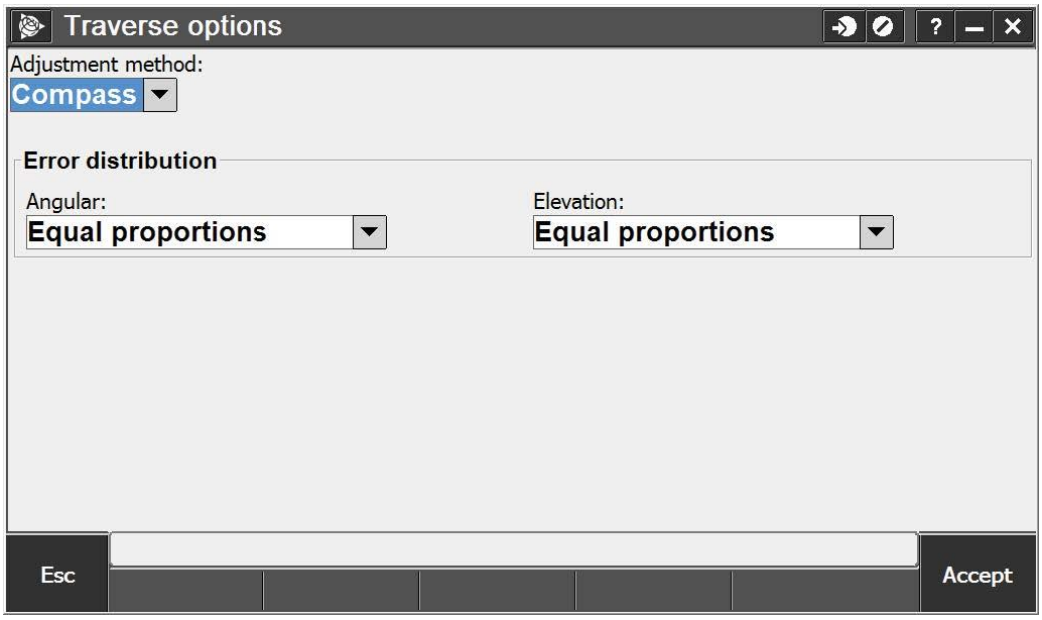


Figure 4

Click "**Add**" in the bottom right hand corner of the screen to add stations. If only one point was measured from each setup it will automatically add that station. If other points were measured from a particular setup a box will pop up with all the points measured from that setup. In this case, select the point number of the next station in the traverse. Continue to click "**Add**" until the last occupied published point appears. When all points have been added, click "**Close**" at the bottom of the screen.

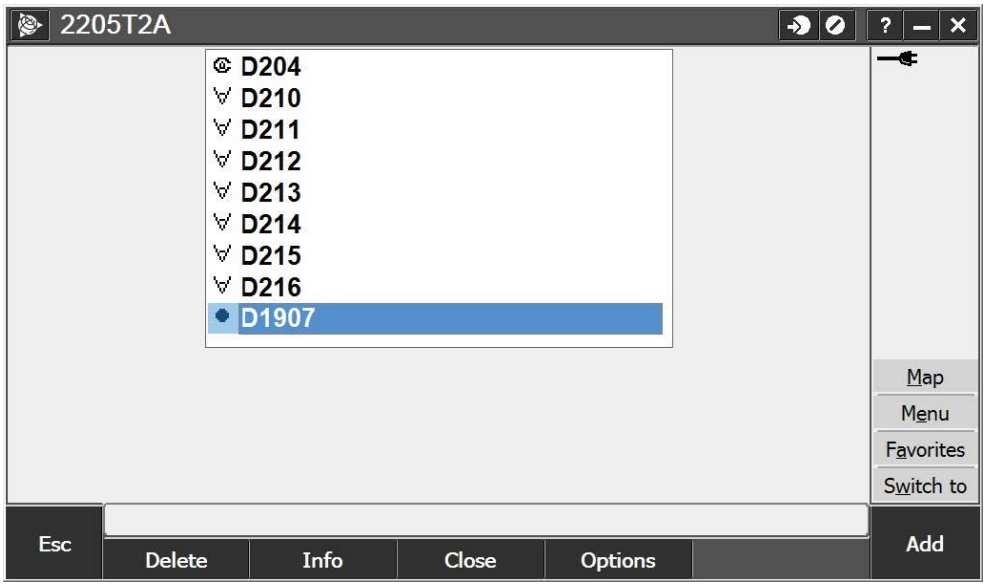


Figure 5

Make sure the backsight point and foresight points are correct in this screen. You can change them if they are not. Click "**Enter**".

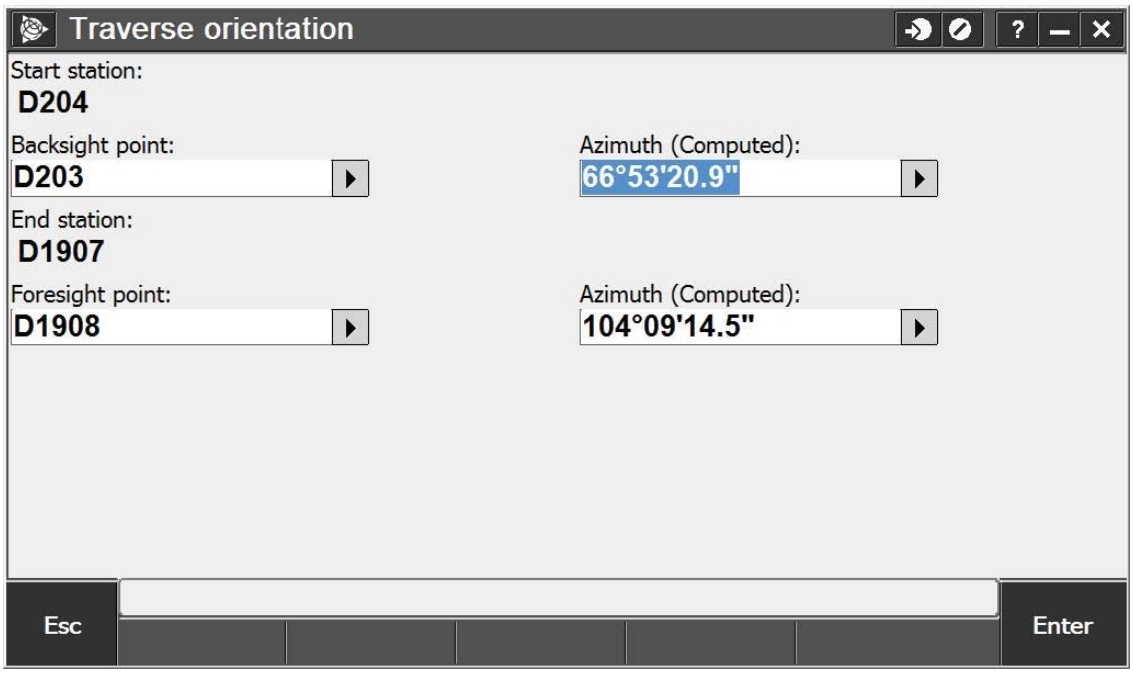


Figure 6

This screen shows you're angular closure, distance closure, and raw precision. Make sure the angular closure is within tolerances set in the Automated Survey Manual on page 15, section "D". Click "**Store**" next to the "Esc" key. Click "**Adj.ang**" in the bottom right for angle adjustment.

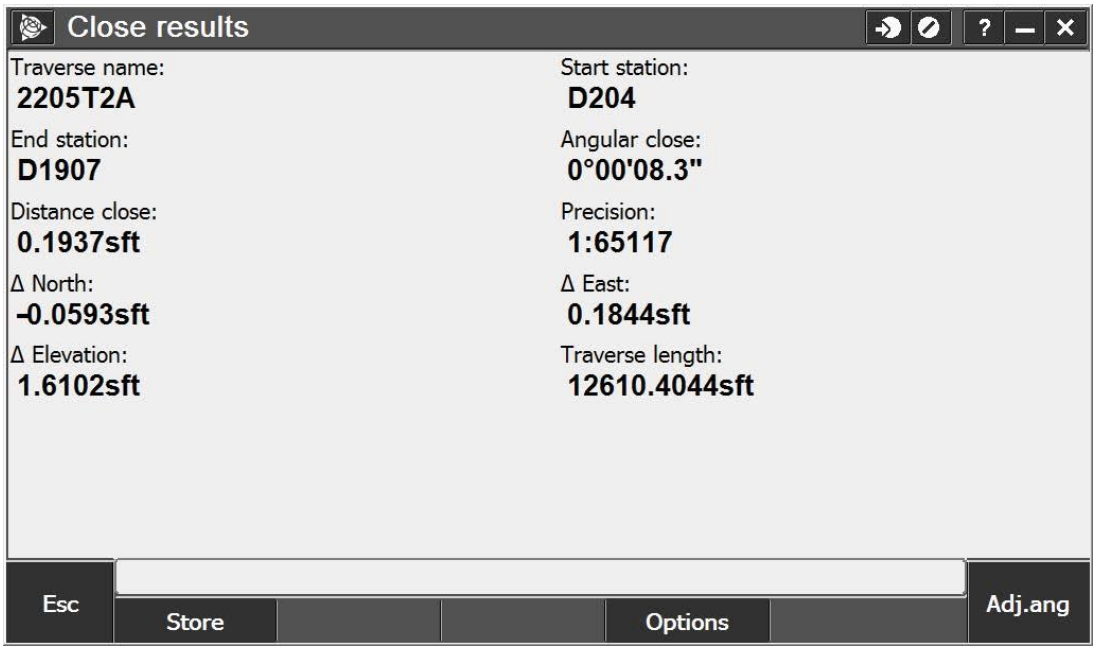


Figure 7

This screen shows results after the angle adjustment. Make sure the precision is within tolerances set in the Automated Survey Manual on page 15, section “D”.

Click “**Store**”.

Click “**Adj.dist**” in the bottom right for distance adjustment.

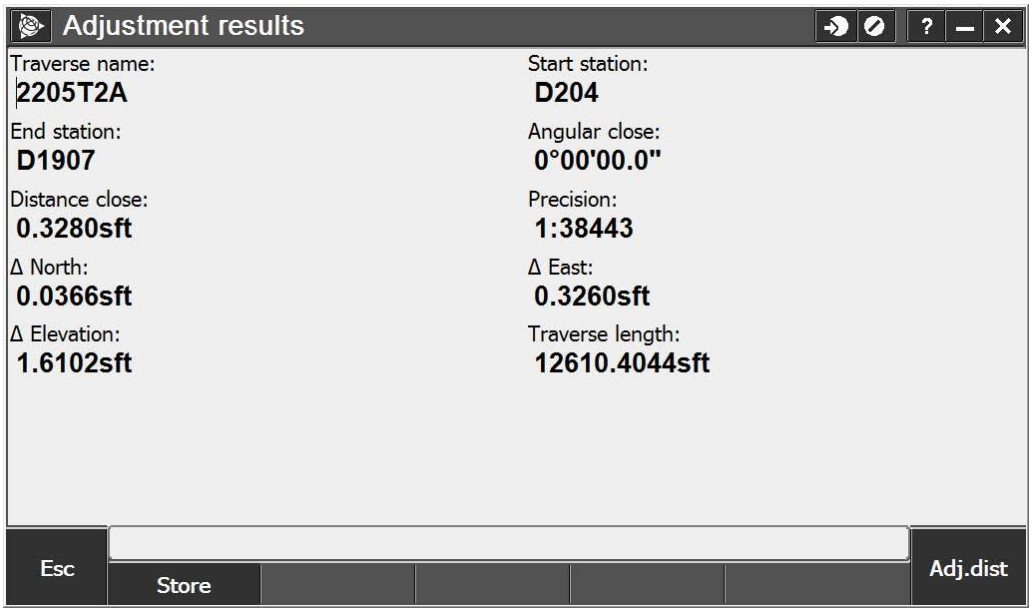


Figure 8

The traverse is adjusted. For a quick check go to “Point manager” and make sure the adjusted points have a rotating icon next to them. (Example: D210 to D216 below) They will also appear in the map screen.

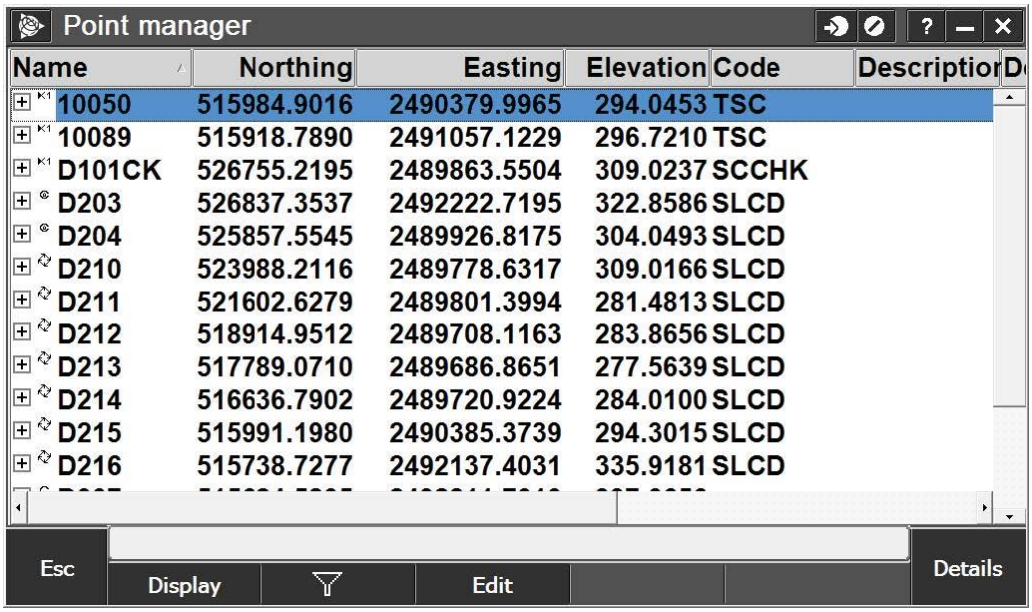


Figure 9

To create the traverse adjustment report, from the General Survey screen click "**Jobs**", "**Import/Export**", **"Export custom format**". Use the drop arrow next to File format and select "**Traverse adjustment report**". Give the file a name and use the folder icon to send it to a different location if needed. Click "**Accept**".

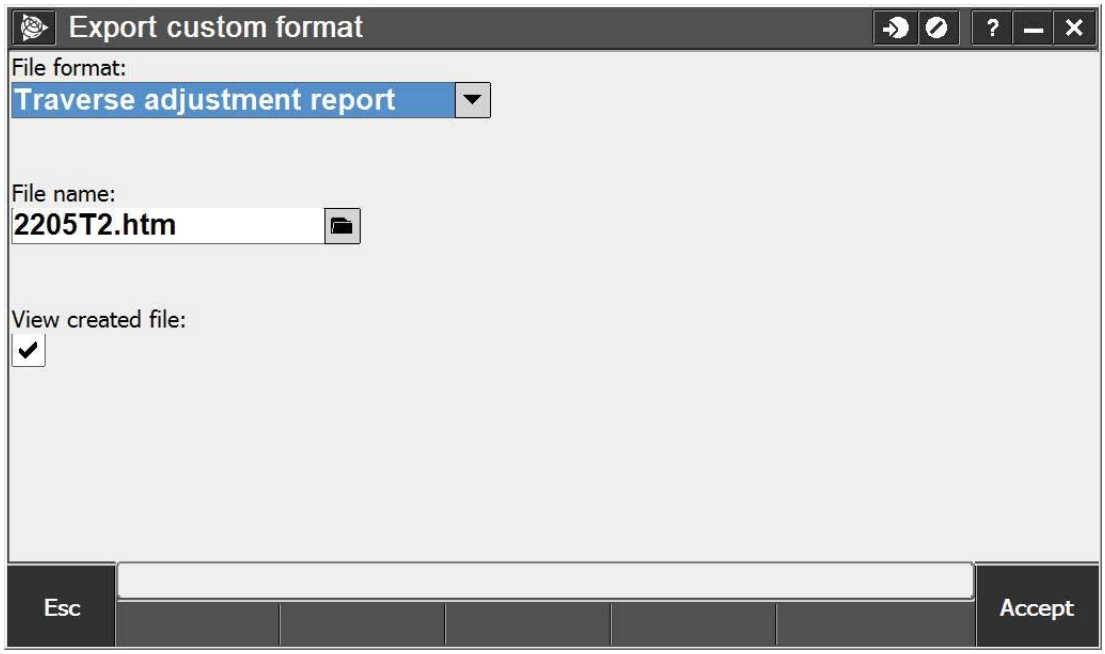


Figure 10

The traverse report can be copied to the thumb drive and placed with the job files on the computer.

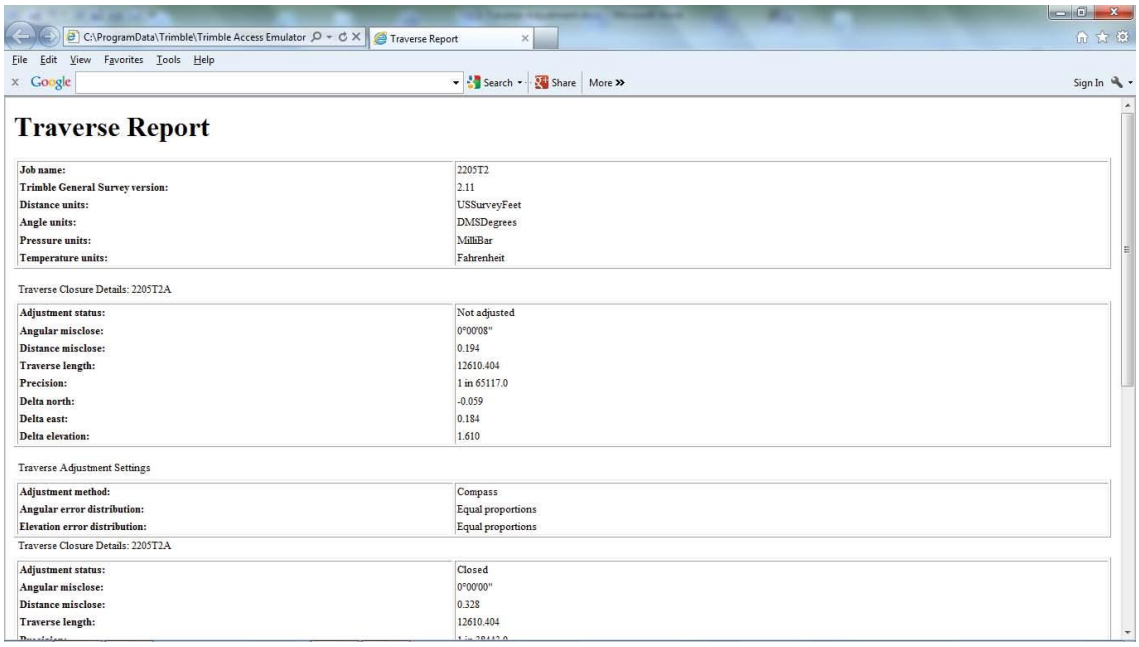


Figure 11

2.7 Locating Property and Easements

A. Equipment Needed:

1. Pin Finder
2. Shovel
3. Compass
4. 100-foot tape or chain

B. Using the tax maps, plats and deeds of the property, easements and record plans, perform the following task:

1. Locate all existing property corners adjacent to the survey that can be found.
2. Locate all back corners that can be conveniently shot.
3. On property where back corners were not found or could not be conveniently turned to, use the plat or deed to calculate a point on the property line approximately 200 feet beyond the required right-of-way line. On the calculated property points, always check the adjacent plat to see if the angles correspond and then perform a stakeout to see if property line direction fits the physical property features such as; yard line, fence line, and etc.
4. Locate all deeded easement lines and corners and mark with small nail for reference points to collect when tying down property and easements.
5. After collecting easement and property features, pull up all temporary points that have been set.

2.8 Locating Existing Right-of-Way and Easements

A. Using Right-of Way Deeds and Record Plans:

1. Locate all existing right-of-way markers.
2. Locate all right-of-way easements and mark with temporary points (small nails or stakes).
3. Establish points in the center of the existing roadway (**Two** points on each tangent and **three** points on each curve). However with the implementation of **CAiCE**, and **INROADS**, the collection of curve data has changed slightly. You must now use the **Five-point curve** or the **True Spline** technique to collect points on a curve. Remember; always insert a tangent point between two curves. Make sure tangent shots are taken before and after the curve (Always begin and end with a tangent shot).

2.9 Prescriptive Right-of-Way

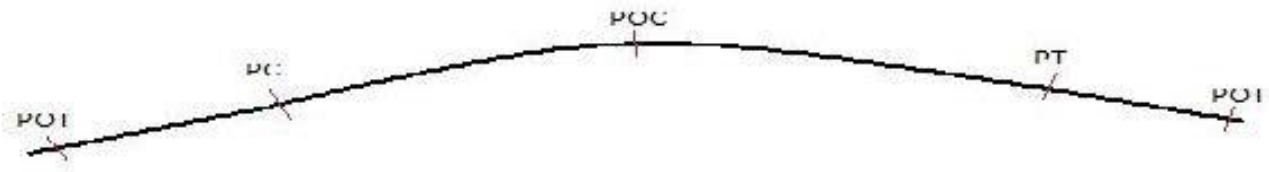


Figure 12

A. On public roadways that do **not** have a deeded right-of-way:

   1. Surveyors should notify the Preconstruction Engineer in writing that the roadway does not have a deeded right-of-way.
   2. Locate the area that has been maintained by the Department or local government (back of ditch to back of ditch, etc.).
   3. Mark on tax map or mapping all areas that do **not** have deeded right-of-way.

NOTE: It is important to keep an accurate field sketch of data collected with the data collector. An extra set of blueline mapping is excellent for recording point numbers, etc., on. **Always record point number of occupying point; back sight point; first and last point shot from each setup. If mapping is available; plot deltas on mapping.**

2.10 Collecting Field Property Easements and Right-of-Way Data

A. Coordinate all property and easement points found or set. After turning to them, pull up all temporary and easement points set (**small nails or stakes**).

B. Coordinate all right-of-way markers found.

C. Coordinate all State Lines, County Lines, City Limits, GMD Lines and Land Lot Lines.

D. Coordinate all alignment points (on existing roadway, **two** points on all tangents, **and three** points on all curves). However, with the implementation of CAiCE, the collection of curve data has changed slightly. You must now use the **Five-point curve** or the **True Spline** technique to collect points on a curve. Remember; always insert a tangent point between two curves.

E. Coordinate physical features (back of ditch or that which the Department or local government is maintaining) if there is **no** deeded right-of-way.

2.11 Submitting Field Property Data

A. For surveyors who prefer to chain the property together and want to submit the property to the SDE along with his corrected .ASC file, it is strongly recommended that he/she use the **Surveyor's Guide to CAiCE (SGC)** as a reference. The **SGC** completely details each step of processing the Property Data in CAiCE.

B. Since the property parcels are stored as geometry chains, a KCM file must be used to export this data. To produce KCM files, select **Tools => Database Explorer** command in

CAiCE. Click the **Write Selection** tab and the **Load** button under **Dialogue Input.** This will allow you to navigate to the file **WRITEPRP.TXT** that is to be open and used. Make sure **Include Chain Element** option is checked so that chains and all their elements will be written out at one time. In the **KCM File Name** field you should use the following naming convention: PI# +PR.KCM (i.e.: 888888PR.KCM).

C. Once the property has been written to a KCM file, it is time to submit your data to the District SDE. Make sure you submit the final and corrected .ASC file and the property KCM file using a personal share on your District Server or by any of the other means of electronic file transferal. Using FTP, PCCommon, or Email are some of the other options that come to mind.

NOTE: It is mandatory to download data collectors to the PC or removable storage device after each day of collecting data and especially on last day of the work week.

2.12 Alignment Staking (CAiCE)

A. **NO** centerline staking is required for projects on **EXISTING** location.

B. Centerline staking is required on all new location projects except for minor relocations such as flatting of curves.

C. New location centerlines should be staked and flagged at least every **200 feet** along the centerline.

D. A point should be staked, flagged or painted at every location where the centerline crosses an existing road.

E. To stake a new location the SDE will first have to get the stakeout file or alignment from the Designer. Since most designers are reluctant to provide a stakeout file, they usually send the CAiCE .**ZIP** file to the SDE so the alignment can be generated by the District. The SDE will then have all the information he needs to produce an .**ASC** file of the alignment using the **GDOT Stakeout Survey Data** macro in CAiCE. The SDE will then transmit it accordingly too his survey personnel so it can be staked out.

PREPARING A STAKING FILE FOR LOCATION (CAiCE)

1. SDE will generate an .ASC file by clicking upon the Write Out Survey Data button. Upon clicking the Write Out Survey Data button, a LOG file is created by using the ASC filename specified and using a ".LOG" file extension instead of ".ASC". The current project database is then read and the points matching the following feature codes are obtained:

   PCF, RWE, RWM, RWC, RWU, POEL, PPC, SNGSCM, SLCM, SLCD, SDCD, SBNCHMK,REQD, PESMT, TESMT, DWESMT, RWRM, CONSTCL, SIDECL

   For each point, the CAiCE Alpha Prefix (i.e. SVXO, KC, and SVA) is stripped off, it is checked for duplication, and then it is written to the ASC file. If any points are duplicated, the user receives a warning message and the same message is written to the LOG file. Upon successful completion, the user is notified by a message box and the file viewing buttons are activated.

2. To generate a description of the alignment, the SDE will use the following pull-down item: **Geometry => Geometry Chains => Describe** in CAiCE. The chains always need to be described in grid distance format and not in ground distance format.
3. The electronic file(s) is made available to the survey office through electronic mail, by copying it to a personal share, or by using a PCCommon NT folder.
4. After the surveyor receives the electronic **.ASC** file, it will need to be uploaded from the PC to the SMI data collector by using SMI Transfer 98 program.
5. The description of the chain lists the point number assigned to the starting station, so you can determine the other centerline stations' point number listed in the stakeout (.ASC) file.

G. The surveyor should always keep an original of the **(Filename.ASC)** to copy and use later with the data collector.

PREPARING A STAKING FILE BY HAND (CAiCE)

A. If there is some reason why the surveyor chooses not to use the file or point numbers generated from the CAiCE database as described on **Page 36,** he/she still has the option of taking just the electronic alignment file that he/she has received from the SDE and computing all the right-of-way and easement points with his/her data collector.

B. Some surveyors still choose this technique so they can check the plans curve data. While computing all the points, that need to be staked, they record the point numbers by labeling them on a set of plans. This set of marked up plans becomes a valuable reference of all the computed points while they are used in the field.

*FILE NAME: Sample.ASC
*
*DATE: 10-08-99 P.I. NO: 888888
*
*PROJECT NO.: PEST-1000 COUNTY: Somewhere
*
*DESCRIPTION: File generated from Stakeout.FXF
*
*PROJECT DATUM - HORIZONTAL: NAD83 ZONE: WEST
*
*PROJECT DATUM - VERTICAL: NAVD88 UNITS: ENGLISH G.F.: 0.99986123
*
*SURVEYED BY: CREW #1
*

*PT NO.	EAST	NORTH	ELEV.	FEATURE CODE
180	2257613.54940	1363048.55602		
181	2257613.63306	1363048.23919		
182	2257626.91879	1363047.44217		
183	2257638.87677	1363047.78227		
186	2257659.75862	1363047.85841		
187	2257689.75725	1363046.96229		
188	2257706.44226	1363046.50671		
189	2257716.20700	1363047.10999		
191	2257762.53532	1363046.36770		
192	2257762.53466	1363045.87095		
193	2257799.05329	1363045.78808		
194	2257799.05592	1363045.29552		
196	2257827.23171	1363045.45950		
197	2257827.35442	1363044.87984		
198	2257835.41870	1363042.53808		
199	2257835.00729	1363042.12181		
200	2257838.56896	1363035.27796		
201	2257838.09750	1363035.25033		
204	2257854.55646	1363018.07422		
205	2257836.97185	1362985.46198		
206	2257836.43248	1363985.43705		
207	2257835.19659	1362929.39556		
208	2257834.68773	1362929.00045		
209	2257834.17592	1362895.85166		
210	2257833.70053	1362895.78910		

Please note that this is a sample alignment or staking file (.ASC) that will be provided to you from your SDE. This particular file was produced using the Flexible File Format in CAiCE after choosing the **STAKEOUT.FXF** format. You have probably noticed that this format does not carry elevations. If you need to stake out points with elevations, then the SDE must select the ASCDATA.FXF format

Remember: If this CAiCE project has multiple segments, then the SDE must specify what points that needs to be written out of this file. If the dialogue box (in CAiCE) does not contain the proper segment, then this file would contain points from all segments, which can cause a problem with duplicate points. Use of the automated macro described on **(Page 37)** is recommended.

*FILE NAME: Sample.ASC
*
*DATE: 10-08-99 P.I. NO: 888888
*
*PROJECT NO.: PEST-1000 COUNTY: Somewhere
*
*DESCRIPTION: File generated from **ASCDATA.FXF**
*
*PROJECT DATUM - HORIZONTAL: NAD83 ZONE: WEST
*
*PROJECT DATUM - VERTICAL: NAVD88 UNITS: ENGLISH G.F.: 0.99986123
*
*SURVEYED BY: CREW #1
*

*PT NO.	EAST	NORTH	ELEV.	FEATURE CODE
180	2257613.54940	1363048.55602	1026.60070	
181	2257613.63306	1363048.23919	1026.75060	
182	2257626.91879	1363047.44217	1027.51943	
183	2257638.87677	1363047.78227	1028.41819	
186	2257659.75862	1363047.85841	1029.47954	
187	2257689.75725	1363046.96229	1031.49856	
188	2257706.44226	1363046.50671	1032.52845	
189	2257716.20700	1363047.10999	1032.82562	
191	2257762.53532	1363046.36770	1035.25643	
192	2257762.53466	1363045.87095	1035.67513	
193	2257799.05329	1363045.78808	1036.78336	
194	2257799.05592	1363045.29552	1037.13241	
196	2257827.23171	1363045.45950	1037.69756	
197	2257827.35442	1363044.87984	1037.93001	
198	2257835.41870	1363042.53808	1037.97968	
199	2257835.00729	1363042.12181	1038.08103	
200	2257838.56896	1363035.27796	1038.02082	
201	2257838.09750	1363035.25033	1038.34238	
204	2257854.55646	1363018.07422	1038.56787	
205	2257836.97185	1362985.46198	1037.62729	
206	2257836.43248	1363985.43705	1038.04254	
207	2257835.19659	1362929.39556	1035.99294	
208	2257834.68773	1362929.00045	1036.24645	
209	2257834.17592	1362895.85166	1034.75046	
210	2257833.70053	1362895.78910	1035.03235	

Please note that this is a sample alignment or staking file (.ASC) that will be provided to you from your SDE. This particular file was produced using the Flexible File Format in CAiCE after choosing the **ASCDATA.FXF** format. You have probably noticed that this is the format that does carry elevations.

2.13 Alignment Staking (InRoads) - Exporting Geometry Data to LandXML

GENERAL DESCRIPTION:

This procedure is used to export Geometry Data such as COGO Points, Horizontal/Vertical Alignments, etc. from InRoads to a LandXML File. This LandXML file can then be uploaded to the GDOT Trimble Business Center/GDOT Trimble Data Collectors for use in staking out Survey Data.

WORKFLOW PROCEDURE

Open the InRoads ALG file. Then utilize the LandXML Translator to select the COGO Points and Horizontal/Vertical alignments which will be written out to create the LandXML File.

FEATURE STYLES TO EXPORT TO LANDXML FOR STAKEOUT

Following is a Table listing the Feature Styles to include in the LandXML file.

• PROP_E_PAR	• PROP_E_RWE	• PROP_E_RWM
• PROP_E_RWC	• PROP_E_RWU	• PROP_E_POEL
• PROP_E_PPC	• PROP_E_PCF	• TOPO_E_SNGSCM
• TOPO_E_SLCM	• TOPO_E_SLCD	• TOPO_E_SDCD
• TOPO_E_SBNCHMK	• REQD_P_*	• MAIN_P_CONSTCL
• MAIN_P_SIDECL		

WORKFLOW STEPS

A. **Open the Geometry Project (.ALG) in InRoads**

1. In InRoads, select **File => Open**.
2. Set the Files of type: *Geometry Projects (*.alg)*.
3. Select the .ALG File (Geometry Project) that contains the Cogo Points and Alignments that are to be exported to the LandXML file.

B. **Create the LandXML File**

1. In InRoads, select **File => Translators => LandXML Translator**.
2. Select the ***Export Alignment*** tab.
3. Select the ***Geometry Project:***
4. Click in the **Include:** field to activate the **Filter** button.
5. The Geometry Selection Filter dialog box opens. Select all of the Alignments that are to be included in the XML file. Then click **OK**.
6. Ensure that LandXML: ***Version 1.0*** is selected.
7. Check the box to ***"Include All Cogo Points".***

Note: This box can be left unchecked if no Cogo Points need to be included in the LandXML file.

8. **Important** - Change the Linear Units to: ***US Feet***
9. Change the State: to **proposed**
10. Click the **Save As** button. The **Export** dialog opens. Key in **the File Name:** and click **Save**.
11. In the **File Name:** field - the name of the file will be listed.
12. Ensure your dialog box is similar to the one depicted below: **Figure L1-1**

Note: If the LandXML file is written by Survey, the ALG file Name will be PI#_SDE.

If the LandXML file is written by Design, the ALG file Name will be PI#_Exist

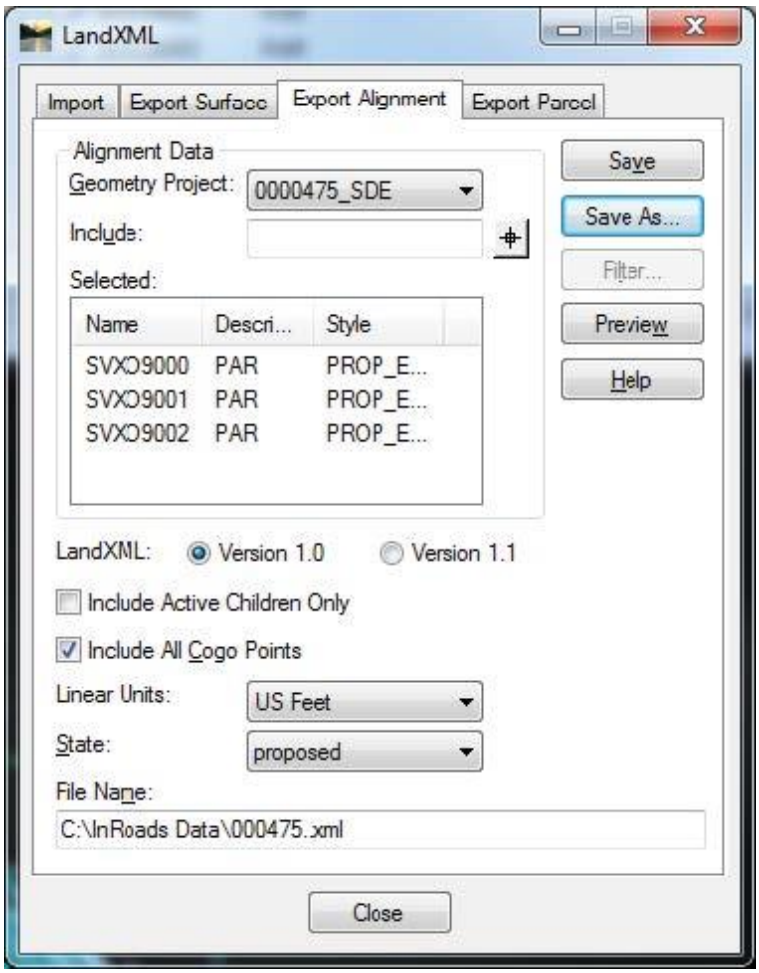


Figure L1-1

13. Next, click Close to close the dialog box.
14. The LandXML file will be created in the Path depicted in the File Name: field.

C. **Import .XML file to TBC and Export .RXL file to TSC3 Data Collector**

1. Copy .xml file to Trimble Business Center folder in My Documents or any folder of your choice.

2. Open **TBC** and create project.
3. Click the **Import** Tab and a dialog box will appear.
4. Use Browse **Tab** […] to locate .xml file and highlight. (**Figure 1-2)**

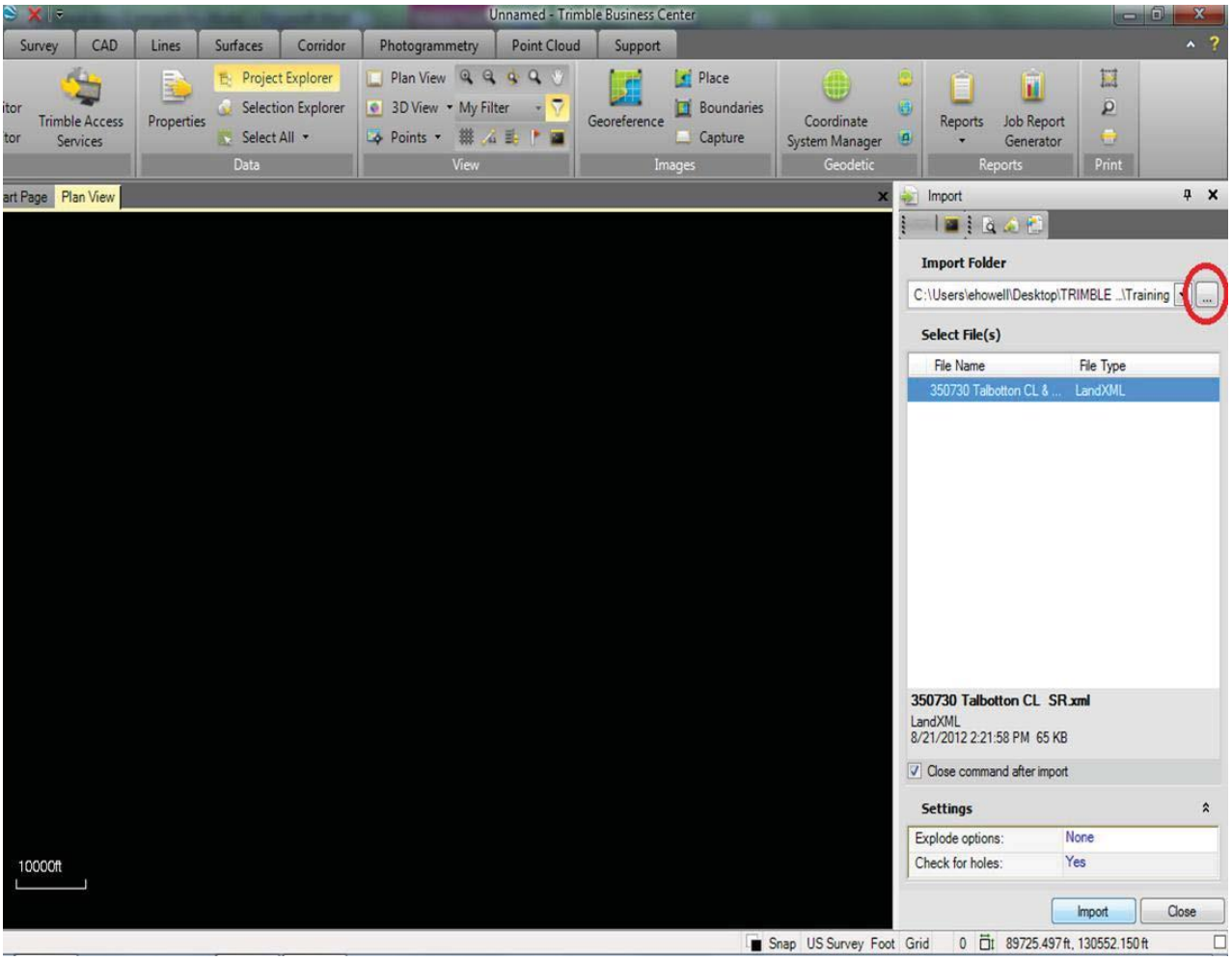


Figure 1-2

5. Click on Import and alignment and points will appear in Plan View. (Figure 1-3)

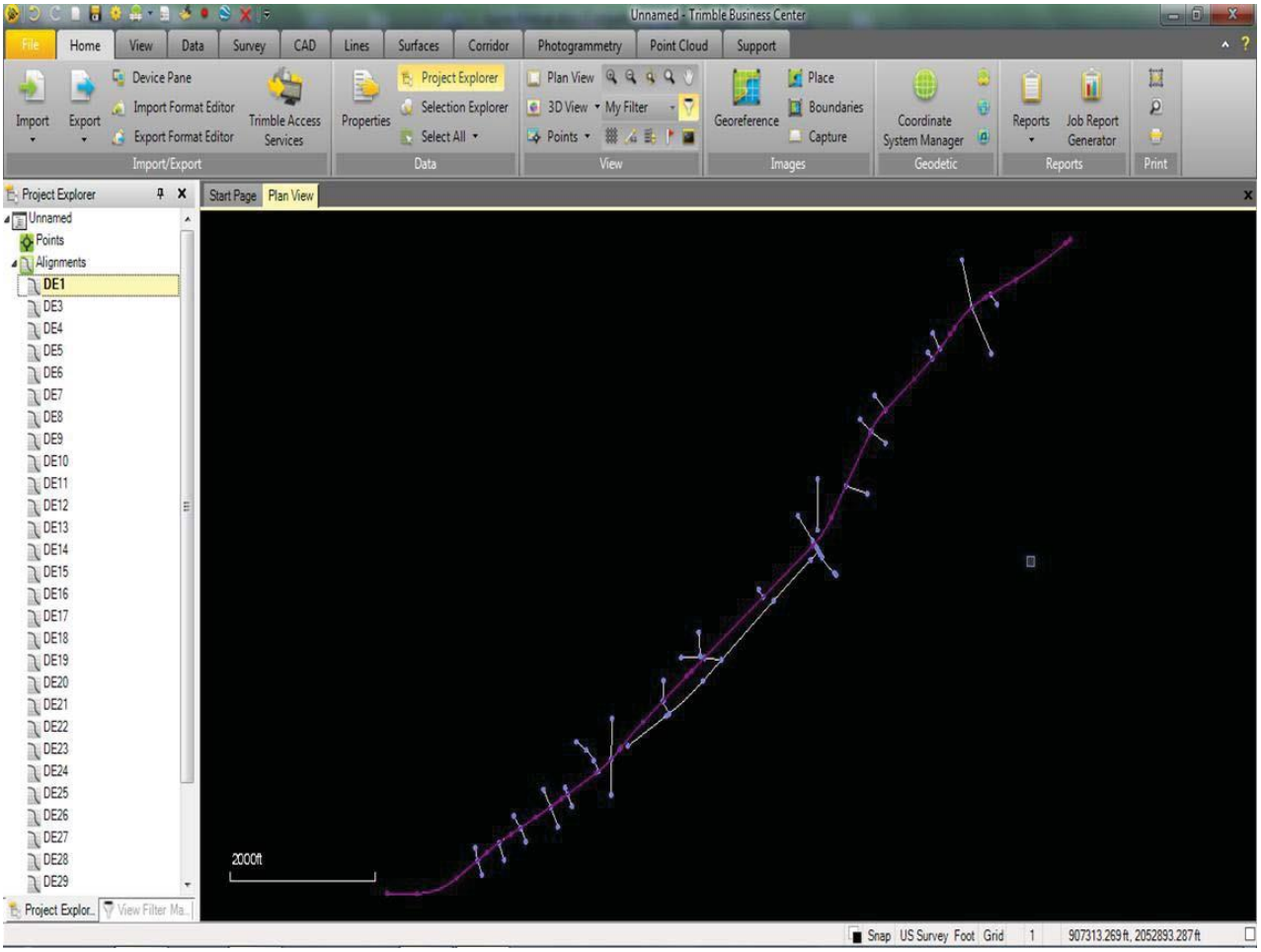


Figure 1-3

6. Next, click the **Export** Tab and the dialog box will appear.
7. Select the **Corridor** Box in the **File Format** section (upper right corner of screen) then select **RXL road exporter from surface option**. Next choose **Horizontal Alignment** from Drop-Down Box. (See **Figure 1-4** on next page).

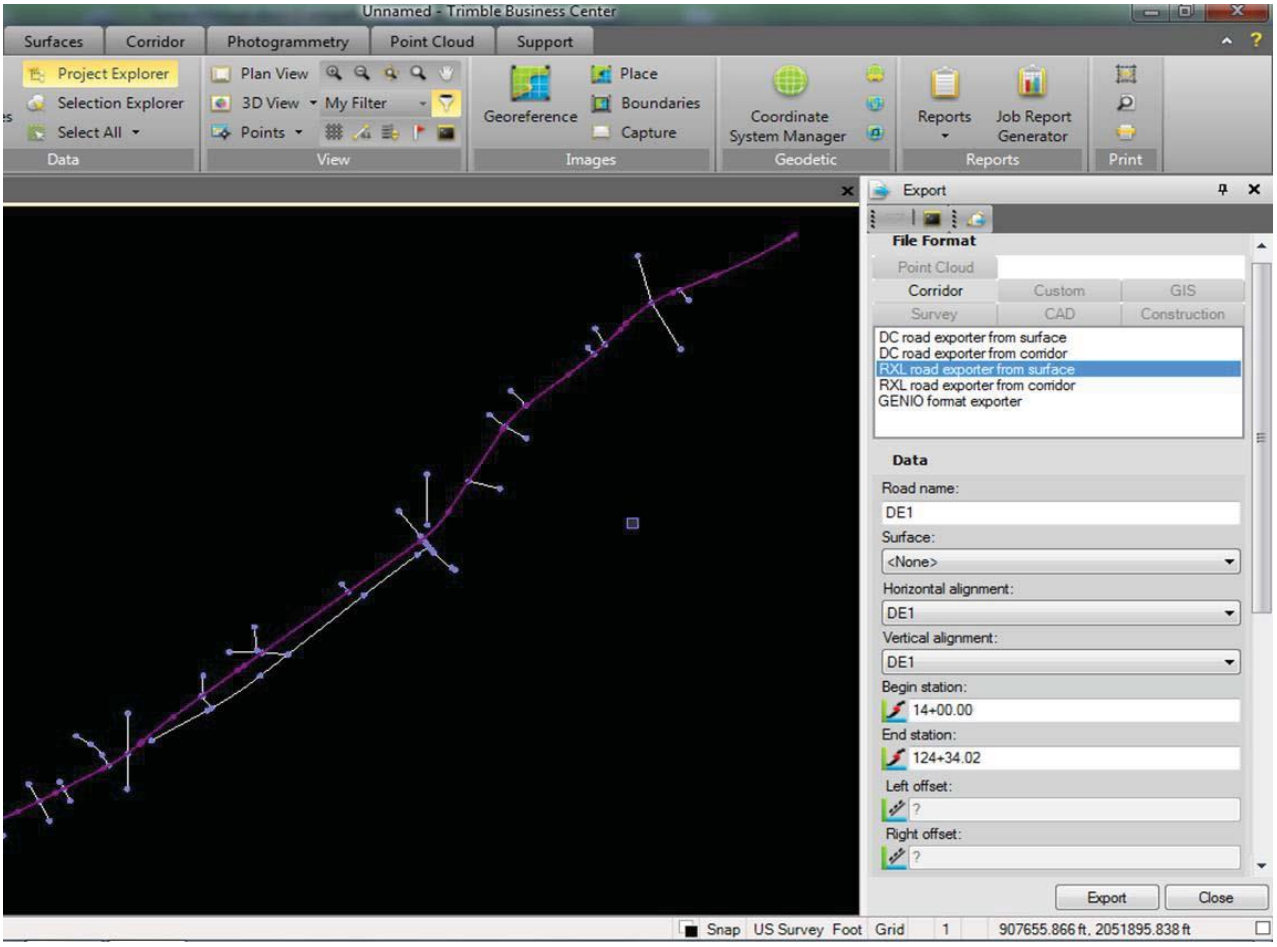
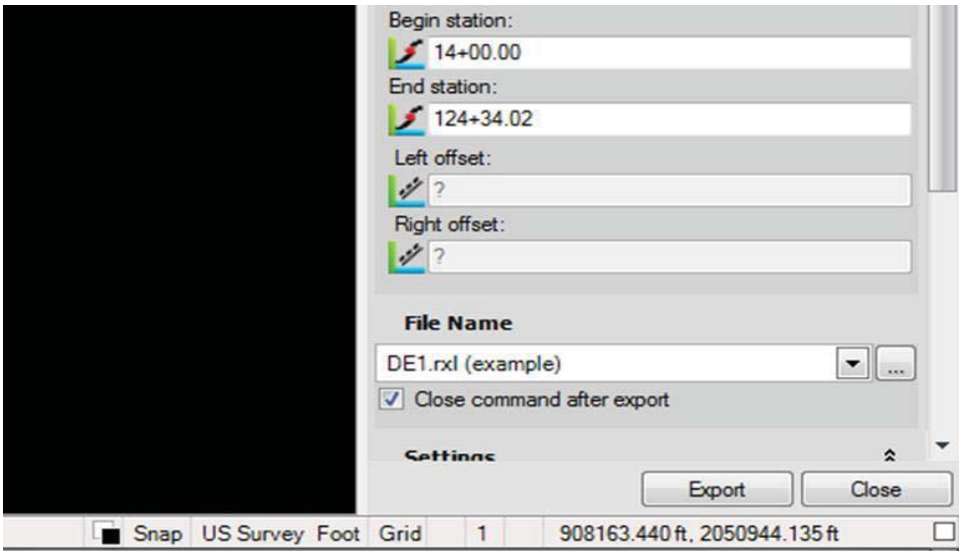


Figure 1-4

Note: Each alignment that is exported needs to have a different file name that denotes the road name.



8. Next go to Trimble Business Center folder in My Documents and select .rxl file. Then right click, and Send to Removable Storage Device (Thumbdrive) for transfer to the corresponding job folder in the TSC3 Data Collector. (See Figure 1-5 below).

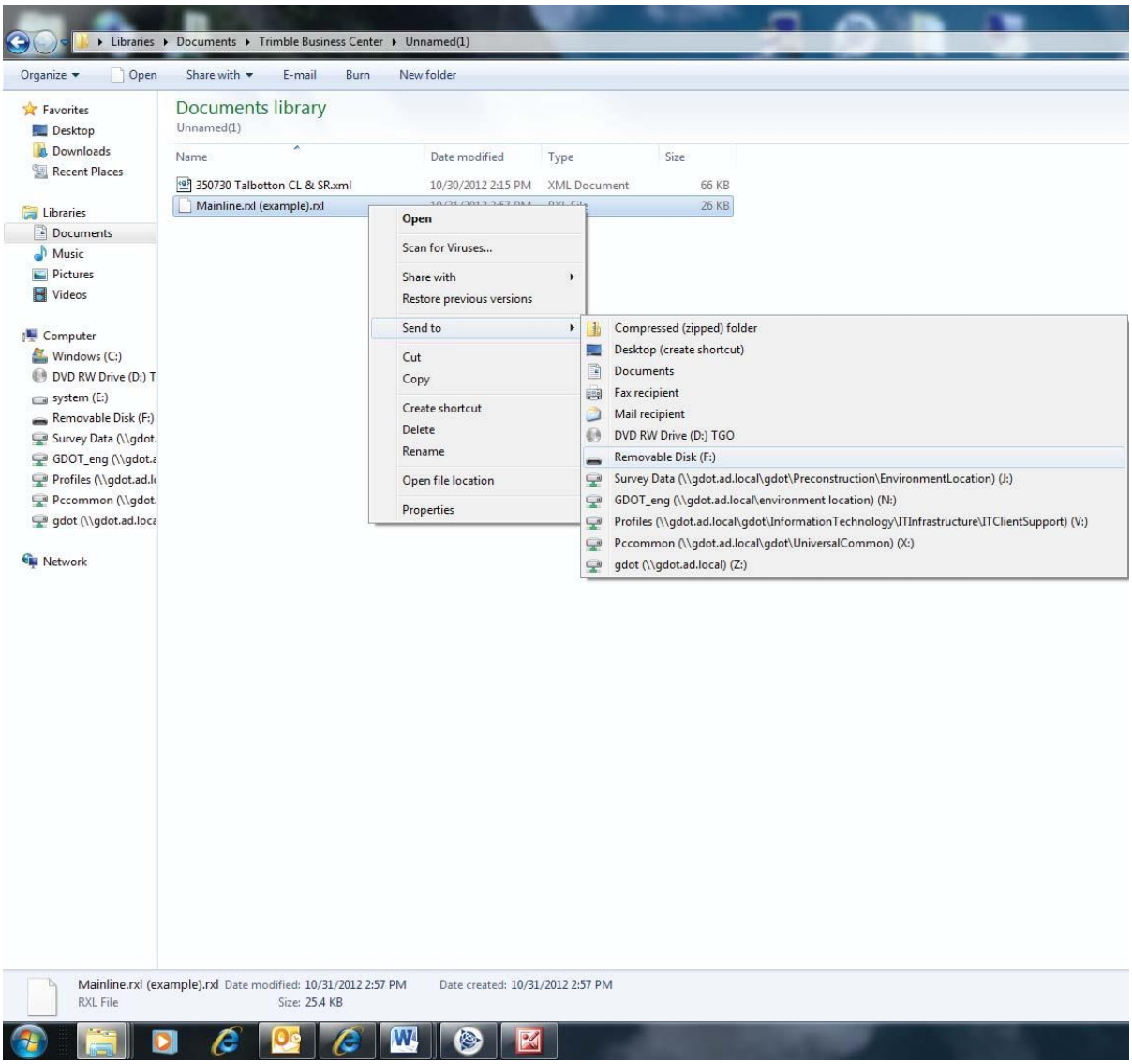


Figure 1-5

9. After you enter the stakeout routine on the TSC 3 and select Alignments you should see an **"Add"** tab at the bottom of the screen. Tap add and you will be taken to the job directory and then you select the desired .rxl file for staking.

****Note:** If points are desired for stakeout from the LandXML file, select the points in TBC and export a .csv file and copy to the TSC3. The .rxl file is alignment data only!!!

2.14 Mapping Update

A. If possible, the mapping update should be done on days when the weather or crew size doesn't permit normal survey activities.

B. The mapping update should be done with a **red** ball point pen or pencil on the first set of blueline mapping (this is the set of mapping that is sent to the designer along with the remainder of the project survey data). See **Page 2-31** for an example.

Items to Enhance:

1. **Buildings** (describe type and use – frame residence; brick store/ "Ace Hardware"; tin storage shed; etc.).
2. **Fences** (height and type).
3. **Paved driveways** (type).
4. **Sidedrain pipes** (size, type, condition, and flow direction).
5. **Crossdrain pipes/culverts** (size, type, condition and flow direction). (See section 3.6 for drainage collection in MS4 counties)
6. **Describe landscape** (cultivated field, grass pasture, planted pines, lawn, etc.).
7. **Show Road/Street Names** and/or numbers and type of pavement.
8. Plot all stormdrains on the mapping along with the top and flowline elevations and the direction of flow.
9. **Show all mile** posts and their number on State Routes and railroads.
10. Show all pertinent topo features not shown on Mapping.

Note: Before submitting the updated mapping, the **COPIES SHOULD BE UPDATED** with a **lead pencil** or **ballpoint pen** and retained at the District Office or the Survey Office.

For Reference Only

2.15 Additional Topo

A. Additional topo should be collected in conjunction with collecting the property data.

B. A second set of blueline mapping should always be used to keep a field sketch of the work performed, such as points occupied with the total station, points sighted, numbers of points shot, chains, strings, etc.

C. The Survey Data Engineer should return the blueline field sketch to the Survey Office for filing after processing the survey data.

D. Coordinate all items of importance not shown on mapping such as:

1. **Buildings** (use description 2 attribute as a description of the building type: 1 story brick, 2 story wood, etc.) (Although on mapping, buildings in the required right-of-way, or on or within **2 feet** of the required right-of-way, should be positioned with coordinates).
2. **Pavement: All Mainline Pavement** including curb/gutter, and sidewalk will be collected on the Mainline and 100' on all side roads (turnouts, parking areas, additional lanes, etc.).
3. **Stormdrains** (elevate top and flowline).
4. **Crossdrain** pipes and culverts (elevation needed) (**don't** position side drain pipes unless they are in a major drainage ditch). (See section 3.6 for drainage collection in MS4 counties)
5. **Above Ground Utilities:** major electrical boxes, high voltage transmission power poles, and other utilities that could alter the alignment of the proposed project should be shown.
6. **Private signs** on or near the required right-of-way should be positioned with coordinates.
7. **Driveways** (on dirt and paved driveways, coordinate the outside edges of the drive).
8. **Storage tanks** (coordinate each end if possible. If the ends cannot be located, coordinate the filler cap).
9. **Landfills and hazardous waste sites** (coordinate the boundaries).
10. **Septic Tanks and Drain Lines** (See Section 2.5)
11. **Monitoring Wells** (Usually located at gas stations and near underground storage tanks) (See Appendix A.1 for examples)

NOTE: Water meters, gas meters, telephone pedestals, telephone poles and low voltage power poles need to be shown also. (See page 2-35 and 2-36 for policy 4465-1).

Cells used in Mapping and/or Field Survey

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Georgia Department of Transportation

GDOT Publications
Policies & Procedures

Policy: 4465-1 - Preconstruction Survey Procedures--Utilities
Section: Surveys
Office/Department: Office of Design Policy & Support
Reports To: Division of Engineering
Contact: 404-631-1000

The following is a general procedure that each District or consultant surveyor should follow for obtaining above ground and underground utility information. Above ground utilities will continue to be shown by the Photogrammetry section on mapping projects; also, the following utilities will be enhanced and shown as part of the Location survey. Minor electrical transmission poles, telephone poles or pedestals, water meters or valves, gas meters or valves, substations, high tension power poles or towers, sanitary sewer covers, or other special items that will affect the alignment of the proposed project. Underground utilities such as sanitary sewer flow lines do not have to be collected by the surveyor.

1. All owners of utilities impacted by our project shall be notified that they shall be responsible for identification and location of their utilities. They will be advised that available maps, plans, photographs or Microstation files will be provided on which they are to place all pertinent data, i.e., type, size, horizontal and vertical position.
2. The maps, plans, ~~or~~ photographs or Microstation files will be furnished as follows:

    a. *Projects that are mapped by photogrammetric methods.* The Statewide Location Bureau Chief will provide reproducible copies of these maps, prior to survey, to the District Preconstruction Engineer. The District Preconstruction Engineer will then provide the District Utilities Engineer with sufficient copies to give to all utility companies involved on the project.
    b. *Projects with existing plans that are not to be mapped.* The District Preconstruction Engineer shall obtain reproducible copies and furnish a sufficient set of plans to the District Utilities Engineer prior to the start of survey.
    c. *Projects without existing plans that are not to be mapped.* Prior to the start of the survey, the District Preconstruction Engineer will determine if aerial photography is available. If available, the photography will be ordered at the appropriate scale (1"=50' urban or I"=100' rural). Copies will be provided to the Utilities Engineer.
    d. *Mapping, Plans or Photography not available.* The District Preconstruction Engineer shall furnish the District Utilities Engineer a hardcopy of the first preliminary data available from design that will enable a Utility Company to accurately show the location of its facilities and equipment. The District Preconstruction Engineer shall advise in writing to the appropriate design office, that copies of the preliminary data is needed. A copy of all such correspondence sent to the General Office shall be transmitted to the Statewide Location Bureau Chief.

3. The District Utilities Engineer will transmit this data to the Utility Companies accompanied by a statement giving the date by which the information must be returned.
4. The information returned will then be reviewed by the Utilities Engineer and the Preconstruction Engineer.
5. Utility information will then be transmitted to the appropriate design office.

PROJECT SCHEDULES

The schedule of projects shall not be delayed by these procedures. The District Preconstruction Engineer must insure that all necessary utilities information is completely available and usable when the scheduled time to complete surveys is exhausted. The

District Preconstruction Engineer shall notify the District Engineer and/or the Statewide Location Bureau Chief whenever it is apparent that the normal procedures will not produce the utilities survey within the scheduled time of surveys. The District Engineer and/or the Statewide Location Bureau Chief shall evaluate the project schedule and determine what measures are appropriate.

SPECIAL EXCEPTIONS

There may be times when small utilities owners do not have the manpower resources or expertise to furnish the needed information. The District Engineer shall evaluate these problems on an individual project basis and advise the Preconstruction Engineer of the effort needed to provide design with the necessary information. Exceptions on large projects will be made only with the prior approval of the Statewide Location Bureau Chief.

References:

None.

History:

revised 1st par, added Microstation files to 1 and 2, changed blue line copy to set of plans in 2b and hard copy in 2d: 08/01/14; office name change: 08/21/13; added to Manual of Guidance: 06/01/93
Reviewed: 8/1/2014

2.16 Digital Terrain Model (DTM) Mapping

NOTE: Before performing any DTM fieldwork, an instrument calibration check should be made in accordance with the Department's Guidelines for instrument calibration **(Section 2.22)**.

A. **Field Enhancement of Obscured Areas on Mapping Projects**

(Enhancement of obscured areas should be accomplished in conjunction with collecting property data and topo features not shown on the mapping).

1. The surveyor should consult with Project Designer on the limits of coverage of obscured areas to be field enhanced. The surveyors are not expected to enhance all the obscured areas completely. Only enhance the areas within the defined construction footprint as outlined in the Pre-Survey Field Meeting performed under **section 2.1**.
2. Areas which are obscured from view on aerial photographs for the purpose of photogrammetric mapping will be identified for field enhancement. These areas will be enclosed with a bold thick dashed line and labeled with bold print as **AREA UNDER CONSTRUCTION** for areas that are under construction or **OBSCURE AREA** for dense obscured woods and swamp. Bodies of water such as lakes, ponds and flowing streams/rivers will be identified as obscure by bold thick dashed lines around the boundary with bold print labeled as **LAKE AREA** inside the boundary. **(Examples of Obscure Areas can be found at the end of this section). Obscure areas labeled AREA UNDER CONSTRUCTION will not be field enhanced until grading is complete**.
3. All obscured areas on the mapping that are submitted to the Designer should be labeled in **red**, either **ENHANCED** or **NOT ENHANCED. (See example at the end of this section)**.
4. On obscured areas where only a portion of the area is to be enhanced, a **LIMIT LINE must** be established to define the area that is enhanced. **(See example at the end of this section)**.
5. Breaks in the terrain such as ridges or depressions should be shown by strings or survey chains. Strings should accompany **RANDOM GROUND ELEVATIONS** which help to create a more accurate terrain model. (These string numbers and their approximate location should be kept on the extra set of blueline mapping that is used for a field sketch to aid the Survey Data Engineer in processing the survey data).
6. Point numbers on a string or survey chain **must always increase** in the direction of the string. It is imperative to always show elevation changes on a string as they are approached. **NOTE: Backing up on a string to show a missed shot (change in elevation) will result in erroneous DTM data**.
7. The maximum distance between shots on a string can't exceed **300 feet**. Even on flat not sloping terrain due to software limitations with our existing CAICE Design Software.
8. This maximum distance is reduced to **250 feet** for projects designed with INROADS.

B. **DTM Surface**

CAICE

1. ***The surveyor will need to download daily, the field data stored in the data collector*** to the computer using a transfer program and use **CAiCE** to visually inspect the fieldwork. The purpose of this is for the surveyor to check the collected data for accuracy and completeness before submitting a corrected **.ASC** file to the Survey Data Engineer. For a complete explanation of this process, one should refer to the latest version of the **GDOT SURVEYOR'S GUIDE to CAiCE**. This manual was released in early 1999 and it describes the steps it takes to produce a DTM surface.

2. **Remember**, you must edit your **.ASC** file to reflect any changes you have made in CAiCE when resolving string crossings or mistakes in your data. A VBA Macro has been developed to handle this operation of correction your .ASC file and is now available. It can be found under **Tools => Custom Tools => GDOT Macro Menu => File Tab => Update ASC File**. Select the help tab for this application in CAiCE for this tool macro to view a general description of the application as well as its behavior.

TRIMBLE / INROADS

3. The surveyor will need to download daily the **.JOB** file and an exported **.CSV** file from the TSC3 data collector. The file will then be imported into Trimble Business Center to check for accuracy and completeness before submitting a final **.CSV** file to the Survey Data Engineer.

4. After the surveyor provides the Survey Data Engineer (SDE) with a corrected **.ASC** or **.CSV** file, it is the responsibility of the SDE to make sure that all field enhancements are included and merged correctly with the photogrammetric mapping and DTM data. If the SDE has a question or a problem with the submitted data, **the surveyor will be required to review it with the SDE to insure the accuracy and completeness of the submitted information**.

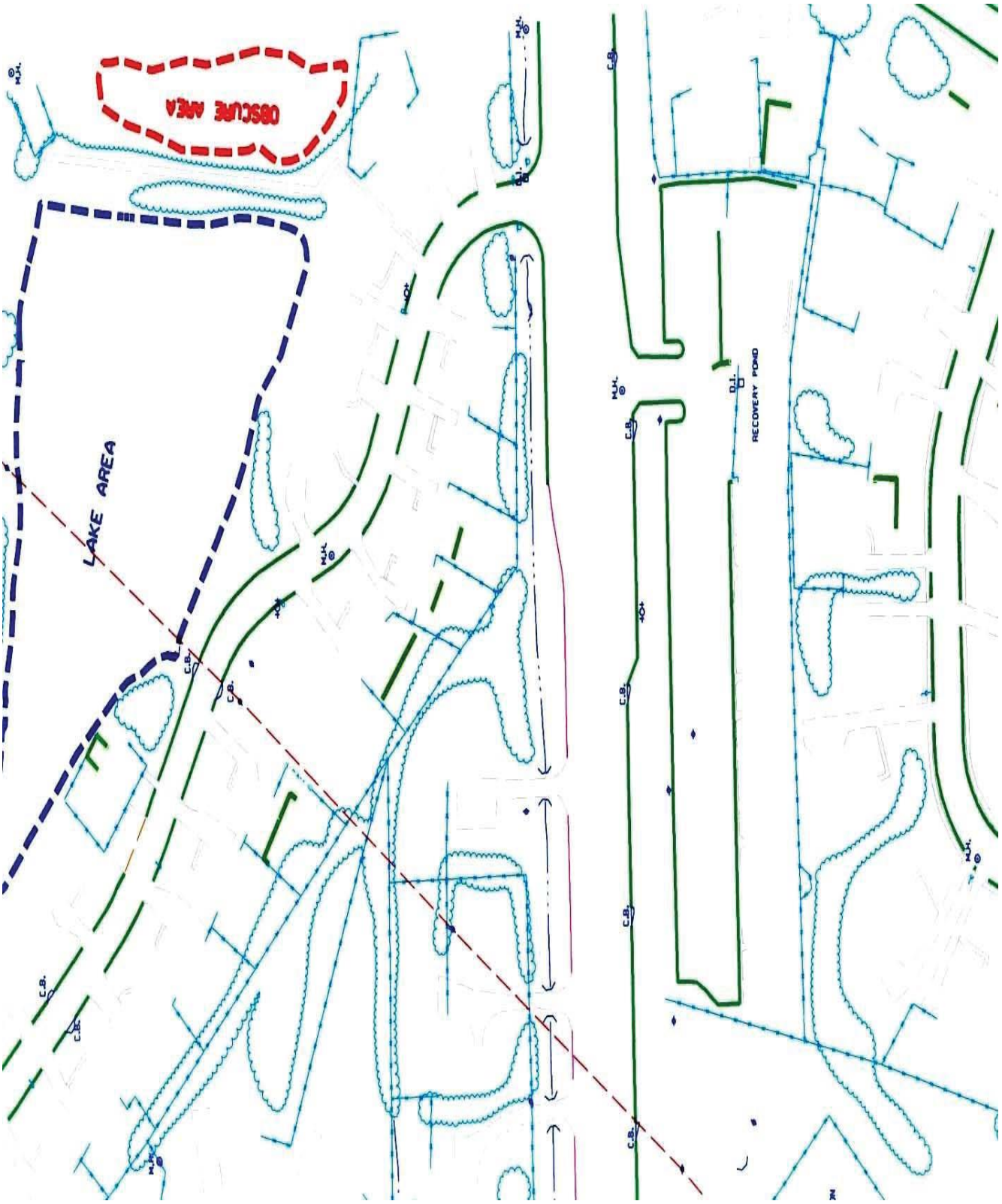
5. Terrain data gathered will be of such quality and completeness as to insure that cross sections and profiles can be created to the following levels of accuracy:

   a. 0.10 foot or less for roadway surfaces (travel lanes)

   b. 0.50 foot or less for ground terrain surfaces

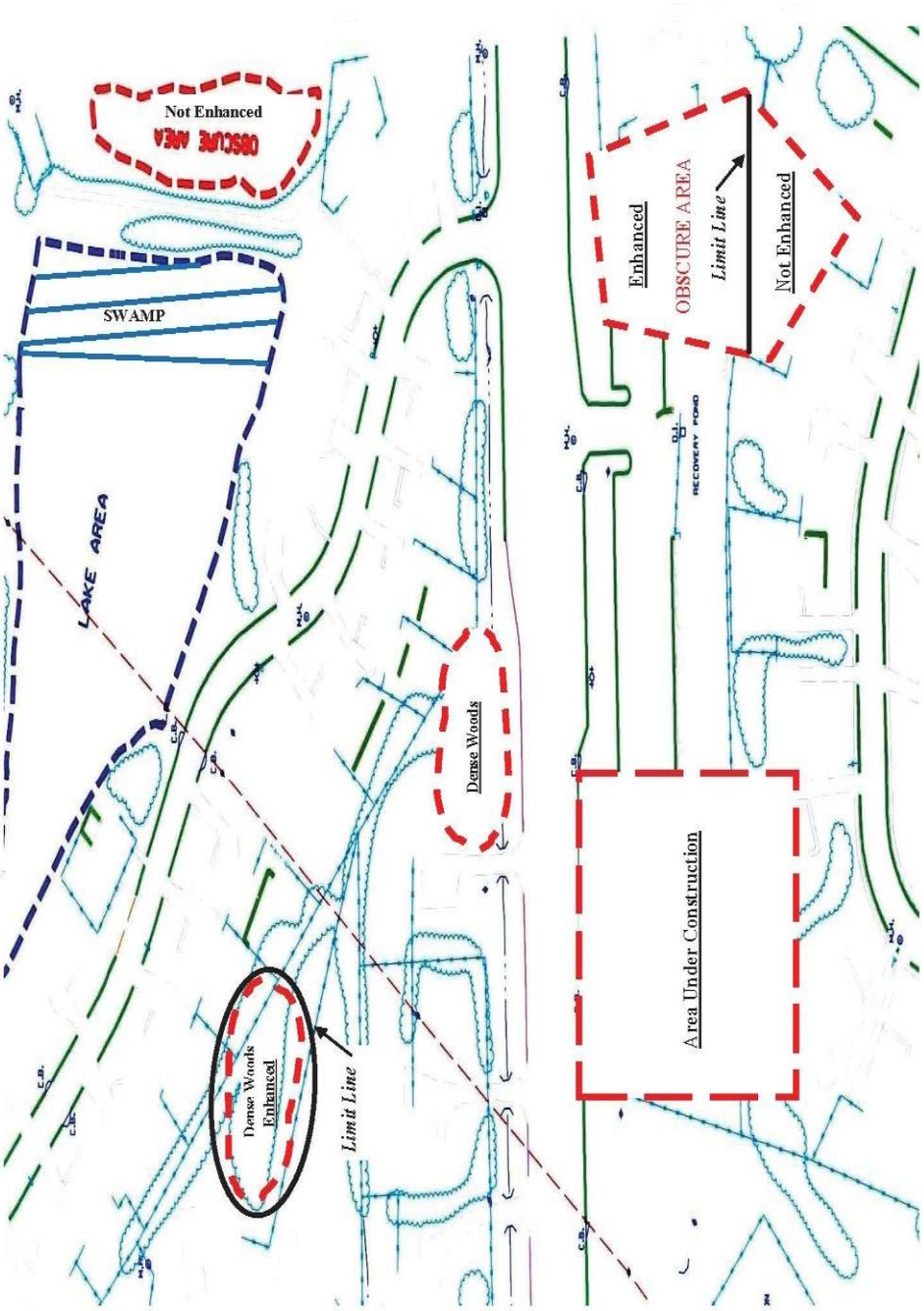
   c. 0.02 foot or less for bridge decks, bent caps and top of rail elevations

SAMPLE MAPPING WITH OBSCURED AREA SHOWN



For Reference Only

SAMPLE MAP OF TYPES OF OBSCURED AREAS



For Reference Only

2.17 Field Cross Sections

CAICE

If the alignment needs to be staked out, then you will have to retrieve an alignment from your District SDE. It is his/her responsibility to provide you with the latest alignment generated from the CAiCE job using the Flexible File Format. If you have a question about this procedure, then, refer back to (**Section 2.12**) for more information concerning this file.

INROADS/TRIMBLE

The SDE will provide an alignment file as described in Section 2.13.

Field cross sections may be taken with a spirit level or by trig-leveling with a total station survey instrument. Either method is acceptable.

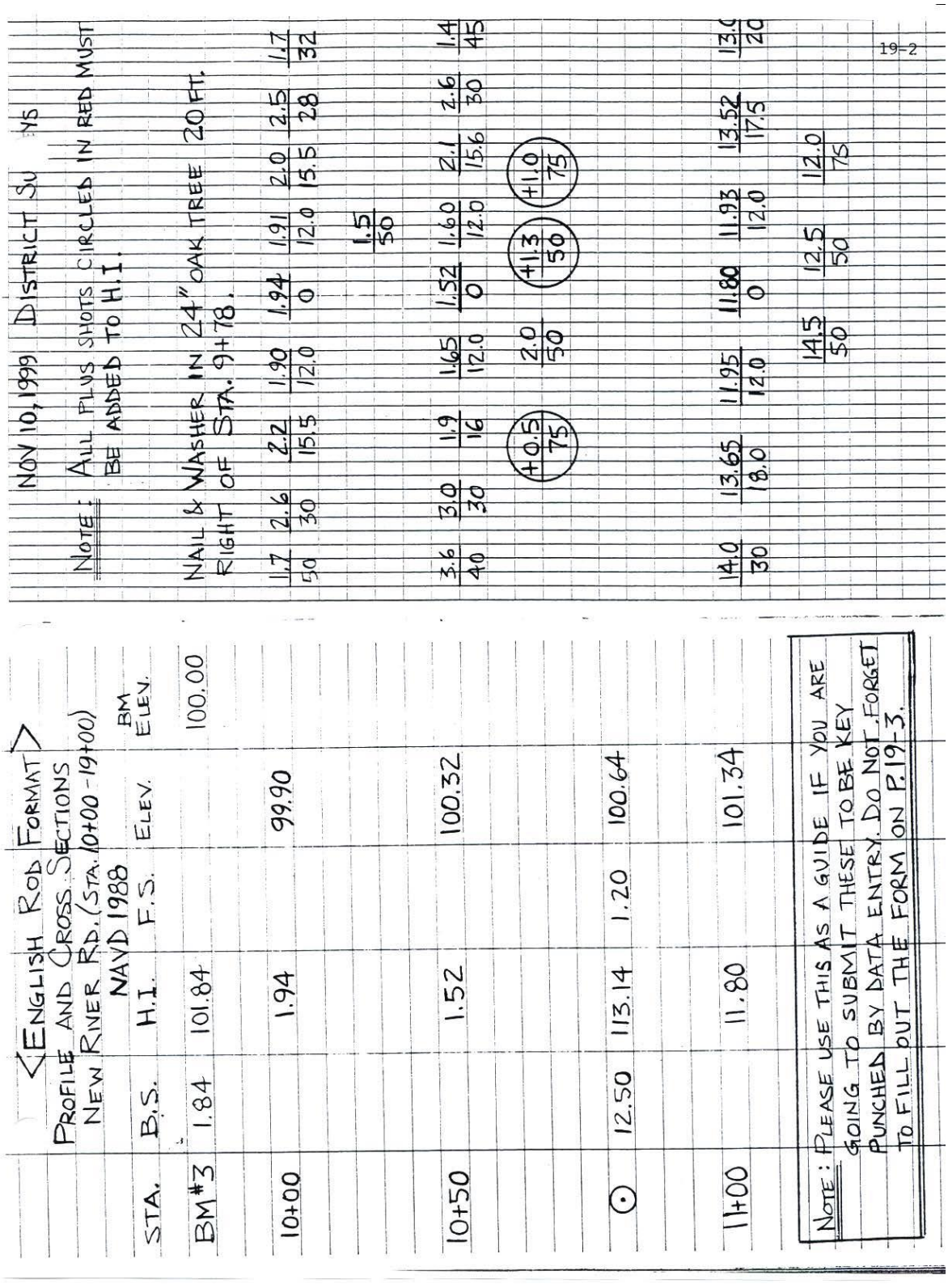
The format of the data entered in the cross section book depends on which type of instrument was used.

If a spirit level is used, the traditional format of level rod readings and offset distances are shown in the field cross section book.

If a total station is used to take trig-levels, the elevation and offset distance is shown in the cut sheet format. The offset distance for each elevation is obtained by using the **Construction 5** program in the data collector. Remember, if you are using this technique to collect cross sections, you will have to code your shots with an existing code or you will have to use a User Defined Feature Code which will be noted in the header of this .ASC file when it is submitted. Make sure that you specifically note which code is being used for your shots.

No matter which method is used, the format of the data entered in the cross section field book should remain the same or consistent throughout the entire alignment. This data will not be keypunched if the format is not clear and compatible.

Example of Profile and Field Cross Section Notes



For Reference Only

2.17.1 Photogrammetric Cross Sections

Georgia Department of Transportation

GDOT Publications
Policies & Procedures

Policy: 4445-2- Guidelines for Construction Cross Sections
Section: Photogrammetric Cross Sections
Office/Department: Office of Design Policy and Support
Reports To: Division of Engineering
Contact: 404-699-4401

This memorandum is written for the purpose of establishing procedures and guidelines for measuring photogrammetric cross sections of construction projects that have excavation as a per unit pay item in the contract.

It is Departmental Policy that projects which have small amounts of excavation will be field cross sectioned because it is more efficient than the photogrammetric process. However, projects which have small amounts of excavation can still be cross sectioned photogrammetrically if any of the following conditions exist:

1. Field survey personnel would be abnormally exposed to unsafe traffic conditions.
2. Insufficient survey personnel to measure cross sections.
3. More accurate earthwork volumes could be determined photogrammetrically due to the geometrics of the roadways (baseline required).

When a construction project has been approved for cross sectioning by the photogrammetric process, the following activities are the responsibility of the Area Engineer:

A. General Requirements

1. Establish and maintain communications with a representative from the Statewide Location Bureau. (404)699-4401

2. Serve as the communication link between the contractor and the representative of the Statewide Location Bureau.

3. Insure that the Statewide Location Bureau has been notified of the Preconstruction Conference.

4. Retain copies of the data (target notes, control network coordinates, profiles, field cross sections, etc.) that are transmitted to the Statewide Location Bureau. All field d**ata should be forwarded immediately after it is gathered. The Project Engineer must insure that all field data is legible and properly recorded.**

B. Original Terrain Cross Sections

1. Insure that the project is properly cleared and grubbed for photogrammetric cross sectioning. Contact the photogrammetric representative three (3) or four (4) days before project is ready to be flown so that it can be inspected and the airplane reserved.

2. During the clearing and grubbing operation, contact the photogrammetric representative to coordinate the staking and elevating of the project control alignment.

   The contractor or a district survey party must stake and elevate either construction centerline alignments or a control network (random survey traverse points) as determined by the photogrammetric representative.

3. Provide profile of the staked centerline alignments or coordinates and elevations of the control network points to the **Statewide Location Bureau.**

4. Insure that the construction alignments or the control network points are properly targeted and that targeting notes are kept. (Detailed instructions will be provided by the photogrammetric representative.)

5. Measure original terrain cross sections in all areas where excavation is required prior to project being flown for cross sections. The alignment from which these cross sections are measured is critical and must be determined in coordination with the photogrammetric representative. Forward this data to the **Statewide Location Bureau** so it can be merged with the photogrammetric cross sections.

6. Provide the **Statewide Location Bureau** with a list (location, description and elevation) of all benchmarks on the project.

7. Inform the photogrammetric representative of any areas which require special cross sectioning consideration (channel excavation, special baselines, areas not to be cross sectioned, etc.).

8. **GPS (Global Positioning System) (real-time) Kinematic Survey Data will be accepted as original and final terrain data, the contractor or surveyor using this process will be responsible for the accuracy set forth by the photogrammetric representative. The deliverables will be a Statistical report containing proof of data integrity and control package showing all survey control and points with level notes and all pertinent survey data including precision data and Rinex reports.**

C. Final Terrain Cross Sections

The normal and expected method of obtaining data to produce final (as built) cross section will be by the template method. There will be some projects or portions of projects for which it will be impractical to use templates. The Director of Construction will determine the most efficient method of computation for these projects. In no case will the Area Engineer assume that because original cross sections were obtained photogrammetrically that final cross sections will also be measured by this method. The Director of Construction will review and approve (in writing) all requests for final terrain cross sections to be measured by the photogrammetric method.

The following is a listing of activities and instructions that the Area Engineer will be required to perform on projects which have been approved for final cross sectioning by the photogrammetric process:

1. Insure that all grading activities on the project are complete.

2. Contact the photogrammetric representative to coordinate the type of control network points (centerline alignment or control network points) that should be staked.

3. Insure that the centerline alignments or the control network points are staked, targeted, and that all points have been elevated. (Forward this data immediately to the **Statewide Location Bureau**.)

4. Contact the photogrammetric representative three(3) or four(4) days before the project is ready to be flown so it can be inspected and the airplane reserved.

5. Inform the photogrammetric representative of any areas which require special cross sectioning consideration (areas not to be cross sectioned, modifications to slopes, etc.).

6. Record the status of all subgrade materials which are in place when the project is flown for final cross sectioning. The photogrammetric cross sections will reflect the terrain/ roadways as they appear on the photography.

7. Provide the **Statewide Location Bureau** with a list (location, description and elevation) of all benchmarks on the project.

D. Earthwork Volumes

1. The final pay earthwork volumes, which are computed by the **District Earthwork Coordinator,** will reflect the amount of excavation which has taken place between the original and final terrain cross sections. These quantities and the final terrain cross sections will not reflect any base and paving excavation or any undercut volumes which have been displaced by base materials which were in place at the time the final cross section photography was flown.

2. The **District Earthwork Coordinator** will only compute terrain earthwork (from original ground to profile grade) volumes on projects where the final terrain was

measured photogrammetrically, or by a surface created from data gathered through the use of HDS (High Definition Surveying) Laser Scanner.

3. The Department's policy is to compute earthwork on all projects using the as-built templates. The design office, either General Office or District Office, must produce design templates that can, with modifications to reflect construction changes, be used for this purpose. The design office will maintain the template files. The file maintained will include the design templates that depict the roadway cross sections at profile grade and also the templates that show the roadway cross sections at the grading template.

References:

None.

History:

Copied to GDOT Publications v.02.00.00 on 2/21/2012
added to Manual of Guidance: 02/12/87 revised: 09/01/95 added to TOPPS: 05/01/96 reviewed: 11/10/06
Created at 9/15/2008 4:22:42 PM by Helene Nickey

2.18 Requirements for Right-of-Way Stakeout

All required right-of-way and easements shall be staked for the entire project limits and such staking shall be in accordance with the following procedures:

REQUIRED RIGHT-OF-WAY POINTS

Using nails **(60 penny)** place nails at all new right-of-way points (break points and property line intersection points) and place red flagging on nails. On all property lines, intersection points, also place blue flagging on nails. A guard stake shall be placed next to each point denoting the identification of the point. Red flagging shall be placed on each guard stake and blue flagging shall be placed on each property line intersection point.

A. Guard stakes should read: "**REQ'D R/W**" on one side of the stake and should show the station and offset on the other side.

B. The maximum distance between stakes shall **be 250 FEET**. Intermediate stakes may be required to achieve this distance. The location of the adjacent points **(each side)** shall be clearly visible from any given point. Flagging may be used as required to make this possible.

EXISTING RIGHT-OF-WAY POINTS

Wooden stakes shall be placed at all existing right-of-way points or existing easement points. Stakes at these points shall read: "**EXIST R/W**" or "**EXIST EAS**" on one side of the stake and shall show the station and offset on the other side. These stakes shall be flagged with white ribbon. **NOTE: Do not place nails at existing right-of-way points**.

REQUIRED EASEMENT POINTS

All easement break points shall be staked using wooden guard stakes flagged with yellow ribbon. The abbreviated words "**CONST EAS**" shall be shown on one side of the stake and the station and offset shall be shown on the other side. Temporary driveway easements are not to be staked unless requested by the **DEPARTMENT**.

2.19 Guidelines for Trigonometric Leveling

To insure accurate field data is gathered, the following guidelines should be used in trigonometric leveling:

On Program Projects, all local district traverses should begin and terminate with control set by the Statewide Location Bureau Control Mapping Section if available. All horizontal traverses should be checked for acceptable closure and adjusted by the Compass Rule Adjustment (the Adjustment Program in the SMI Data Collector or the traverse program in the TSC3). **Rural** traverses should close to within a minimum ratio of **1 in 20,000** and **urban to** within a minimum ratio of **1 in 25,000.**

All vertical traverses should be checked for acceptable closure to within **0.049** feet times the square root of the miles ran. If acceptable horizontal and vertical closure tolerances are met, adjust the traverse with the SMI Data Collector Adjustment Program or the traverse program in the TSC3.

When carrying trig-levels on district traverses, distances between the district set control deltas should not exceed **800 feet** and **never what environmental conditions will allow.** If distances between district control deltas exceed **800 feet** a spirit level should be used to elevate the control deltas. Caution should be taken by the instrumentman in aligning the vertical and horizontal cross hairs on the prism axis. Distances should not be shot when the target cannot be seen clearly. **Taking too long of a shot is a common mistake when carrying elevations with the total station.**

The Allegro Data Collector and the Trimble TSC3 automatically computes the correction for refraction and curvature of the earth's surface. If not using the Data Collector in the trig-level operation, the formula to correct for refraction and curvature of the earth's surface is **h' = 0.021M Square. (h' = correction and M = thousands of feet).**

2.20 Carrying Elevations with Sideshot Program

The instrument is set on a pre-controlled and elevated delta with the point number and the height of the instrument recorded in the field notes. The backsight is set on a pre-controlled and elevated delta with the point number and the height of the target also recorded in the field notes.

Allegro

From the setup screen ensure the occupied point number is correct. If not key in the correct point number and press the OCCUPY KEY (E KEY). After the correct occupied point has been entered, key in the backsight point number and press the ALT KEY. After pressing the ALT KEY press BKPT on the touch screen. The data collector will then measure the back point. The amount of error in the setup will be shown on screen as well as recorded in the raw data job file for future reference.

Collect the desired sideshots. Care should be taken in: measuring the height of the Prism Rod each time the Prism Rod height changes and in recording the change correctly in the data collector. Care should be taken to insure that the cross hairs are aligned on the axis of the prism.

If a point has been occupied for more than 30 minutes then a re-check on the backsight will need to be carried out. To execute this operation simply point the total station to the backsight point and press the ALT key and then RE-0 (0(zero) KEY). This will show the amount of error in the backsight angle on screen as well as record this error in the raw data job file for future reference and will re-zero the total station. After re-zeroing the instrument, perform the previously described backsight

check routine. After these two operations have been performed and are acceptable you may continue data collection.

The last operation from each set should be the check backsight and re-zero routines to ensure data quality.

Trimble TSC 3

From the General Survey Screen click **Measure** and select your total station. Select **Station Setup** and enter the point number of your instrument setup and instrument height. Click **Accept**. Enter your backsight point number and backsight height and click **Measure**. If the error is within tolerance, click **Store**.

Collect the desired sideshots. Care should be taken in: measuring the height of the Prism Rod each time the Prism Rod height changes and in recording the change correctly in the data collector. Care should be taken to insure that the cross hairs are aligned on the axis of the prism.

If a point has been occupied for more than 30 minutes then a re-check on the backsight will need to be carried out. To execute this operation, simply turn to the backsight and in the **Measure Topo** screen click the "**Check**" box at the bottom twice to enter the backsight check mode. Click **Measure**. An error screen will appear with a drop down box with different options. Select the option **Store and Reorient** or **Store as a Check** and click **Store**. Press the **ESC** key to get back to the Measure Topo screen. Continue your data collection.

The last operation from each set should be the check backsight and re-zero routines to ensure data quality.

The above procedures are used on each set-up when gathering field data in the sideshot / Measure Topo routine. This procedure will take a little more time, but is more than compensated for by not having difficulty resulting from incorrectly collected field data.

2.21 Borrow Pits

1) Property owners' name

2) Existing data

3) Intermediate data

4) Final data

5) In a situation where a property owner has multiple pits then the data should be described as Pit#1, Pit#2, Pit#3, and etc.

2.22 Guidelines for Instrument Calibration Checks

A calibration instrument check should be done at least once per month to ensure that the total station is in proper adjustment. Checks should also be made before beginning a large survey or whenever the total station is suspected of having been jarred, or anytime there is suspicion that the instrument is out of calibration.

A controlled environment should be chosen to perform the calibration check. A large room with at least **20 feet** of length in a Field Survey Office would be an ideal location. The instrument should be exposed to room temperature at least two hours before the calibration instrument check is performed, preferably overnight. It is recommended that on one side of the room, a permanent mark be made on the floor, on which to set the total station each time a calibration check is made. On the opposite wall, two permanent targets should be mounted. The lower target should not be more than **1 foot** off the floor. The upper target should be plumb with the lower target and at least **7 feet** from the floor. It is recommended that the targets be flat graduated scales mounted level on the wall.

A. **Plate Level-Vial Calibration Check**

1. Set the instrument over the permanent floor point.
2. Level the instrument and center the plate level-vial bubble.
3. Rotate the head of the instrument **180 degrees** and check to see if the vial bubble is centered. If not, proceed to step 4.
4. With an adjusting pin, rotate the bubble one half the way to the center and use the adjusting screws to level the bubble the other half. Repeat steps 3 and 4 until the level-vial is in proper adjustment.

NOTE: Before performing the following instrument checks, the plate level vial should always be in proper adjustment.

B. **Optical Plummet Calibration Check and Adjustment**

1. Set the instrument over the permanent floor point.
2. Level the instrument precisely while keeping it positioned (centered) over the floor point.
3. With the optical plummet target centered over the floor point, rotate the instrument head **180 degrees** while observing the target. If the target moves off the floor point, the optical plummet is out of adjustment. Proceed to step 4 for adjustment instructions.
4. Place a pencil point or some other small object one halfway between the projected point on the floor while looking through the optical plummet eyepiece and the permanent floor point (this should be measured with a scale). With an adjusting pin, adjust the optical plummet target to the marked point on the floor.
5. Reset and re-level the instrument over the floor point and check to be sure that the optical plummet stays centered. If it does not, then repeat step 4 until it does.

Since the optical plummet adjusting screws are very fragile, extreme caution should be taken in turning them to prevent stripping or breaking. Before attempting to adjust the optical plummet, always read the owner's manual and heed all precautions. If you feel that

none of your staff is qualified to make the adjustment, it is recommended that the total station be sent to a qualified instrument repair center for proper adjustment.

C. **Horizontal Adjustment Check**

1. Set the instrument over the floor point and properly level.
2. Sight the target nearest the floor (a graduated scale), aligning on a definite mark.
3. Record on paper the reading of the scale.
4. Zero the instrument.
5. Loosen the horizontal clamp and rotate the instrument head **180 degrees,** then invert the instrument head and sight on the same scale at the exact same place.
6. Read the angle. Whatever is over or less than **180 degrees** is half the angular error that the instrument is out of adjustment. This should not exceed **20 seconds,** which would result in **10 seconds** of instrument error**.** If the instrument error exceeds **10 seconds,** the instrument should be sent to a qualified instrument repair center.

D. **Zenith Angle Adjustment Check**

1. Level the instrument over the permanent floor point.
2. Sight one of the wall targets being careful to align the horizontal reticle on a spot that can be re-sighted with ease.
3. Read and record the zenith angle on paper.
4. Loosen the horizontal clamp and rotate the instrument head **180 degrees.**
5. Invert the telescope and sight the exact same spot again.
6. Read and record the zenith angle under the first reading and sum the two angles. The total should be **360 degrees.** Whatever is over or under is half the error that the total station is out of adjustment. This error should not exceed **20 seconds,** which results into **10 seconds** of instrument error. It is recommended that an instrument with more than **10 seconds** of instrument error be sent to a qualified instrument repair center for adjustment. An instrument error of **10 seconds** at a maximum sight distance of **800 feet** would result in an elevation error of **0.039 feet.**

E. **Vertical Swing Adjustment Check (Two flat graduated scales are needed as targets to perform this check**).

1. Center and level the total station over the permanent floor point.
2. Sight the vertical cross hair on a point on the lower target, making note of the graduation mark.
3. Loosen the vertical clamp, focus on the upper target and record the scale reading.
4. Loosen the horizontal clamp; rotate the instrument head **180 degrees,** sight on the lower target at the exact spot as before with the vertical cross hair.
5. Loosen the vertical clamp, set crosshair on and read the upper scale and record the reading which should be the same as the first.

F. **Always perform an instrument calibration check immediately after receiving an instrument back from an instrument repair center**.

G. **Spirit Level Calibration Check**

1. First stake off a straight line of **220 feet** by marking points along the line at **0 feet, 20 feet, 120 feet,** and of course **220 feet.** Do not exceed one rod length in elevation in the entire **220 feet** length. Proceed to **Step 2**.
2. Set the spirit level up on the **120 feet** mark and precisely level. If the level vial bubble is out of center, adjust by using the **"A"** of this section (plate level vial calibration check). After confirming this adjustment, proceed to **Step 3.**
3. With the spirit level precisely leveled, read the level rod on the **20 feet** mark and the **220 feet** mark. Subtract one reading from the other. The result will be the same if the level is in poor or perfect adjustment. The difference will be a balanced reading. Proceed to **Step 4.**
4. Set over the **0 feet** mark and fine level the spirit level. Read the level rod on the **20 feet** mark and the **220 feet** mark. Subtract one reading from the other. Subtract the result from the balanced reading acquired in **Step 3.** The result will be the amount of error that the spirit level is out of adjustment. Proceed to **Step 5,** if it is necessary to adjust.
5. **Spirit Level Adjustment.** Always consult the manual and follow the instructions to adjust the level's cross hairs. An adjustment will need to be performed if the level error is shown to be 0.003 or more US survey feet. Sitting on the **0 feet** mark, read the **20 feet** mark and the **220 feet** mark and bring the difference in elevation of the reading to coincide with those obtained in **Step 3.** This will complete the adjustment. After completing this step begin a new calibration check. This will be necessary to verify the adjustment made.

*****CAUTION! Never try to adjust a total station using this method. *****

Example of a Spirit Level Calibration Check (Peg Check)

DATE: 6/21/05 INST: M. SKIPPER RODMAN: J. FLETCHER

	A ROD	B ROD	DIFFERENCE
AT THE 0	4.299	5.558	1.259
AT THE 120	2.559	3.818	1.259

DIFFERENCE AT 0	1.259	
DIFFERENCE AT 120	1.259	
TOTAL DIFFERENCE	0.000	ERROR IN LEVEL

DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA

INTERDEPARTMENT CORRESPONDENCE

FILE: Equipment Care **OFFICE:** Stwd. Location Bureau

DATE: November 5, 2008

FROM: Jeffery Fletcher, Engineering Management Operations Manager

TO: District Location Engineers/ SRE'S

SUBJECT: TOTAL STATION CALIBRATION AND REPAIR

Discussions with various district survey personnel have revealed a misconception of the involvement and importance of quality total station cleaning, adjusting, repair, and calibration. The monthly/pre-job equipment checks as outlined in the GDOT Automated Survey Manual are good checks; however these instruments are expensive and delicate pieces of equipment and have to be kept in synchronization for them to achieve a high level of accuracy. It is recommended that the following levels of service be observed. Also, insist that the items under the appropriate level be performed by a certified technician. This office can be contacted for assistance.

Level I:	**Minimum Service**
One Year Clean & Calibrate	Exterior clean of instrument Calibration of horizontal & vertical crosshairs, level vials & optical/laser plummet Cleaning of case & accessories Certificate of Calibration

*Charges for this service could cost between $170.00 and $410.00 depending on instrument model.
** Labor only, parts would be extra.

Level II	**Minimum Service**
2 to 3 Year Preventive Maintenance	Incoming inspection Circle cleanliness inspection Cleaning and lubrication of focusing system Cleaning and lubrication of clamps & tangents Cleaning and lubrication of tribrach Cleaning and lubrication of eyepieces Inspecting of laser beam paths [IR/RL EDM & ATR] Adjusting of horizontal collimation & vertical index Determining and storing EDM constant Outgoing inspection Cleaning of instrument & accessories Certificate of calibration

*Charges for this service could cost between $490.00 and $720.00 depending on instrument model.
**Labor only, parts would be extra.

DEPARTMENT OF TRANSPORTATION
STATE OF GEORGIA

INTERDEPARTMENT CORRESPONDENCE

FILE: Administrative
Equipment Care

OFFICE: Stwd Location Bureau

DATE: 09-30-08

FROM: Jeffery Fletcher Engineering Management Operations Manager

TO: District Location Engineers/ SRE'S

ATTN: All Survey Personnel

SUBJECT: Total Station Equipment Issue

It is imperative that all personnel actively engaged in manipulating the electronic total stations be educated regarding one critical point of procedure. Care and maintenance of these units is both vital and essential.

Recently, one of the units was transported to a qualified technician for the purpose of annual cleaning and calibration per guidelines. The cost involved in this process alone is substantial and involves a loss regarding the equipments production also. Problems noted by technicians which may facilitate replacement of parts results in the cost multiplying exponentially along with the loss of the units productivity.

I would like to issue a subtle reminder to all personnel. The total stations cohesive bond should never be broken for any reason or under any circumstance. The calibrated tribrach assembly and the amalgamated E.D.M. unit must remain conjoined as calibrated. ***Do not dislodge the calibrated tribrach assembly from its parental unit.***

These partners are engineered and calibrated to remain united as a single functioning entity. Machined surfaces are highly polished and fitted using close integral tolerances which must be observed and maintained. Separation of the two and subsequent substitution of an inferior or sub standard part results in spall. This spall generates grooves which cannot be erased except through intricate machining. A secondary solution can be applied, but only on a limited basis. Shims must be inserted and carefully matched to achieve the required tolerance variables.

This information was given in answer to a question posed asking why the "hop scotching" of the prisms and total station was not a good idea. I think this explanation should just about cover it.

Do not remove the calibrated tribrach from the total station it was calibrated with, FOR ANY REASON!

Your cooperation regarding the aforementioned matter is appreciated.

Survey Equipment Checks

Total Station Checklist

Date	Total Station (Brand)	Serial Number	Horizontal Check	Vertical Check	Vertical Swing	Circular Level	Plate Level	Optical Plummet	Instrument Cleaned	Case Cleaned

Other Equipment Checklist

Date	**Level (Brand)**	**Level Serial #**	Level Bubble	Level Peg Check	Tribrach Level	Tribrach Plummet	Prism Pole	Targets Level	Tripods	Instruments Cleaned

Comments: _____

_____

_____

District # _____ Office: _____ Resident Engineer: _____

2.23 GDOT Standard Survey Feature Codes (CAiCE)

CAICE Field Survey feature codes can be accessed at the link below.

They are on page 12-17 of the CAICE Survey Processing Guidelines Manual.

http://www.dot.ga.gov/PartnerSmart/DesignSoftware/Caice/Spg_guide.pdf

2.24 GDOT Feature Codes (InRoads) and Consultant Survey Database QA Checklist

Updated InRoads Field Survey feature codes can be accessed at the link below.

This is a living document that will be updated as needed.

http://www.dot.ga.gov/PartnerSmart/DesignSoftware/INROADS/InRoads%20Field%20Survey%20Feature%20Codes.pdf

The Consultant Survey Data Processing QA Checklist and the review guide can be accessed at the links below.

http://www.dot.ga.gov/PartnerSmart/DesignSoftware/INROADS/Survey_Data_Processing_InRoads_QA.pdf

http://www.dot.ga.gov/PartnerSmart/DesignSoftware/INROADS/INROADS%20Survey%20QA%20Review%20Guide%20for%20Consultants.pdf

Please click on the link below to download the latest Trimble FXL library file for InRoads Codes.

For any questions related to the use of the file, contact the Statewide Cadastral Supervisor at (404)699-4442.

http://www.dot.ga.gov/PartnerSmart/DesignManuals/SurveyManual/GDOT_ALPHA.fxl

2.25 Survey Manpower to Meet Project Schedule

Georgia Department of Transportation

GDOT Publications
Policies & Procedures

Policy: 4465-6- Survey Manpower to Meet Project Schedules
Section: Surveys
Office/Department: Office of Design Policy and Support
Reports To: Division of Engineering
Contact: 404-699-4401

The Department has established schedules for project letting that meet the projected construction work program. It is very important that surveys, both districts, field, and photogrammetric, provide the design survey data on schedule. It is to this end that I request that each District Engineer pay close attention to the survey schedules in the Department's Project Management System (Primavera P6).The Districts must keep in mind that either the data is to be delivered on schedule or a project schedule change is to be requested well in advance of the delivery date. This project schedule change is to be requested so as to allow time to evaluate alternatives for production. These alternatives will include a transfer or reassignment of DOT personnel or the use of consultants to provide data as scheduled. **The last option to be used is to change the project schedule.**

The following procedures are to be followed by the District Engineer when problems with meeting scheduled delivery dates are projected:

1. Document manpower available.
2. Document manpower required to meet the schedule. This information should be directly available in the DPMS.
3. If surveys other than those shown in Primavera P6.(i.e., construction staking, county contract, etc.) require manpower, include documentation for these projects.
4. This information and any other supporting data is to be sent to the Location Bureau Chief for review. This information is to be accompanied by a statement requesting additional manpower.
5. The Location Bureau Chief will review this documentation and make a recommendation to the Preconstruction Director.
6. The decision of the Preconstruction Director will be communicated to the Location Bureau Chief and appropriate action will be taken.

To recapitulate, the action taken can be as follows:

1. Re-assignment and/or relocation of DOT personnel;
2. Consultant contract;
3. Change the schedule.

Whenever design work is proposed to be let to consultants, the Project Manager shall inform the Location Bureau Chief so that appropriate manpower adjustments can be made.

References:

None.

History:

Copied to GDOT Publications v.02.00.00 on 2/21/2012
added to Manual of Guidance: 01/03/90 added to TOPPS: 05/01/96 reviewed: 11/10/06
Created at 9/15/2008 4:36:50 PM by Helene Nickey

2.26 3D Data Collection for GDOT Surveys

A. GDOT is in the process of transitioning into 3D design deliverables. To support this effort, small changes are needed during the field survey collections. Specifically, we need good elevations on all survey points.

In the past, there may have been points collected with less than standard elevations because it was known the elevations would not be used or triangulated.

Please follow the following guidelines for elevations on survey points:

- All Triangulated Points should have accurate elevations
- All non-triangulated points should have elevations accurate to 0.40' the exception to this is bridge decks. They do not triangulate, but should continue to be accurate to 0.02'
- Any drainage pipes that are not accessible or locatable, such as pipe directional shots, should have the phrase "ESTIMATED ELEV" added in Description 2 and the elevation should be estimated.
- Points such as Power Poles, Telephone Pedestals, etc. should have the elevations shot at the ground.

Chapter 3. Drainage - Contents

Chapter 3. Drainage

3.1 Flowing Streams

All flowing streams that are crossed by the survey centerline require a stream traverse. **SEE ATTACHED POLICY ON PAGE 3-3**.

A. The following items are needed on **FLOWING STREAMS** at culvert, pipe or new location survey sites:

1. **ALIGNMENT** (A stream alignment traverse for **300 feet** left and right of the survey centerline.
2. **TOPO** (Topo of the flowing stream shall be taken at sufficient intervals to accurately define the banks of the stream. Show the size and type of all pipes; culverts or other structures located in the stream).
3. **BENCHMARKS** (A benchmark shall be set and described at the crossing of each stream).
4. **PROFILE AND CROSS SECTIONS** (Profile and cross sections of the stream bed and stream banks should be taken at a maximum of **100 feet** intervals. If collecting stream data in the **DTM** format, sufficient points should be shot to accurately represent the streambed and banks. Show the flowline elevation of all pipes; culverts or other structures located in the stream).

3.2 Outfall Ditches

A. The following items are needed on **OUTFALL DITCHES** found at small culverts and pipes draining roadside ditches or on new location surveys:

1. **Alignment** (Sufficient points should be shot to accurately describe the ditch alignment for **100 feet** perpendicular from the centerline on the up fall side of centerline and for **300 feet** perpendicular from the centerline on the down fall side of centerline).
2. **TOPO** (Provide the size and type of all pipes, culvert or other structures located in the ditch).
3. **Profile or DTM Data** (Show Flowline elevation of all pipes, culverts or other structures located in the ditch. Elevations should be taken at a maximum of **100 feet** apart. If surveying in the DTM format, sufficient points should be taken to accurately represent the ditch. If a rate of fall on the downfall side of **.10 feet** per **100 feet** is not obtained in **300 feet**, the ditch alignment and profile should be extended until the outfall rate of **.10 feet** per **100 feet** is obtained for the total distance the ditch is surveyed).

NOTE: ALL LAKES and STREAMS within 300 feet along the project shall be identified. A field survey traverse for all drainage channels or streams shall be run out to a distance of 300 feet perpendicular on each side of the centerline. Elevations along the stream bed lines shall also be obtained.

NOTE: **If there is mapping for the survey, check the mapping for the above data to prevent duplicating survey information.**

Georgia Department of Transportation

GDOT Publications
Policies & Procedures

Policy: 4465-5- Streamline Traverse Surveys
Section: Surveys
Office/Department: Statewide Location Bureau

Reports To: Office of Design Policy and Support
Contact: 404-699-4401

The following procedures are to be implemented on all location projects:

Streamline Survey Procedures for Flowing Streams

The District Survey Crew (DSC) will, during the course of the survey, perform a stream traverse of all flowing streams crossed by the proposed project.

The stream traverse should extend a minimum of 300 feet on each side of the project centerline and should establish the centerline of stream and profile of the stream bed. The DSC will also establish a benchmark at each flowing stream.

This information is required in order to design the drainage structures.

Questions concerning these requirements are to be directed to the Statewide Location Bureau at 404-699-4401.

References: None.

History:

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added to Manual of Guidance: 09/16/88 added to TOPPS: 05/02/96
Revised: 08/14/13
Created at 9/15/2008 4:35:19 PM by Helene Nickey

Policy: 4465-5 - Streamline Traverse Surveys
Date Last Reviewed: [Date Last Reviewed]

For Reference Only

3.3 USACE 404 Permit Perennial Stream Profiles & Cross Sections

USACE 404 Permit

GDOT Survey Guidelines for Perennial Stream Profile & Cross Sections

Pre Field Survey Meeting

The purpose of the meeting is to discuss and review the USACE 404 Permit requirements and available information.

- An office or field meeting should be scheduled with the project engineer, ecologist and surveyor to discuss stream location, profiles, cross sections and to schedule placement of survey flags to indicate bankfull and cross section locations.
- The Project Engineer should supply the required electronic files (dgn format) of the proposed culvert locations.

Field Survey Meeting

The purpose of the meeting is to discuss and determine the stream profile limits and the locations of required cross sections.

- After completing the field staking of the proposed culverts, a meeting should be scheduled with the project engineer, ecologist and surveyor to discuss placement of the survey flags indicating bankfull and cross section locations based on field conditions.
- Carrying hard copies of the drawings showing the location of the culverts during the field visit is recommended.

Preliminary Field Survey

Utilizing a GDOT approved control package, the surveyor can use established control points for staking the proposed culvert ends and collecting the data to be used in the DTM.

If additional control is required to be set closer to the areas where the culverts are to be constructed, the surveyor should follow the GDOT guidelines set forth in the GDOT Survey Manual for Conventional control and or GPS and Real Time Kinematic System Surveys.

Using an electronic file established by the engineer, the surveyor should begin by staking the placement of the proposed culvert ends as per the approved GDOT construction plan.

Survey Limits for Regional Conditions

For existing and proposed culverts the DTM should cover 100 feet, measured along the stream channel, from the upstream and downstream end of the culvert. A total minimum coverage of 200’ for both proposed and existing culverts is required. (The length of the proposed culverts will be included in the total DTM length).

For Existing Culverts:

- Surveyor picks up a DTM covering the required area 100 feet upstream and downstream from each end of existing culverts. The existing culvert will be shown as a DOBSC and the Limit Line will include each side of roadway stream and DOBSC chain. This will be a continuous DTM. The break lines included in the DTM should be the Limit Line, both Top of Bank, flow line profile (deepest run) of the stream, to include breaks at all elevation changes

in the stream profile, and also both edge of stream chains as well as an Obscure Area line chain taken at the toe of the slope above each end of the culvert.

Top of water elevations should be collected at the beginning and end of the DTM area as well as at each end of the culvert. Within the DTM area two features should be picked up, if they have been flagged by the Ecologist. The Stream Bank Full (**SBF**) location which will be designated by a pink flag or ribbon and a Stream Cross Section point (**SXS**) which will be denoted by a Blue flag or ribbon. Care should be taken to insure that a flow line profile shot is gathered on a 90 degree offset from the Bank Full flag or ribbon and is included in the profile chain.

For Proposed Culverts:

All of the information above will be required for proposed culverts, with the only differences being a SXS shot will be required at the center of the culvert.

Standard File Naming Conventions:

**	File Type	File Name
•	**CSV – Field Survey for Perennial Streams** **1st Culvert Survey CSV** **2nd Culvert Survey CSV** **3rd Culvert Survey CSV, Etc.**	 PI#CA_404 Permit.csv PI#CB_404 Permit.csv PI#CC_404 Permit.csv, Etc.

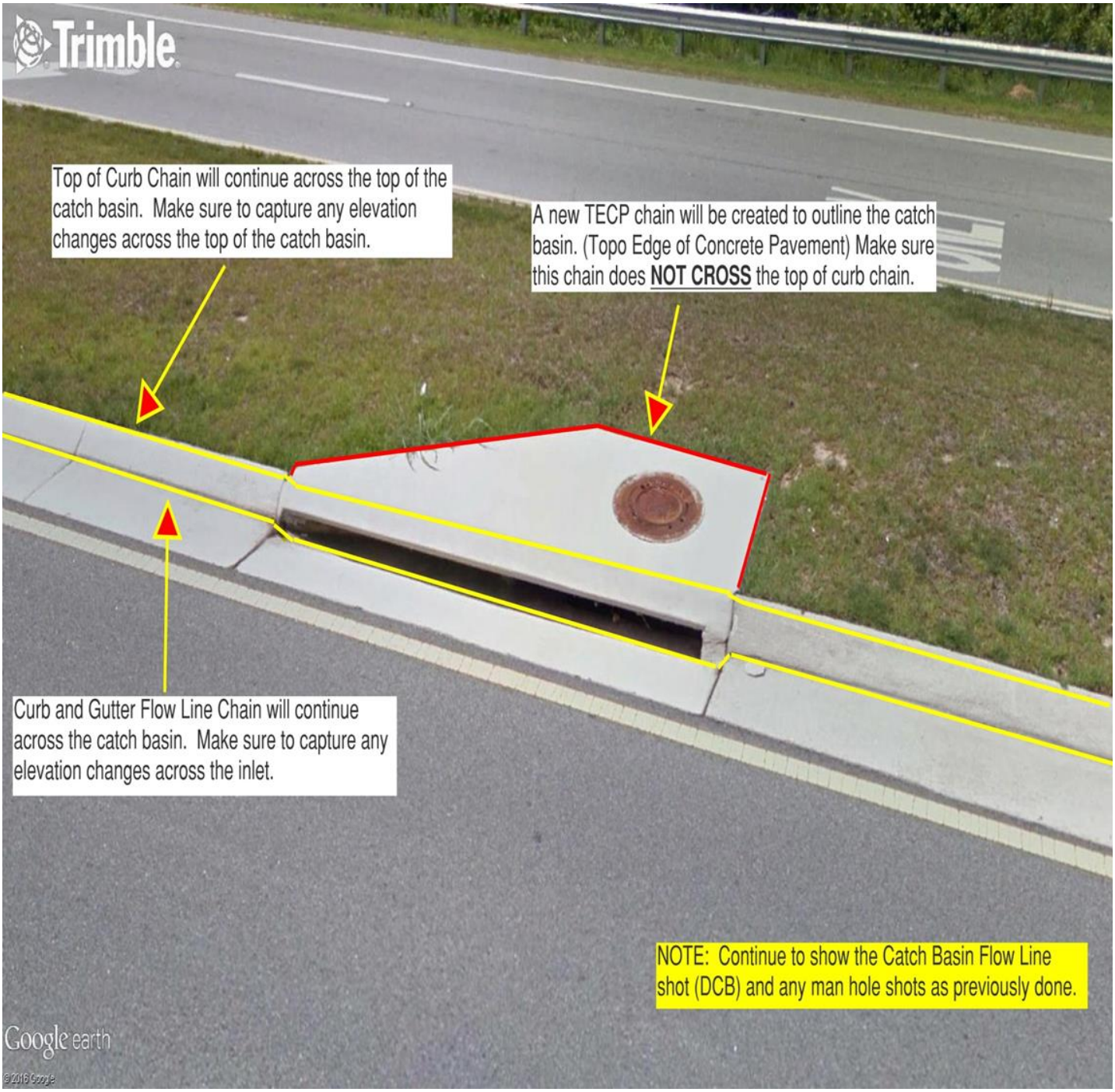
Key to Naming Conventions:

File Name	File Denotation
• **1234567CA_404 Permit**	**1234567= PI Number** **CA = Culvert Location A** **404 Permit = Type of Surface**
• **1234567CB_404 Permit**	**1234567= PI Number** **CB = Culvert Location B** **404 Permit = Type of Surface**

3.4 Catch Basins, Culvert and Pipe Headwalls and Wingwalls

A. Collection of Catch Basins on All Projects

See the illustration below to ensure all Catch Basins are collected properly in the field:



B. Collection of Culvert/Pipe Headwalls and Wingwalls on All Projects

All headwalls and wingwalls will be collected using the following codes:

DHWT (Headwall/Wingwall Top) will be used to collect the top of the wingwalls and headwalls as one solid chain, from one wingwall end and across the headwall to the other wingwall end, ensuring all elevation changes along the chain are captured.

DHWB (Headwall/Wingwall Bottom) will be used to collect the bottom end of a wingwall and carried across the culvert to the end of the other wingwall, ensuring all elevation changes along the chain are captured. (Especially at the invert of the pipe or box)

See the illustration below to ensure all headwalls and wingwalls are collected properly in the field:

3.5 Culvert/Pipe Condition Surveys

The table below outlines the variables for culvert/pipe conditions which are picked up by surveyors in the field. The survey crew's rodman will be responsible for the pipe rating and relaying this information to the instrument man. All cross drains under any public roadways shall be rated within the survey limits. (No driveway pipes required.)

This rating will come after the size of the pipe in the "Description 2" field of the CSV file.

Example:

Point ID	Northing	Easting	Elevation	Code	Description1	Description2
10054	16834.256	232569.704	897.354	DPC1 ST	ATTRNAME	24IN C1F2

An "E" will be placed at the end of the description if erosion is present and should be picked up accurately in the field by using break lines and random shots when applicable.

Example:

Point ID	Northing	Easting	Elevation	Code	Description1	Description2
10096	16834.256	232569.704	897.354	DPM1 ST	ATTRNAME	18IN C1F1E

C = Condition	Description	F = Function	Description
1	Good Condition-Culvert/Pipe with No Damage or Rust	1	Unobstructed Flow-Culvert/Pipe with less than 25% blockage
2	Fair Condition-Culvert/Pipe with Minimal Structural Damage or Rust	2	Slightly obstructed flow-Culvert/Pipe with 25% to 50% blockage
3	Poor Condition-Culvert/Pipe with Major Structural Damage/Rust But still **operable**	3	Obstructed Flow-Culvert/Pipe with 50% and higher blockage
4	Inoperable-Culvert/Pipe with Major Structural Damage/Rust	4	Inoperable-Culvert/Pipe with total Blockage/100%

This chart may be printed out for field crews as a guide in the field.

3.6 MS4 Storm Water System Surveys

Storm water systems are a necessary and major phase in the design of roadway projects. In MS4 counties (see attached map on the next page) designers need more information on the existing drainage system than what is typically requested in non-MS4 counties. Specifically, they need the outfall of the storm drains in MS4 counties. Please refer to the attached map for MS4 county areas.

Please follow the following guidelines for storm drain collection in MS4 counties:

- Collect storm drain inverts, flowlines, structure tops, sizes, etc. as is required on any GDOT survey.
- Collect the drainage to (2) structures past the survey limits unless directed otherwise at the pre-survey meeting.
- The designers will utilize online resources/old plans, Arcadis GIS database, and county GIS database to get the information needed for MS4 design. Once they have exhausted these resources, it may be necessary to field collect more survey data.
- The designer will send a request to SLB, Location Bureau Chief, with specific request and scope of additional drainage survey needed. SLB will coordinate with the district to obtain the data. If any coordinates of the needed drains/info exists, this should be included in the request.
- The district should use all available information from the designers to collect the necessary information. Coordinates, plans, maps, etc…
- If the necessary drainage information cannot be located, contact SLB for use of the Ground Penetrating Radar (GPR) to assist in location.
- Once all field methods have been exhausted, the designer will be contacted and a discussion held on other methods of collection.

Please refer to the following link for a zip file containing a kmz and a dgn of Georgia's MS4 Areas

http://www.dot.ga.gov/PartnerSmart/DesignManuals/NPDES/MS4 Permitted Area Map_TMDL Stream Locator.zip

Chapter 4. Bridge Surveys - Contents

Chapter 4. Bridge Surveys

4.1 Over Flowing Streams

The length of a bridge survey should normally start **1000 feet** before the beginning of the bridge, cover the length of the bridge and extend for **1000 feet** beyond the end of the bridge. If a stream lies beneath the bridge, a stream traverse **500 feet** upstream and **500 feet** downstream, for a total of **1000 feet** is required. If a railroad lies beneath the bridge, a railroad survey for **500 feet** on each side of the bridge is required. If a bridge is over an existing road, a roadway survey for **300 feet** on each side of the bridge is required.

A. Collect the following items for a **BRIDGE SURVEY OVER A STREAM:**

1. **A Property Survey, which covers the roadway alignment and a stream traverse.** Tax maps, property owner's names and addresses, deeds and plats are also required for the Property Survey. The **right-of-way** should always be **verified** by **deeds**.
2. **Alignment of the existing bridge and also the alignment of the roadway for 1000 feet from each end of bridge.** The beginning and ending centerline station should be established on the ground or pavement along with the beginning and ending centerline stations of the bridge and any PC's PT's.
3. **DTM Bridge Surveys.** To define the right-of-way limits and alignment, take a shot in the center of the bridge at the **BFPR, two shots** on each **tangent** of centerline and the **5 point curve** or the **Spline curve** technique for curves in the centerline. (See Section 4-7 for example of requirements) Note: Center of bridge columns should be collected at all bridges. This includes replacement projects and widenings. If a bridge is very large contact SLB @ 404-699-4401 for guidance on bridge column collection.
4. **TOPO.** The topo coverage of the floodplain should extend at least 100 ft. left and right of each centerline for the first and last 500 ft. of survey. For the area from 500 ft. before each bridge to 500 ft. after each bridge, the topo coverage should extend 200 ft. left and right of each centerline. The coverage should extend to an elevation 2 ft. above the flood of record elevation. **For sites where the floodplain is very wide and flat contact the Bridge Hydraulics Group to determine limits of the survey coverage required**. The topo should be detailed enough to define the terrain beneath the bridge to include end rolls, stream banks, stream bed elevations and other breaks in the terrain. (See Pages 4-34, 4-35 and 4-36 for detailed instructions).
5. **Benchmarks.** Three benchmarks are required: One at the beginning of the survey, one at the bridge or stream site near the right-of-way and one at the end of the survey. These **3** benchmarks should be described with a sketch which also shows the X, Y, and Z coordinates. All elevations shall be referenced to mean sea level datum. **Benchmark elevations should be established with an electronic or spirit level. Do not use trigonometric levels!**
6. **Cross Sections or DTM Survey coverage should have the same limits as the Topo limits.** Elevations along the bridge deck centerline and the gutterlines at the intersection with the centerline of each end bent and at each mid-span should be established with a

SPIRIT LEVEL. SEE EXAMPLE ON PAGE 4-3. Adequate plus stations or **DTM** shots should be taken to accurately define the profile of the terrain beneath the bridge, to include endrolls, stream channel banks, stream centerline, scour and any other breaks in the terrain.

7. **Stream Traverse.** The stream traverse should begin **500 feet** upstream from the bridge centerline with station **10+00.00** and then continue downstream to a station **500 feet** below the bridge centerline. Atop of water elevation shall be taken at the **500 feet** upstream, **500 feet** downstream, and at the bridge centerline sites. The topo, profile levels, and cross sections of the stream can be shown either by the plus and offset method or by the **DTM** method. Whichever method is used, sufficient data should be taken to accurately represent the profile of the stream bed. If there are no defined banks but there is running water, the stream should be delineated as accurately as possible utilizing random shots and edge of water points. Guidance from the bridge office may be necessary in these situations.

8. **Floodplain Cross Sections. If the 2 feet above high water mark is not achieved in the topo area of the bridge survey,** two floodplain cross sections are required and should extend to a point **2 feet** above the high water mark that has been established for the stream at the bridge site. The floodplain elevations are to be taken at **100 feet** intervals on natural ground, preferably between **50** and **100 feet** on each side of the roadway. These cross sections should be perpendicular to the stream C/L and continue until 2 ft. above the high water mark has been attained. When floodplain cross sections extend past the Bridge Survey alignment, the floodplain cross sections should be taken at **500 feet** intervals until the **2 feet** above the high water floodplain has been reached. Also if not using the DTM method, five shots or elevations are needed at each station cross section, one at the centerline of the road, one on each edge of the pavement and one on natural ground on each side of the road. Floodplain cross sections may be required for bridges located within **2000 FEET** upstream or downstream of the Bridge Survey. On these bridges the surveyor should always call the Bridge Hydraulic Office to verify the requirement for floodplain cross sections. **For sites where the floodplain is very wide and flat contact the Bridge Hydraulics Group to determine limits of the survey coverage required**. **Note:** Floodplain cross sections will not be needed if DTM coverage provided covers the 2 feet above high water mark elevation requirement. (See Pages 4-35, 4-35 and 4-36 for detailed instructions).

9. **Overflow Bridge's or Culverts within Floodplain.** A distance from the bridge being surveyed to any overflow bridge or culvert that is within its floodplain should be shown along with a bridge sketch, the elevation of the deck or size of the culvert and the flow line elevation.

10. **Structures within 2000 feet up and downstream of project:** Channel hydraulics will not be needed all the way from the project site to the structure. Only the 500' from project up or downstream is required. The required survey data for the additional structures are: Channel hydraulics to 100' each side of structure, the opening of the structure, the deck or top of the structure, and 300' of alignment of the roadway from

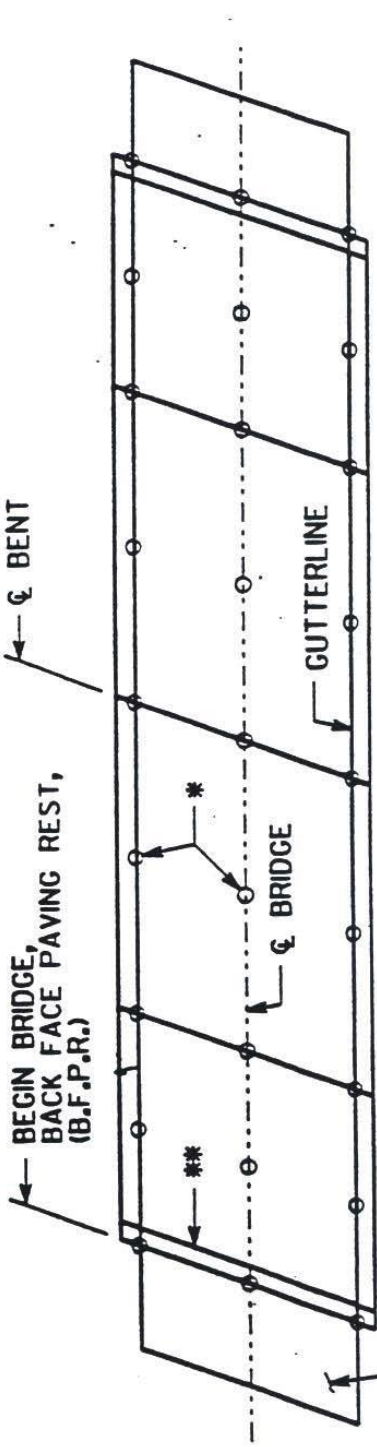
each end of the structure. Flood plain cross sections are also required and will run perpendicular to the stream at 100’ intervals until 2’ above high-water mark is obtained.

11. **Hydraulic Surveys for Culverts:** If a culvert has a span of 20 feet or greater or if there is an existing FEMA study at the location of the culvert, then a full bridge survey will be necessary at the culvert location. This survey should meet the same guidelines as a full bridge survey

EXAMPLE "A" BRIDGE DECK ELEVATIONS

* PROVIDE DECK ELEVATIONS AT B.F.P.R., ℄ BENTS AND AT MIDSPAN ALONG ℄ BRIDGE AND GUTTERLINES.

IF BENTS ARE PARALLEL, PROVIDE SPAN LENGTHS (℄ BENT TO ℄ BENT OR B.F.P.R. TO ℄ BENT) ALONG ℄ BRIDGE. IF BENTS ARE NOT PARALLEL, ALSO PROVIDE SPAN LENGTHS ALONG GUTTERLINES.



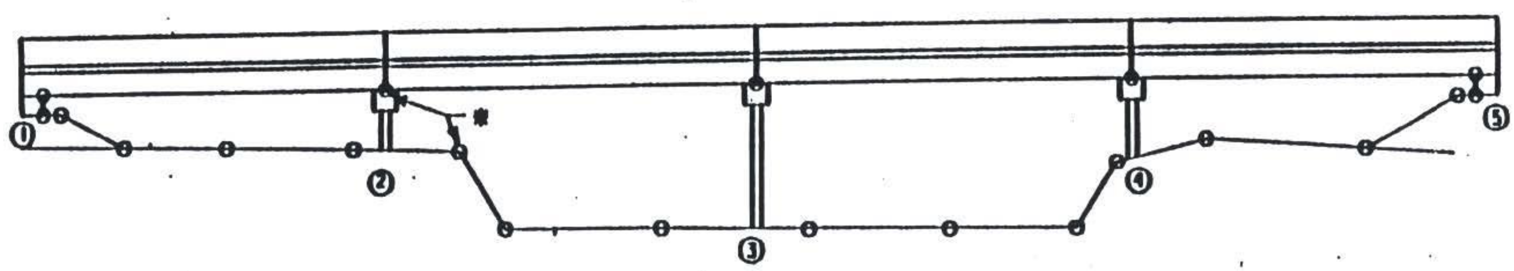
** IF TWO JOINTS APPROXIMATELY 8" - 15 " APART ARE PRESENT AT BRIDGE END, THE ONE ADJACENT TO THE APPROACH SLAB IS THE B.F.P.R.

BRIDGE DATA FOR WIDENINGS
(4 SPAN BRIDGE SHOWN)

For Reference Only

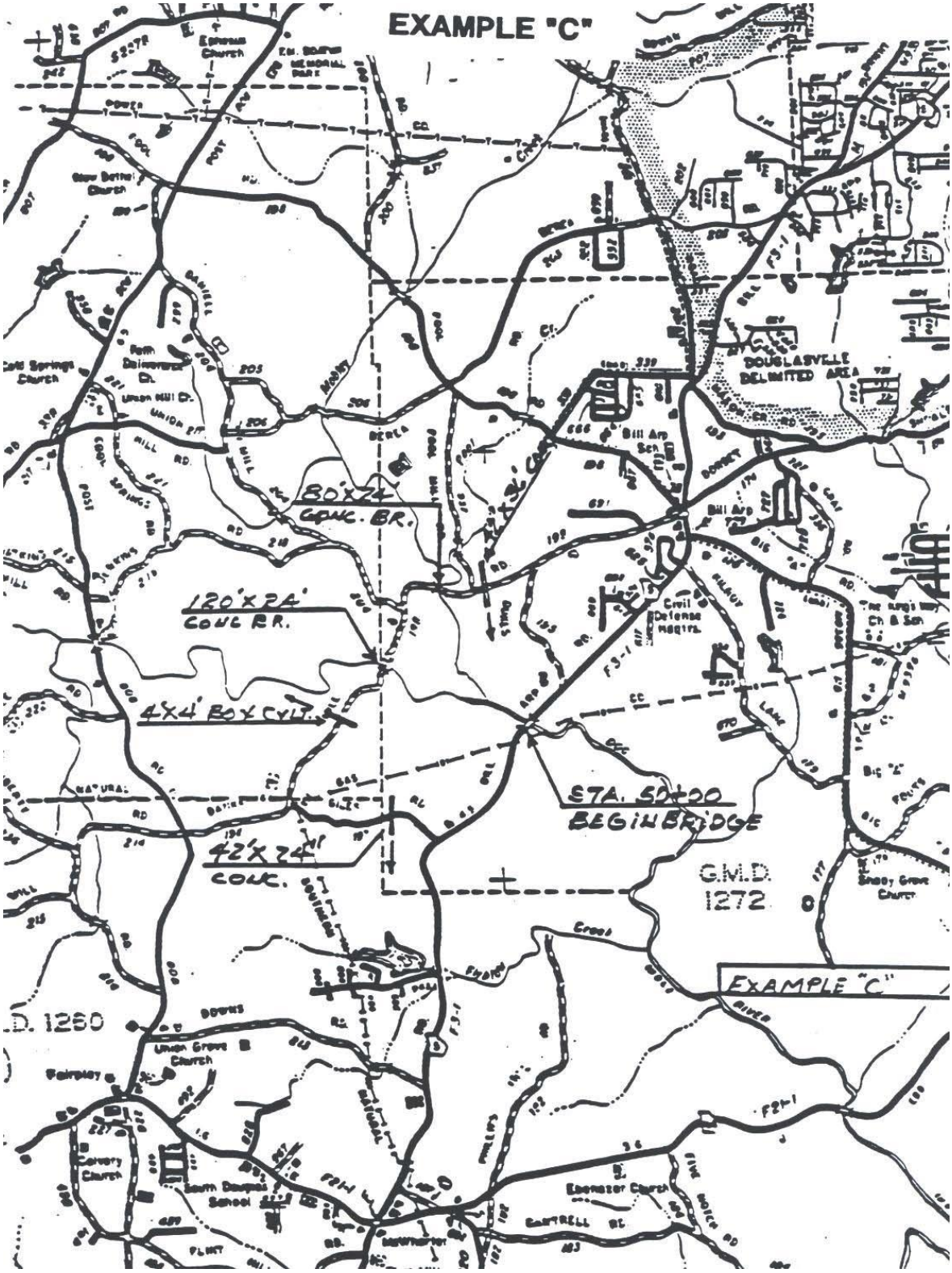
EXAMPLE OF BRIDGE OPENING PROFILE

* PROVIDE STATIONS AND ELEVATIONS OF BRIDGE OPENING AS REQUIRED BY ITEMS C2 AND C3 UNDER REQUIRED EXISTING BRIDGE DATA SECTION.



TYPICAL SECTION-PROFILE OF BRIDGE OPENING

For Reference Only



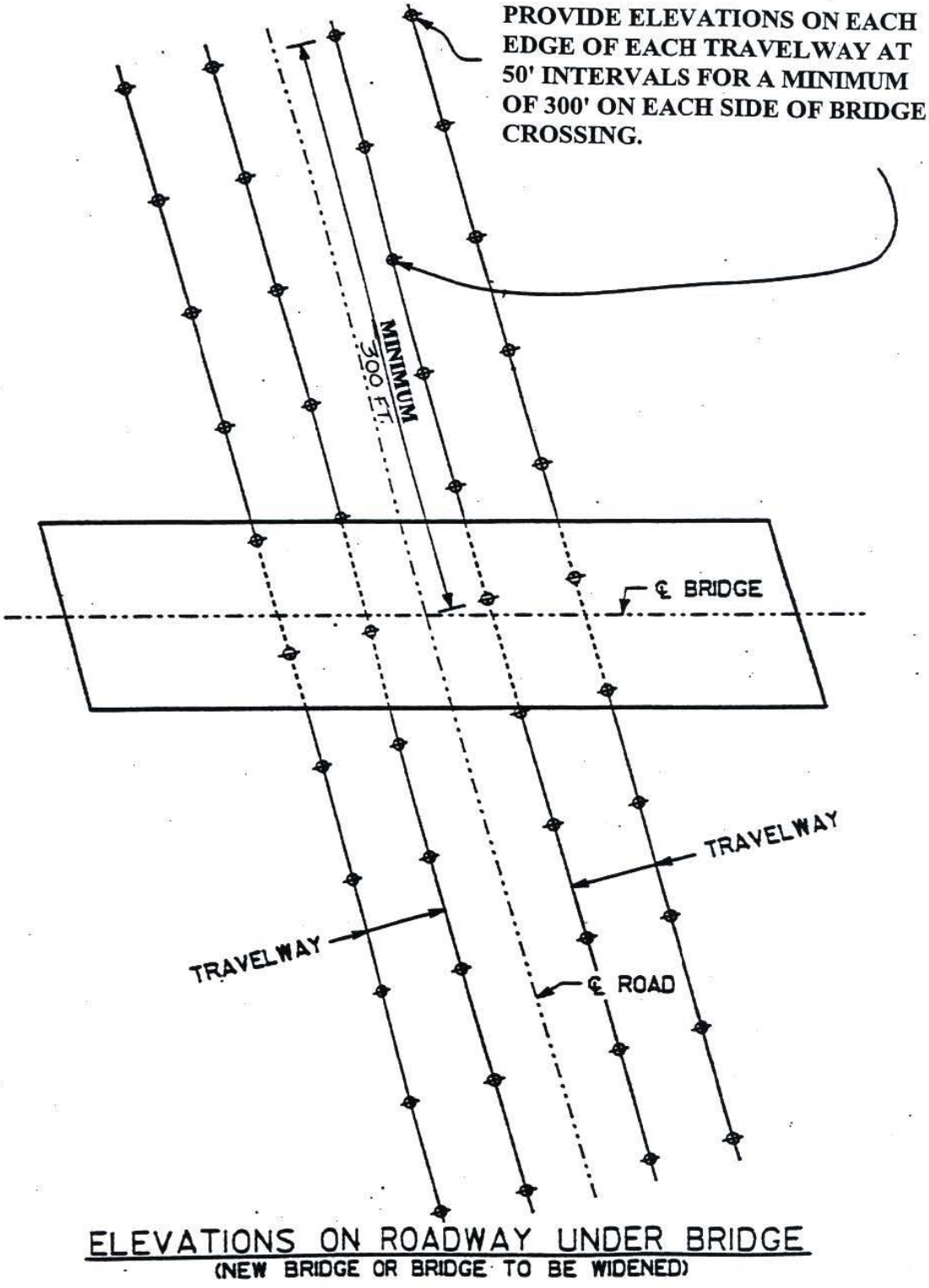
For Reference Only

4.2 Over Existing Road

A. **BRIDGE SURVEY OVER AN EXISTING ROAD**.

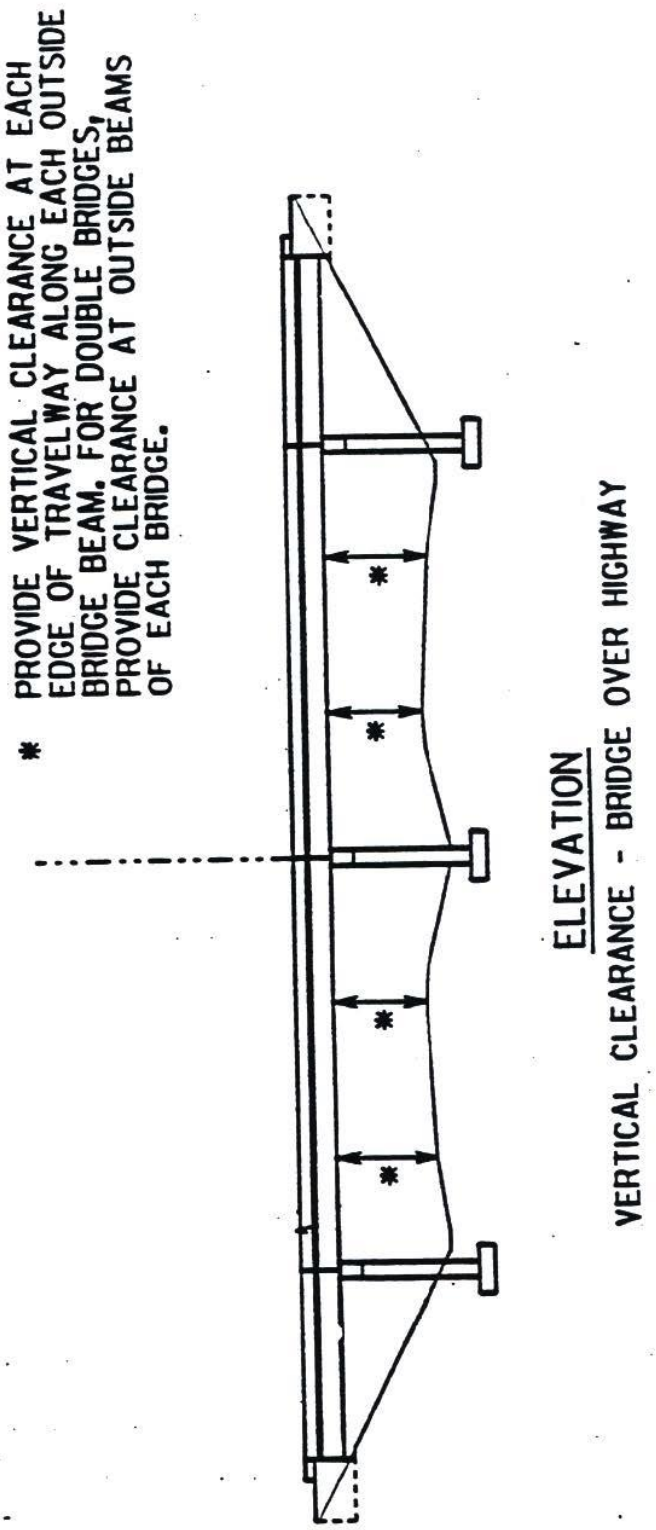
1. **Property Surveys** (Same as A-1; Chapter 4).
2. **Alignment of Existing Bridge and Roadway** (Same as A-2; Chapter 4).
3. **Topo** (Same as A-3 and A-4; Section 4.1). (Also see 4-7)
4. **Benchmarks** (Same as A-5; Chapter 4).
5. **Profile and Cross Sections or DTM coverage should have the same limits as the Topo limits. SEE EXAMPLE ON PAGE 4-3 for the location of needed elevation on bridge deck**.
6. **Roadway Beneath Bridge** (The road beneath a bridge for **300 feet** left and right of the bridge requires a complete survey which includes: **Alignment, property, topo, profile levels and cross sections or DTM survey data.** (See section 4.1A).

EXAMPLE — ROADWAY BENEATH BRIDGE



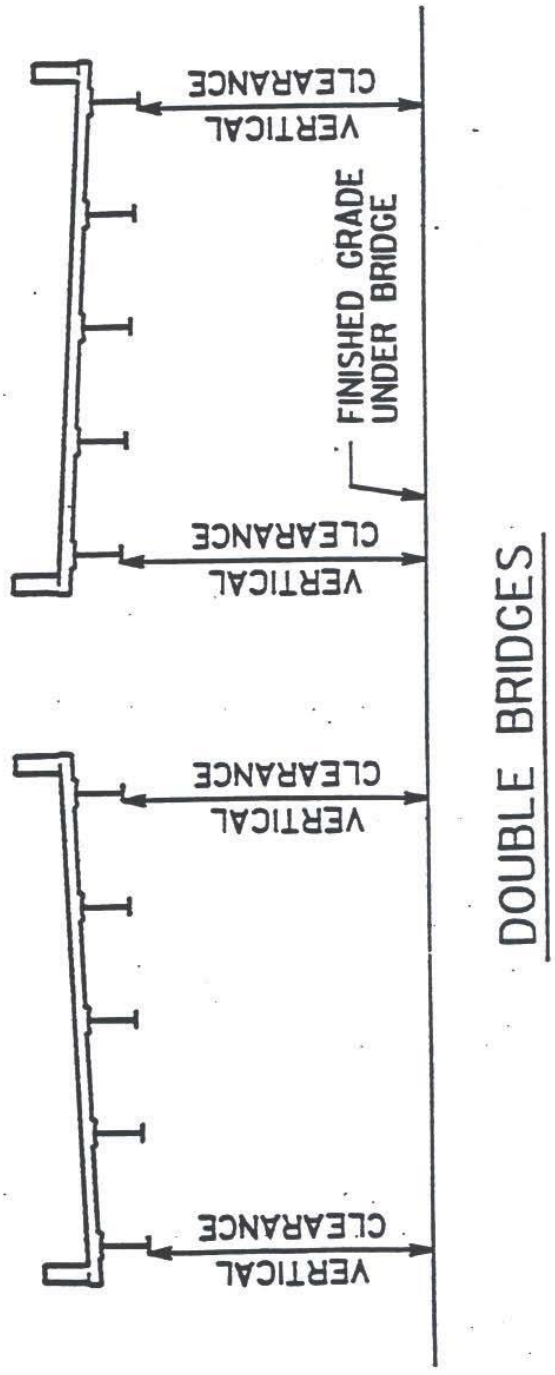
For Reference Only

EXAMPLE OF
BRIDGE OVER HIGHWAY



For Reference Only

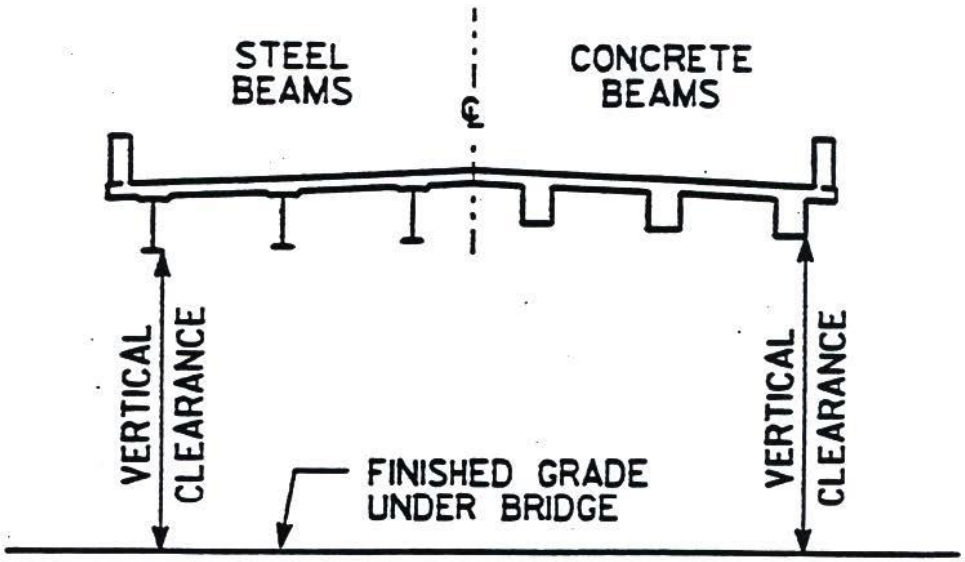
EXAMPLE OF
DOUBLE BRIDGES OVER HIGHWAY



For Reference Only

EXAMPLE OF

BRIDGE OVER HIGHWAY



SINGLE BRIDGE

For Reference Only

4.3 Over Railroads

A. **BRIDGE SURVEY OVER AN EXISTING RAILROAD:**

1. **It is required to obtain a Right of Entry from the Railroad before entering into the Railroad's property to perform survey, bridge staking or other tasks instead of sending them a survey letter**.
2. **Property Surveys** (Same as A-1; Chapter 4).
3. **Alignment of Existing Bridge and Roadway** (Same as A-2; Chapter 4).
4. **Topo** (Same as A-3 and A-4; Section 4.1). (Also see 4-7)
5. **Benchmarks** (Same as A-5; Chapter 4).
6. **Profile and Cross Sections or DTM coverage should have the same limits as the Topo limits. SEE EXAMPLE ON PAGE 4-3 for the location of needed elevation on bridge deck**.
7. **Bridge over a Rail Road**. The railroad beneath the bridge for **500 feet** left and right of the bridge requires a complete survey, which includes:
8. **Alignment**. The alignment of the centerline on the main railroad tracks for **500 feet** left and right of the bridge shall be surveyed. The intersection of the bridge alignment and the railroad alignment shall be tied to a railroad mile post.
9. **Property**. (Same as A-1; Chapter 4).
10. **Topo**. The topo coverage limit shall be **100 feet** left and right on each side of the track. If the location has multiple tracks, coverage should be **100 feet** beyond the centerline of the outer most track. The location of the existing bridge pilings should be located from the railroad survey centerline.
11. **Profile Levels and Cross Sections or DTM Survey Data**. The profile and cross sections or **DTM** survey data shall be taken a minimum of **100 feet** each side of track. If the location has multiple tracks, coverage shall extend for **100 feet** beyond the centerline of the outer most track. Elevations are to be taken on the top of each rail. If collecting elevations in the cross section format, minimum of (**5**) cross sections shall be taken between the proposed right-of-way limits. One at the proposed right-of-way, one half-way between the proposed right-of-way and the bridge centerline, one at the bridge centerline and the same for the other side of the bridge. These cross sections will be taken perpendicular to the railroad track centerline and extend for **100 feet** beyond the centerline of the outer most track.
12. **Drainage**. All drainage structures and features within the **1000 feet** Railroad Survey shall be provided.
13. **Warning Device Structures**. All warning device structures should be located in DTM survey data.
14. **Milepost Direction**. Show direction mileposts are running by locating 2 mileposts or go to website at link below to determine direction.

Any questions should be directed to Railroad Liaison Engineer @ the Office of Utilities.

Link to locate Railroad Mileposts:

http://fragis.fra.dot.gov/GISFRASafety/

B. Railroad Update / Verification Survey:

Issues with top of rail elevations have presented themselves during construction. Specifically, the railroad performed maintenance on the rails after the initial survey. This resulted in elevation errors during construction.

Therefore it is now necessary to collect updated rail elevations at the intervals outlined below for the following project types:

- Roadway Bridge over Railroad
- Railroad bridge over Roadway

Timing:

- After Database approval, the top of rail elevations should be collected every 3 years.
- If FFPR is less than 3 years from the database approval date, then the new data should be collected and incorporated in the database 3 months prior to FFPR.

Note:

The new rail data should be collected conventionally utilizing the published project control.

This additional data should be ***collected by the consultant assuming the task order and contract have not expired***. Contact the SLB Location Bureau Chief to schedule in-house resources for the collection on in-house projects or consultant projects with expired task orders. Typical time frame is 2 months for R/R coordination/flagging, and 2 days for field collection/processing.

It is required to obtain a Right of Entry from the Railroad before entering into the Railroad's property to perform survey, bridge staking or other tasks instead of sending them a survey letter

Examples of Inventory Numbers

Examples of Inventory Numbers

4.4 Bridge Stakeout

A. Bridge Stakeout

All bridge sites are to be staked out and inspected by representatives of the District Preconstruction Engineer. The approved preliminary layout is sent from the Office of Bridge and Structures to the Project Manager with a request that the bridge be staked out and inspected. The Project Manager then routes the ***stake out request*** either to a prime consultant under contract to perform the work or to the State Location Bureau Chief (**slbsurveyrequests@dot.ga.gov**) for in-house assignment.

Bridge stakeout is needed to verify the bridge design fits the site. The PM should provide the approved preliminary bridge layout, alignment, and survey control package. All stakeouts should be performed using primary control from the GDOT approved survey control package. If secondary control is needed, it should be established per section 1.2 C in the survey manual. Survey control should be verified before beginning any stakeout work. The surveyor should follow the three steps below for stake-out:

1. Establish the bridge center line. Sometimes this center line differs from the line used to construct the roadway. Study the plans carefully to determine the correct line. This is not always plainly marked, and it is easy to overlook some variation in the alignment. Resolve any problems before setting stakes. Run the center line (make sure it closes within the site location) and all other controls that are pertinent to the structure.

   End Roll formula:

   HI – Berm Elevation = Grade Rod

   Take reading on natural ground @ gutter line = Ground Rod

   (Ground Rod- Grade Rod) x 2 (for the 2:1 slope) + 5 (for the cap and 2’ berm)

   The formula solution is the horizontal distance, measured from the top of berm, to the intersect point, where the toe of slope meets natural ground.

2. Stake the bridge bents and end rolls. The bridge bents should be staked at the center line of the bent at the bridge gutter line. Stakes should be placed and marked with station and offset, bent number and left or right designations in relation to the centerline and stationing. ***For stream crossings***, the toes of the end rolls and any intermediate bents near or in the stream should be staked. If the stream runs along the embankment or has a sharp bend, stake out the side slopes in that area as well. Clearances from the top of the bank to the toe of the end rolls and to the intermediate bents, as well as the clearances from the side slopes to the top of creek bank should be checked, and the distances reported.

   For grade separations, the toes of the end rolls and intermediate bents adjacent to roads or railroads should be staked. ***Minimum horizontal clearances from the road or railroad to the bent should be verified and reported*** as well as the location of the toe of the end roll.

   Once staking is completed, the surveyor should stand back and “eyeball” the layout to ensure all staking appears correct on the ground.

3. The surveyor will create a ***Bridge Stakeout Report*** outlining the distances and minimum clearances to top of creek bank, nearest rail, edge of roadway, or other critical objects. The report should be on the GDOT interoffice memo template and contain all critical and necessary measurements as stated in section two above. It should then be sent to the District Preconstruction Engineer or designated employee for use during the field site inspection. The report should be copied to the Statewide Location Bureau Chief stating the staking is complete. The Location Bureau will file it in the proper PWISE folder. An example report is below.

GDOT Georgia Department of Transportation

Interoffice Memo

FILE: P.I. 0017176, Decatur County
CR 123 (Attapulgus – Climax RD.) Over Callahan Branch

DATE: July 15, 2020

FROM: Ralph S. Griffin, District Design Engineer

TO: Bill Duvall, P.E. State Bridge Engineer
Attn: Susan T. Beck, Bridge Design Group Leader-Hydraulics

SUBJECT: Bridge Site Inspection- LIBP- CR 123 (Attipulgus -Climax Rd.) Over Callahan Branch

A site Inspection was performed on the proposed bridge location on July 15, 2020

The Endroll at Bent No. 1 LT is located 15.0 feet from the top-of-bank and the Endroll at Bent No. 1 RT is located 23.0 feet from the top-of-bank.

The Endroll at Bent No. 4 LT is located 43.0 feet from the top-of-bank and the Endroll at Bent No. 4 RT is located 40.0 feet from the top-of-bank.

Bent No. 2 LT is located 2.0 feet from top-of-bank away from the channel and Bent No. 2 RT is located 9.0 feet from the top-of-bank away from the channel.

Bent No. 3 LT is located 23.0 feet from the top-of-bank away from the channel and Bent No. 3 RT is located 20.0 feet from top-of-bank away from the channel.

If you have any questions, please contact Sandy Griffin at (229) 391-5460.

RSG:sg

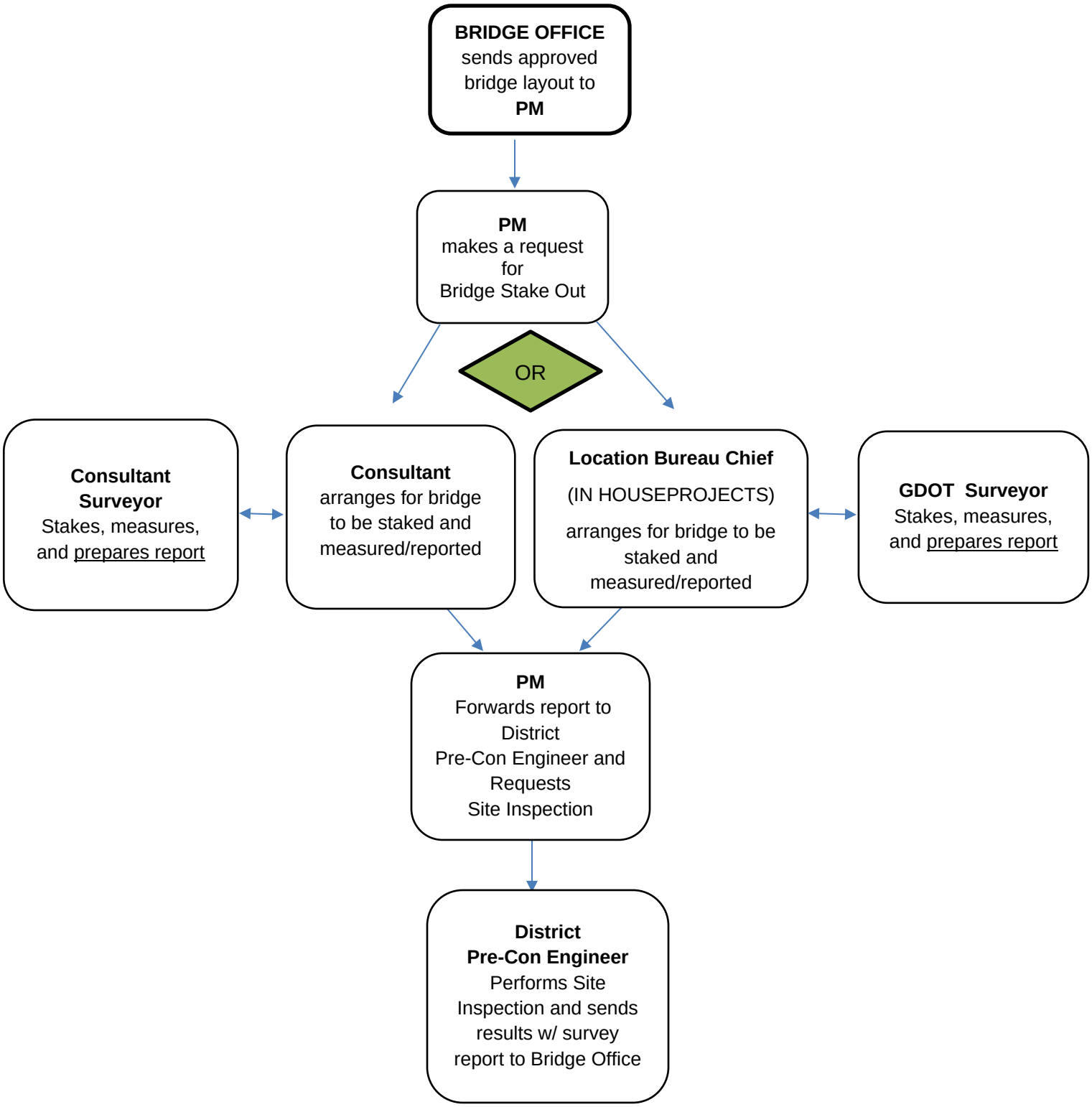
CC
Jason Willingham, District Preconstruction Engineer
Amit Poshiya, Project Manager

B. Bridge Design Field Site Inspection

All bridge sites are to be staked out and inspected by representatives of the District Preconstruction Engineer. ***The inspection must be performed by in-house personnel even if it was consultant survey***. The approved preliminary layout is sent from the Office of Bridge and Structures to the Project Manager with a request that the bridge be staked out and inspected. Once the District Preconstruction Engineer receives the ***Bridge stakeout Report*** from the surveyor, they should inspect the site to verify staking/measurements and consider any potential conflicts between the proposed structure and the site. The bridge site inspection requires that the following be addressed and reported to the District Preconstruction Engineer.

1. Using the bridge stakeout survey report, check clearances across streams, highways, or other obstructions. Always double check all clearances to all existing or proposed structure features to ensure constructability. Errors in locating the footing might necessitate extensive revision in the design of the structure or removal of the incorrectly located foundation. After viewing all stakes, obstructions, and any other features, stand back and “eyeball” the entire layout, if possible, to determine if it looks correct. This is a very important step in determining constructability.
2. Results from the site inspection should be sent to the Office of Bridge Design in the form of a letter from the District Preconstruction Engineer. This letter should report the distances requested above and should also state whether the proposed bridge fits the site. **Survey information should be provided by including a copy of the Bridge Staking Field Report**.

Bridge Staking and Inspection Workflow



4.5 Hydraulic Surveys

A. HYDRAULIC SURVEYS

A Hydraulic Field Report should be submitted in all bridge surveys over streams. Drainage areas for this report will be calculated by the Designer. It is not the responsibility of the surveyor to determine these areas. All other data requested on this report is to be completed by the surveyor. It is preferred that the extreme high and low water information be obtained from a long time resident in the area if possible. If none can be found, record plans or high-water mark on the bridge piling or tree can be used to determine high-water elevation. Provide location and floor elevation of any homes or buildings in the floodplain that have ever been flooded. This information should be plotted on a quadrangle map or county map showing centerline plus and offset.

An example of the **HYDRAULIC FIELD REPORT** is illustrated on the following pages. This form may be updated by the Bridge Department from time to time and the correct and most current version can be obtained from the Department's web site at http://mydocs.dot.ga.gov/info/gdotpubs/Publications/4170-5f.pdf.

There has been issues with consultant submitted Hydraulic Field reports. Data is missing on the reports and needs to be filled out in full by the Survey Party Chief onsite. In the past the Hydraulic Engineers have been completing this form. GDOT feels the Survey party Chief is best for this task, as the report asks for direct information relating to, elevations, terrain features, bridge material/features, House floor elevations, etc.… This data is derived from the survey data and visual inspections onsite. **For future submittals, ensure The Survey Party Chief or equivalent crew member completes this form for submittal.**

HYDRAULIC ENGINEERING FIELD REPORT

I. HYDRAULIC AND HYDROLOGICAL DATA REQUIRED FOR ALL EXISTING OR PROPOSED BRIDGE STREAM CROSSING PROJECTS

A. Project Location

Project No.: _____ County: _____ District: ____

P.I. No.: _____ Stream Name: _____ Route: _____

Surveyed By: _____ Date: _____

B. Site Information

Floodplain and Stream Channel description:

1. Flat, rolling, mountainous, etc.: _____
2. Wooded, heavily vegetated, pasture, swampy, etc.: _____
3. Stream channel description: well-defined banks, meandering, debris, etc.

_____

_____

4. Is there any fill in the upstream or downstream floodplain, which will affect the natural drainage or limit the floodplain width at this site?

_____

_____

C. Required Existing Bridge Information at Project Site

1. Bridge Identification No.: _____
2. Date Built: _____
3. Skew angle of bridge bents: _____
4. Height of curb, parapet or barrier: _____

Substructure Information:

1. Column type (concrete, steel, etc.): _____
2. Size of columns: _____
3. Number of columns per bent: _____
4. Guide Bank (Spur Dike) length, elevation and location (if applicable):

_____

_____

5. Note any scour problems at intermediate bents or abutments:

_____

_____

Note: The above information is required for all bridges within the floodplain (main and overflow bridges) along the roadway. In addition, the location, size and number of barrels are required for all box culverts located within the floodplain.

D. Normal Water Surface Data

	WS ELEV
500 feet upstream of survey centerline:	_____
At the survey centerline:	_____
500 feet downstream of survey centerline:	_____
Normal high tide:	_____
Normal low tide:	_____

E. Historical Flood Data

1. Extreme high water elevation at site: _____ Date: _____
2. Highest observed tide elevation: _____ Date: _____
3. Location of extreme high water elevation (upstream/downstream face of bridge at the centerline or station and offset if not at bridge):

_____

4. Source of high water information: _____

_____

5. Location and floor elevation of any houses/buildings/structures that have been flooded:

_____

_____

6. Information about flood (number of times structure has been flooded, water surface elevations and date(s) of flood):

_____

_____

7. Location and floor elevation of any houses/buildings/structures that have floor elevations within 2 feet of the extreme high water elevation:

_____

_____

F. Benchmark Information

Location 1:

1. Benchmark Name: _____ Elevation: _____
2. Location *(project stations/offset)*: _____
   Northing: _____ Easting: _____
3. Physical description: _____

Location 2:

1. Benchmark Name: _____ Elevation: _____
2. Location *(project stations/offset)*: _____
   Northing: _____ Easting: _____
3. Physical description: _____

Location 3:

1. Benchmark Name: _____ Elevation: _____
2. Location *(project stations/offset)*: _____
   Northing: _____ Easting: _____
3. Physical description: _____

G. Upstream and Downstream Structures

Structure 1

1. Structure Type (railroad/highway bridge, culvert): _____
2. Route Number (if applicable): _____
3. Distance from proposed structure along stream centerline: _____
4. Length of bridge or culvert size: _____
5. Superstructure (slab thickness, beam depth): _____
6. Substructure information: _____
7. Column Type (concrete, steel, etc.): _____
8. Size of Column: _____

9. Number of Columns per bent: _____

Structure 2

1. Structure Type (railroad/highway bridge, culvert): _____
2. Route Number (if applicable): _____
3. Distance from proposed structure along stream centerline: _____
4. Length of bridge or culvert size: _____
5. Superstructure (slab thickness, beam depth): _____
6. Substructure information: _____
7. Column Type (concrete, steel, etc.): _____
8. Size of Column: _____
9. Number of Columns per bent: _____

Structure 3

1. Structure Type (railroad/highway bridge, culvert): _____
2. Route Number (if applicable): _____
3. Distance from proposed structure along stream centerline: _____
4. Length of bridge or culvert size: _____
5. Superstructure (slab thickness, beam depth): _____
6. Substructure information: _____
7. Column Type (concrete, steel, etc.): _____
8. Size of Column: _____
9. Number of Columns per bent: _____

NOTE: The above information is required for all bridges or culverts, which lie within 2000 feet upstream and downstream from the project bridge, unless otherwise directed by the Office of Bridge Hydraulics.

H. Miscellaneous Information

1. Are there water surfaces affected by other factors (high water from other streams, reservoirs, etc.):

   _____

   _____

2. Give location (horizontal distance to dam or spill way along stream centerline), length, width and elevation of dam and spillway, if applicable:

   _____

   _____

II. REQUIRED SURVEY INFORMATION REQUIRED FOR ALL EXISTING OR PROPOSED BRIDGE STREAM CROSSING PROJECTS

Note: It is preferred that the hydraulic survey data be taken in DTM format. The coverage shall be detailed enough to cover all required areas specified in this field report. These survey points should be included in the InRoads/CAiCE file that is provided to the bridge hydraulics office. All survey points should be labeled consistently and clearly identified. Sketches and/or plots can be used to clarify the survey data, but are not required. ALL SURVEY DATA SHALL BE REFERENCED TO NAVD88.

Topo coverage shall be taken at least 100 feet to the left and right of the centerline, except for the area 500 feet before the beginning of the existing bridge to 500 feet beyond the end of the bridge. The coverage in this area should be a minimum of 200 feet left and right of the centerline of the existing road and/or construction/survey centerline. This topo coverage shall extend to an elevation 2 feet above the flood of record elevation on each end of the floodplain. The above coverage limits shall apply to both the existing centerline and proposed centerline, if different.

The topo shall be detailed enough to accurately define the profile of the terrain beneath the bridge, to include endrolls, stream channel banks, streambed elevations and any other breaks in the terrain.

Bridge deck and bottom of beam shots shall be included for all bridges within the floodplain. Invert elevations and locations shall be provided for all box culverts within the floodplain.

A. **Benchmarks**

Three benchmarks are required: one at the beginning of the survey, one at the bridge or stream site and one at the end of the survey. Location referenced to the project stations, elevation, northing, easting and a complete physical description are required for each benchmark. Benchmarks shall be coded as 245(CAiCE) or SBNCHMK(Inroads).

B. **Stream Traverses**

A stream traverse extending 500 feet upstream and downstream of the proposed bridge site. Cross sections of the stream channel are required underneath the existing bridge and at the centerline of the proposed bridge site, if different. Cross sections of the stream channel are required at 50 feet and 100 feet upstream and downstream of the proposed bridge centerline. Additional cross sections are required at 100 foot intervals along this traverse. These cross sections should include top of stream bank, edge of water and streambed shots. A sufficient number of streambed shots shall be taken to insure an accurate stream channel cross section. Traverses and stream cross sections shall be provided for all stream channels in the floodplain. As stated above, the DTM method is preferred, as long as it is detailed enough to accurately define the location and cross section profile of the stream channel 500 feet upstream and downstream of the proposed bridge site.

C. **Floodplain Survey Data**

Note: The required floodplain coverage shall be extended on both sides of the stream channel until an elevation is reached that is a minimum of 2.0 feet above the Flood of Record Elevation. (See Chapter 4.1.8) The top of stream banks and channel cross section shall be

included. A sufficient number of streambed shots shall be taken to insure an accurate stream channel cross section. The floodplain coverage shall include shots where there is a significant change in elevation.

1. Floodplain cross coverage shall be taken at least 100 feet to the left and right of the centerline, except for the area 500 feet before the beginning of the existing bridge to 500 feet beyond the end of the bridge. The coverage in this area should be a minimum of 200 feet left and right of the centerline of the existing road and/or construction/survey centerline. This coverage shall extend to an elevation 2 feet above the flood of record elevation on each end of the floodplain. The coverage limits shall apply to both the existing centerline and proposed centerline, if different. **This data is also required for bridge and roadway sites located along the stream that are no further than 2000 feet upstream and/or downstream of the project site**.
2. Parallel bridge projects and/or projects with the proposed alignment shifted a relatively small distance require a floodplain coverage be taken along the new and/or parallel alignment.
3. New location projects require that a floodplain cross section be taken along the new alignment.

D. **Existing Roadway Data**

Note: This data is also required for roadway and railroad embankments located along the stream and within the floodplain that are no further than 2000 feet upstream and/or downstream of the project site.

1. A profile along the existing roadway extending the full width of the floodplain. This profile shall include shots along the centerline and top outside edges of the roadway embankment. For roads built on a constant cross slope, only the top outside edge of roadway shots are required.
2. Profiles are required of all intersecting roads that are located within the limits of the floodplain. These profiles shall extend 500 feet upstream and/or downstream of the intersection with the project road.
3. Shots along the toe of roadway embankment are required within the limits of the floodplain.

E. **Existing Bridge Data (See Chapter 4-7 for example)**

Note: This data shall be provided for all bridges located within the floodplain. Culvert location, invert elevations, and the size and number of barrels shall be provided for all culverts located within the floodplain.

This data is also required for bridges located along the stream and within the floodplain that are no further than 2000 feet upstream and/or downstream of the project site.

For bridge widening projects where the existing bridge plans are not available, a more detailed survey that gives a complete description of the superstructure and substructure will be required. This includes the center of all bridge columns.

1. For bridge replacement and paralleling projects, top of deck shots at the beginning and end of bridge at the intersection of the Back Face Paving Rest (BFPR) with the centerline, gutterlines and bridge corners are required. If the bridge is built on a constant cross slope/superelevation, only the gutterline and bridge corner shots are required.
2. For bridge widening projects, in addition to the beginning and ending of bridge deck shots, top of deck shots are also required at the centerline of bents and at midspans along the centerline of the bridge, gutterlines and bridge corners. If the bridge is built on a constant cross slope/superelevation, only the gutterline shots are required.
3. Bottom of beam shots for the outside beams at each bent are required.
4. A profile of the groundline and endrolls under the bridge. Shots along the toe of endrolls are required. A stream cross section shall be included. All points shall be clearly labeled.

B. **Normal Water Surface Data**

1. Water surface elevations are required at the survey centerline and at 500 feet upstream and downstream of the survey centerline. These shots shall be taken in the same time period.
2. For tidal sites the normal high and low tide elevations are required.

C. **Historical Flood Data**

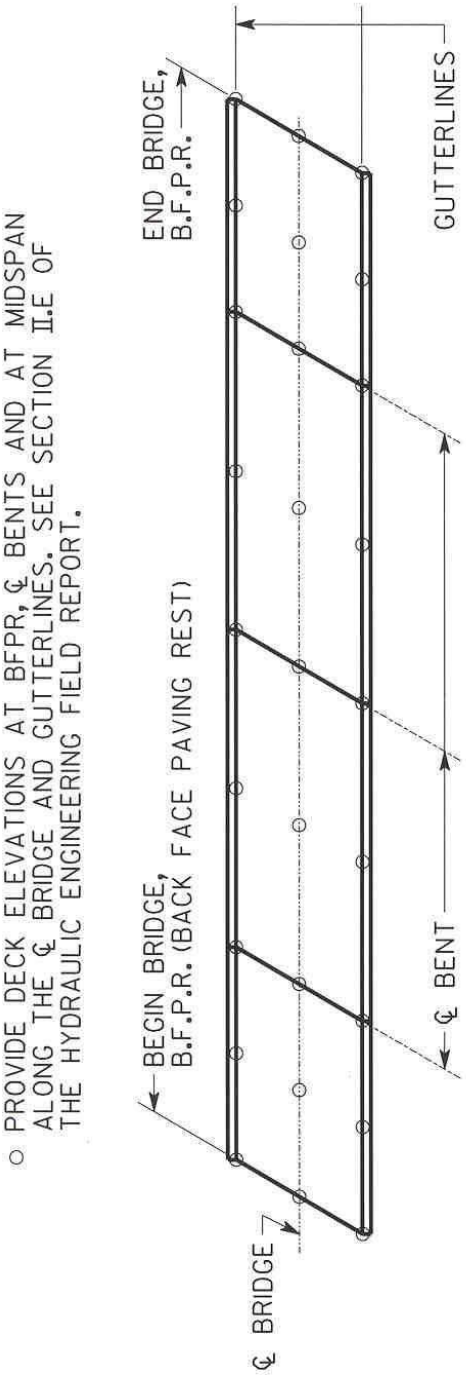
Note: The highwater elevations should be obtained from longtime local residents and/or city/county officials.

1. The extreme highwater elevation (flood of record) shall be obtained along with the date of occurrence, location (upstream or downstream face of the bridge at the centerline or station and offset if not at bridge), and the source for this information. If the site is tidal, then the highest observed tide elevation is needed.
2. The floor elevations and locations of any houses, buildings or any other structures that have been flooded, or have floor elevations within 2 feet of the flood of record. For buildings/structures that have been flooded, the information about the flood shall be provided. This information includes the number of times the structure has been flooded, the date(s), and the highwater elevations.

D. **Miscellaneous Survey Data**

1. **Dams and Spillways.** For sites affected by an upstream or downstream dam, survey shots are required that describe the location, length, width and elevation of the dam embankment and spillway opening. If possible, provide distance along stream centerline to dam. The water surface elevation of the impounded water shall be provided.
2. **Guide Banks (Spur Dikes).** Shots shall be taken that will reflect the location, length and elevation of the guide bank.
3. **Longitudinal Roadway Encroachments on Floodplains.** Additional floodplain cross sections will be required to determine the effects of the longitudinal encroachment. **The surveyor can contact the Office of Bridge Hydraulics for guidance on the extent of additional survey data that will be required**.

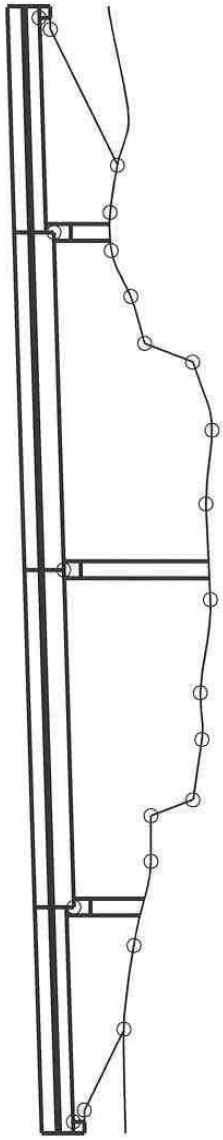
4. If the hydraulics at the project site is affected by other factors such as confluence with other streams, narrow floodplain cross sections, and/or roadway, railroad, bridge crossings, etc., additional floodplain cross sections may be required. The surveyor should contact the Office of Bridge Hydraulics if any of the above-mentioned conditions are present at the site, in order for the hydraulic engineer to determine whether additional information is required.
5. For detailed instructions for required DTM coverage of bridges please see pages 4-34, 4-35 and 4-36.



REQUIRED BRIDGE DECK ELEVATIONS

FIGURE I

For Reference Only



○ REQUIRED BRIDGE OPENING SHOTS. SEE SECTION II.E OF THE HYDRAULIC ENGINEERING FIELD REPORT.

A SUFFICIENT NUMBER OF STREAMBED SHOTS SHALL BE TAKEN TO INSURE AN ACCURATE STREAM CHANNEL CROSS SECTION.

TYPICAL SECTION - PROFILE OF BRIDGE OPENING

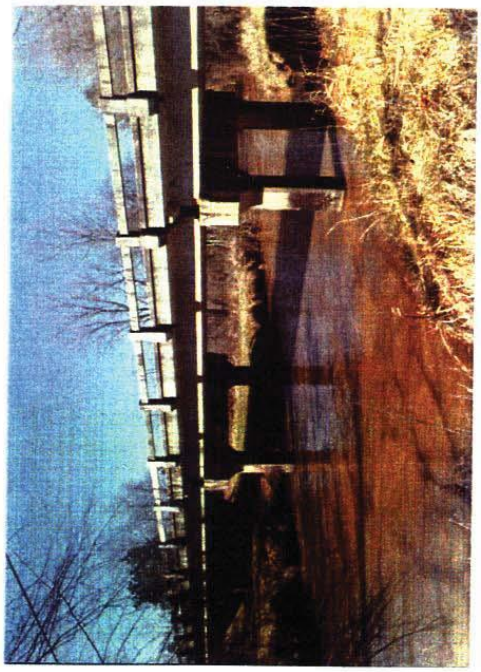
FIGURE 2

For Reference Only

BRIDGE BENT TYPES

CONCRETE BENTS W/WEB WALL

SPECIAL DESIGN

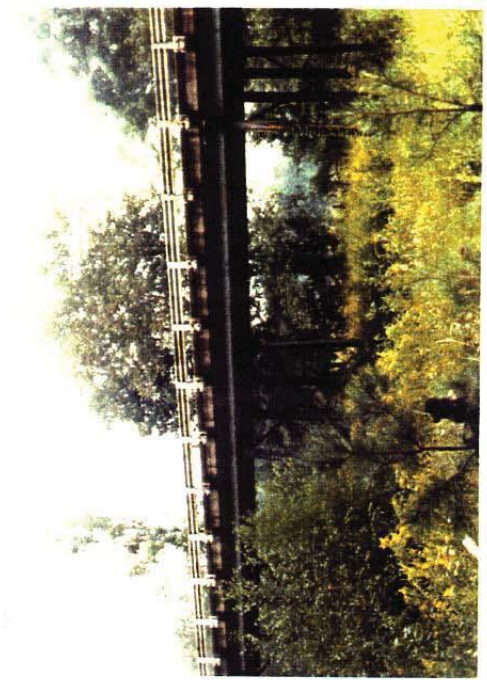


CONCRETE BENTS

VERTICAL ABUTMENT

For Reference Only

BRIDGE BENT TYPES



STEEL "H" PILING

PRESTRESSED CONCRETE PILE

TIMBER PILING

METAL SHELL PILING

For Reference Only

Georgia Department of Transportation

GDOT Publications
Policies & Procedures

Policy: 4120-1- Minimum Survey Data for Bridge Projects
Section: Bridge Surveys
Office/Department: Office of Bridge Design
Reports To: Division of Engineering
Contact: 404-631-1000

I. Survey Elevation Datum

If a site is in a FEMA mapped area or if there are existing plans to Mean Sea Level, the survey should be done to
Mean Sea Level, by referencing to old plans or to a known bench mark.

If a site is not in a FEMA mapped area and if there are no existing plans to Mean Sea Level the survey can be done to an assumed datum. The assumed datum shall be determined by using the elevations in black on the USGS Quadrangle sheets at the intersection of roads, and running that elevation to the site with an accuracy of
0.5 ft. For grade separations, an assumed elevation will be adequate.

II. Bridge Replacements

The profile along the proposed alignment including stream bed elevations, and the existing utilities and their location on the bridge will be required in all cases.

A. Stream Crossing:

The Hydraulic Engineering Field Report should be completed in full with all the required data. This includes a cross section across the entire floodplain to an elevation 2 feet above the reported high water mark and a creek traverse extending 500 feet upstream and downstream showing water surface and bottom of channel elevations.

B. Grade Separations:

Survey data will be needed to give the horizontal and vertical alignment 200 feet in either direction from the point of intersection. The vertical alignment can be determined from elevations taken every 25 feet. If the horizontal alignment consists of straight lines, the bearing of the lines should be given. If the horizontal alignment has a curve, and curve data is not available, locations of the centerline should be given every 50 feet. The typical sections of the roads should be given if

the grade separation is over the road. If the grade separation is over a railroad, the elevations should be given to the top of rail; the distance between rails should be given; the horizontal location can be along one rail, if it is identified.

III. Bridge Widenings

The gutter elevation at the centerline of each bent and at mid-spans is needed. An accurate measurement of each span length and the "out to out" width should be given. The profile along the side of the bridge to be widened including stream bed elevations should be included. The location of the existing utilities on the bridge should be included. On median enclosures the distance between the bridges is required.

A. Grade Separations:

The bottom of beam elevations at both exterior beams is required at the point of minimum vertical clearance. The horizontal clearance from the closest rail or the edge of pavement to the face of the columns at each side or the bridge is required.

B. Stream Crossing:

The Hydraulic Engineering Field Report should be completed in full with all data except the cross section across the entire floodplain and the creek traverse extending 500 feet upstream and downstream.

References: None.

History:

Copied to GDOT Publications v.02.00.00 on 2/21/2012
added to Manual of Guidance: 06/26/85 added to TOPPS: 06/07/96 reviewed: 03/05/08
Created at 9/15/2008 2:02:43 PM by Helene Nickey

Georgia Department of Transportation

GDOT Publications
Policies & Procedures

Policy: 4465-4- Survey Procedures for Highway Bridges Over Railroads
Section: Surveys
Office/Department: Statewide Location Bureau
Reports To: Office of Design Policy and Support
Contact: 404-699-4401

The Department has experienced situations where the Railroads have questioned our design for drainage along their tracks. These questions are most often directed at the areas under the proposed bridge. These questions are usually caused by Railroad personnel not being able to adequately determine existing drainage. To avoid any delays that are caused by their concern, the following minimum requirements for survey are to be followed:

A. The alignment of the track or tracks will be established and referenced to the project's survey centerline. The intersection of the track centerline and project centerline will be referenced to a milepost. This reference to be given in the following format: 1000 ft. north of milepost 641, etc.

B. A minimum of five (5) cross sections will be taken perpendicular to the track centerline. The location of these cross sections for preconstruction will be as follows:
   1. The intersection of the project centerline and the centerline of one track.
   2. The proposed highway right-of-way limits.
   3. A point mid-way between the intersection point and the highway right-of- way limits. This mid-point does not have to be exactly halfway and in fact should be an even 100 ft. or 50-ft. station.

C. The cross sections will measured a minimum of 100 ft. each side of the track. If the location has multiple tracks, measure cross sections 100 ft. beyond the centerline of the outer most track. The cross sections are to include a top of rail measurement on each track.

These are the minimum requirements. The survey crew chief will determine on site if additional measurements are necessary.

If there are any questions concerning this policy, please contact the Statewide Location Bureau at 404-699-4401.

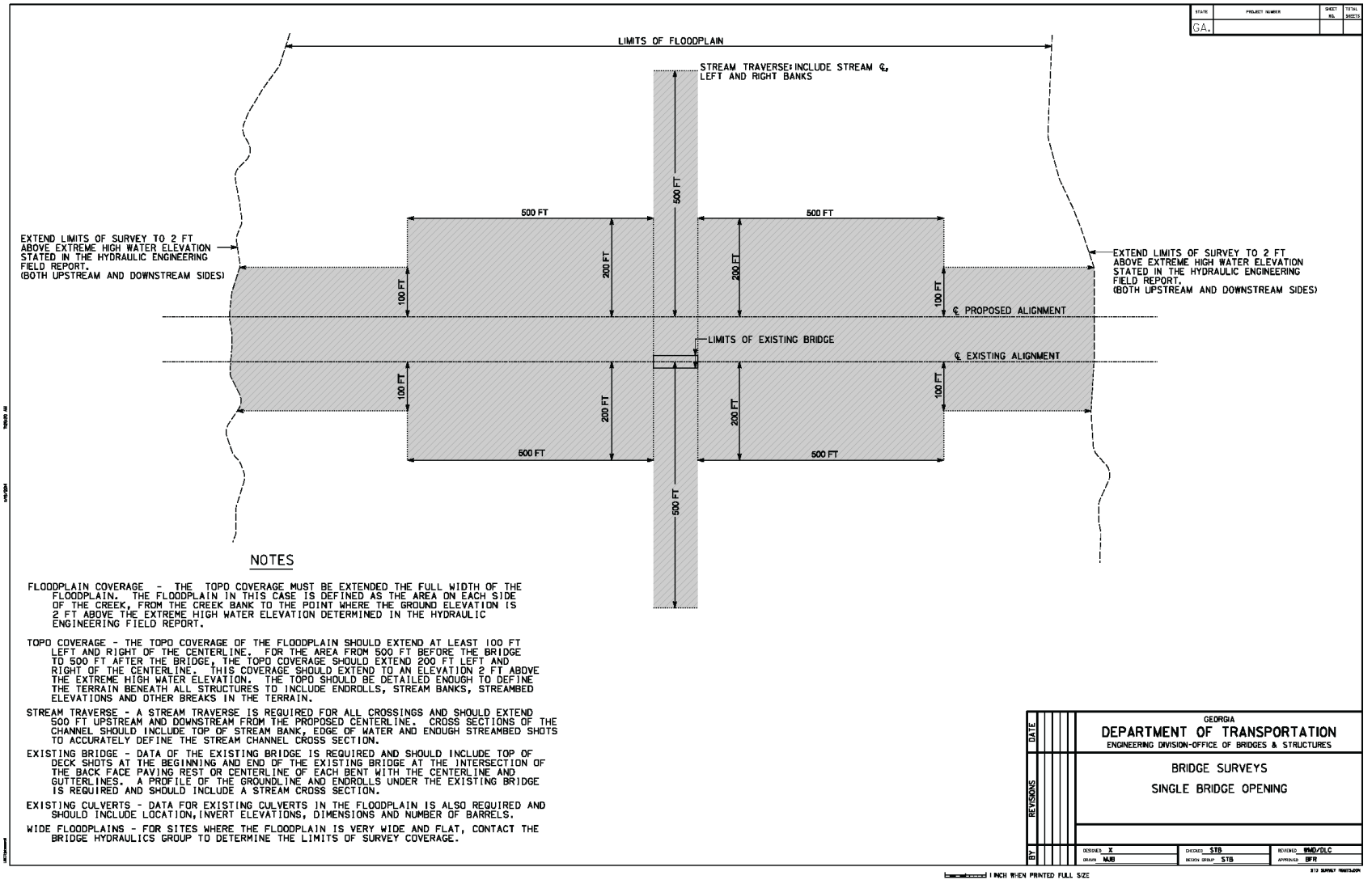
References:

None.

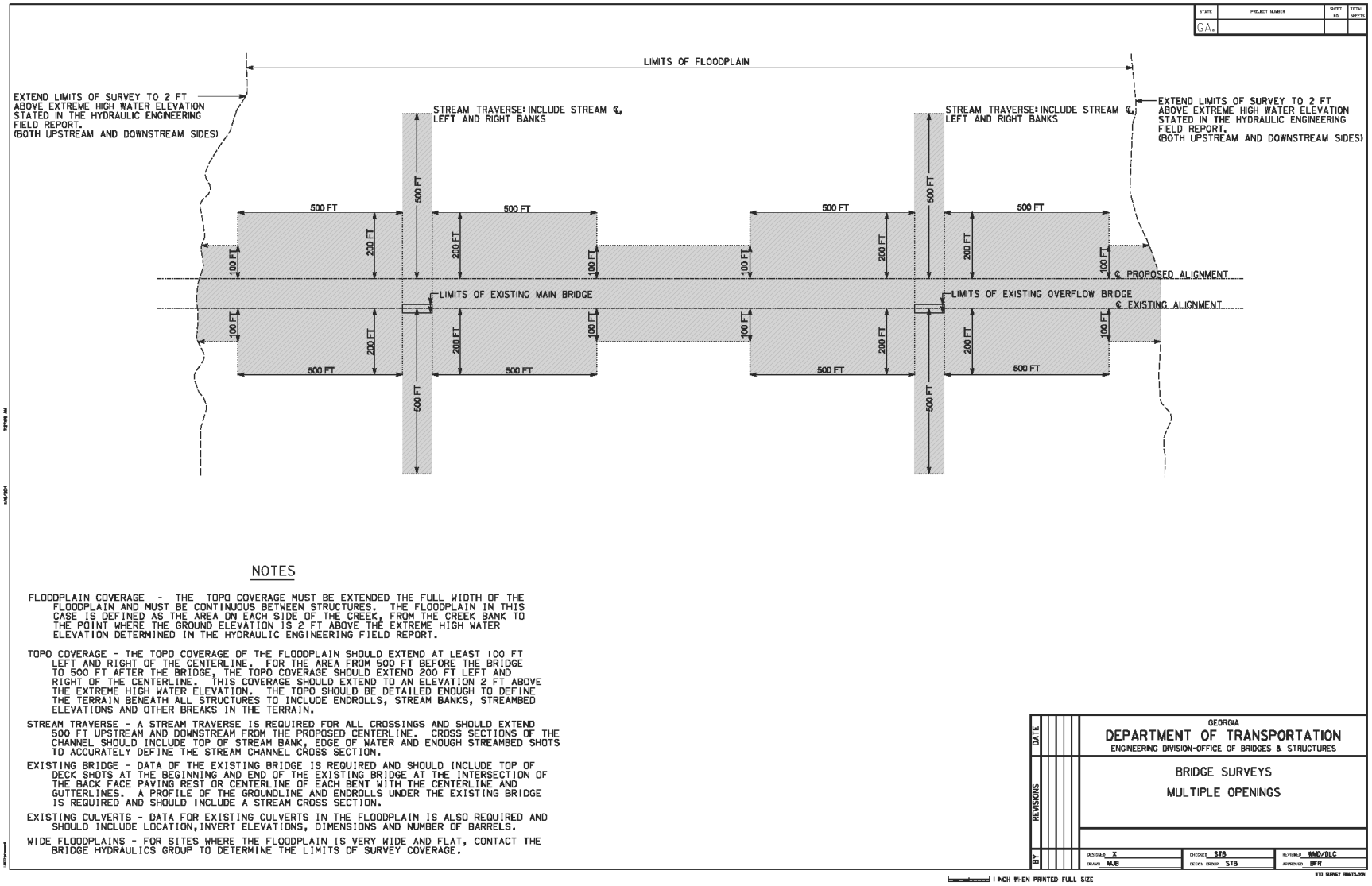
History:

Copied to GDOT Publications v.02.00.00 on 2/21/2012
added to Manual of Guidance: 01/25/88 added to TOPPS: 03/13/01 reviewed: 11/10/06
Revised: 08/14/13
Created at 9/15/2008 4:34:05 PM by Helene Nickey

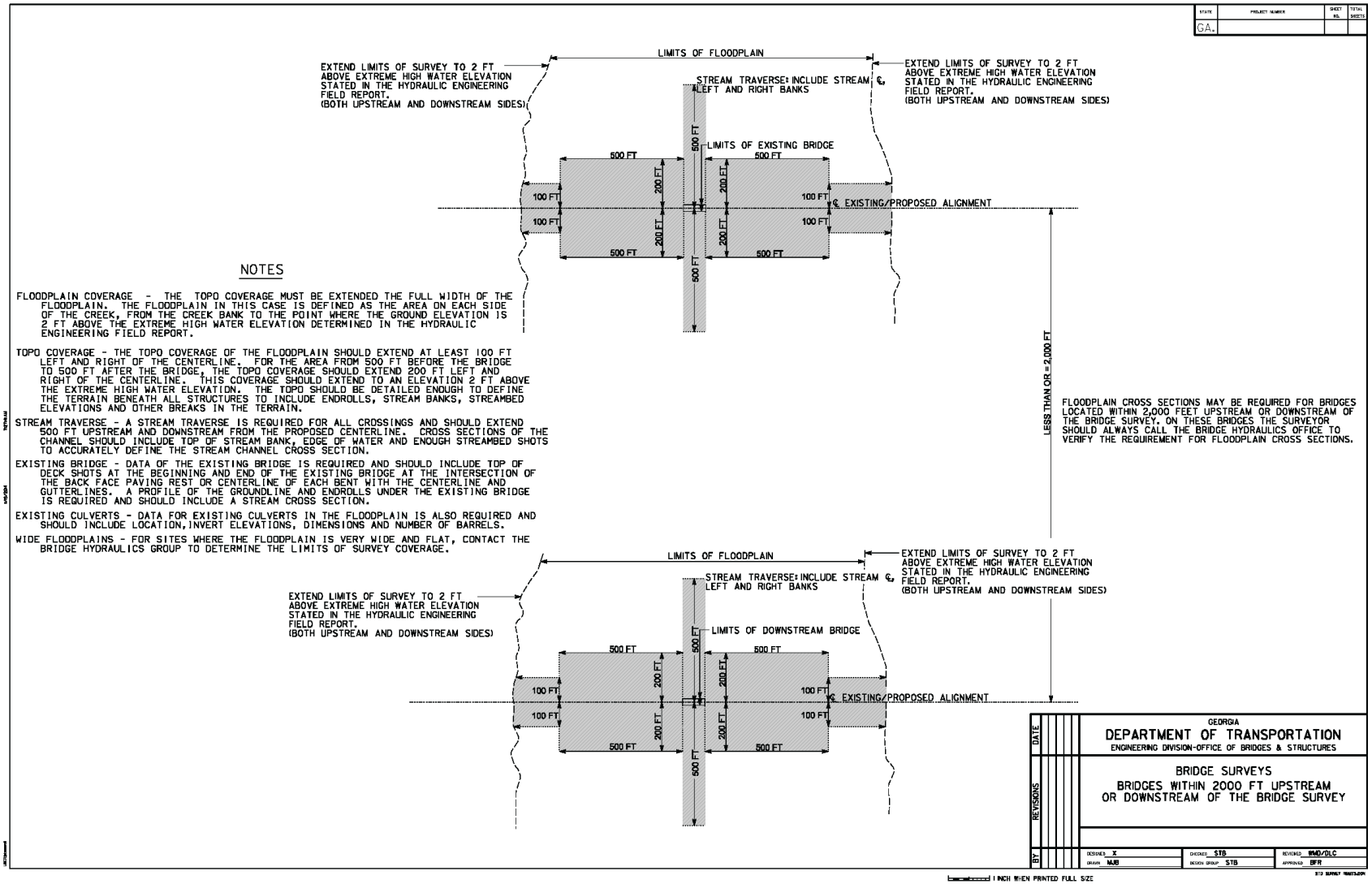
For Reference only



For Reference Only

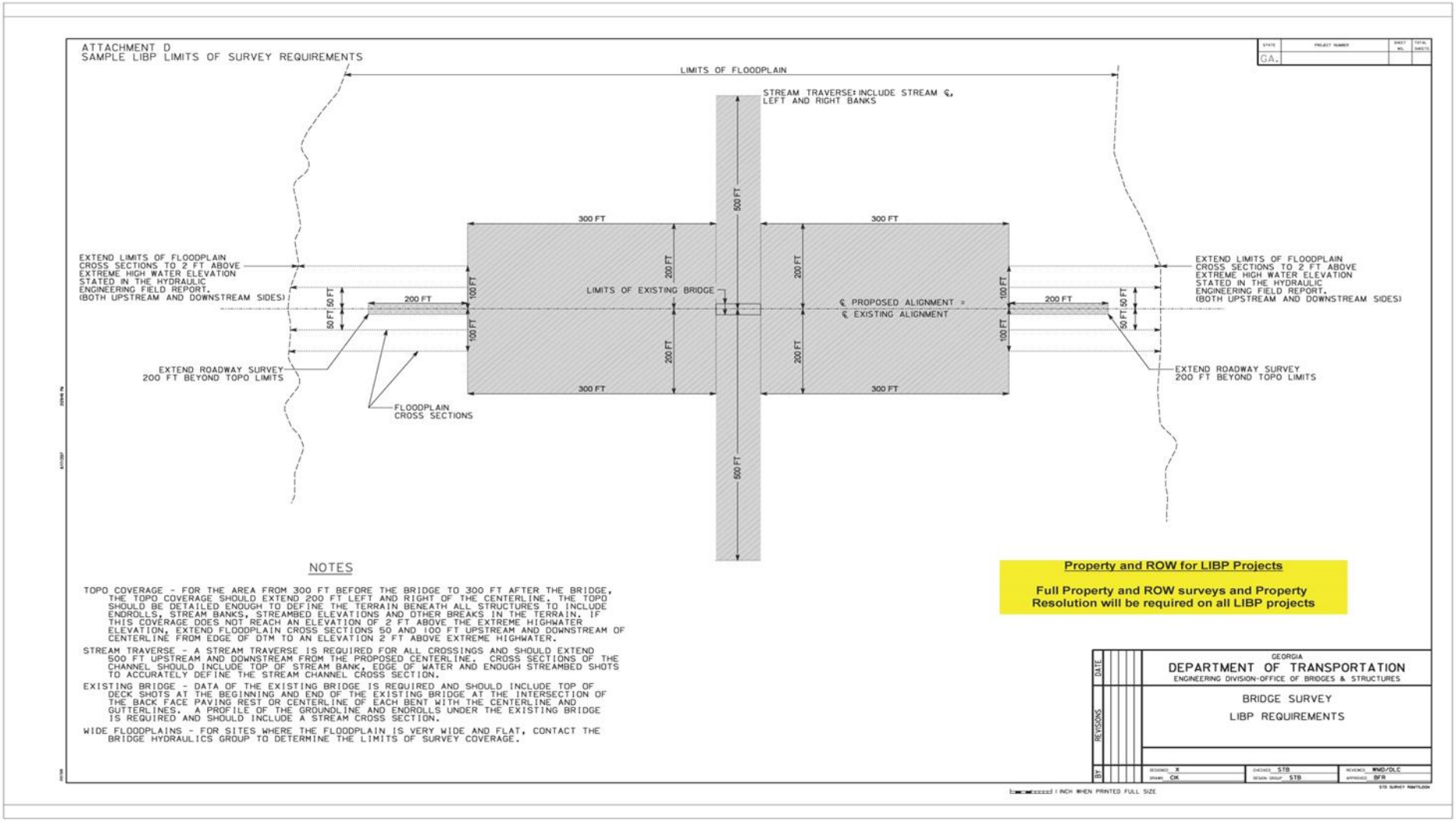


For Reference Only



For Reference only

4.6 Low Impact Bridge Project

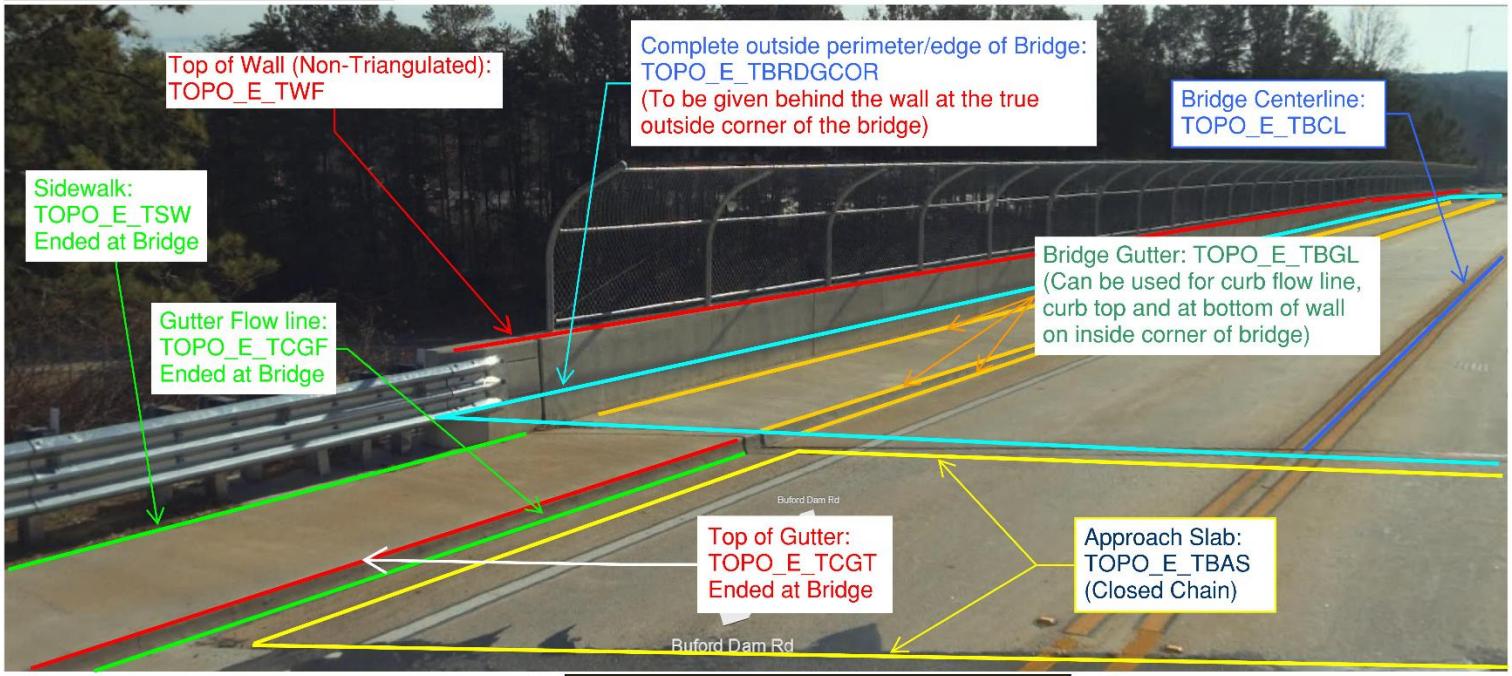


Note: These limits may be changed based on geography and information available at the pre-survey field meeting.
For Reference Only

4.7 Bridge Survey Requirements

**All bridge data should be collected in 3D, however, only Non-Triangulated points and chains should be used on bridges.

Summary of Existing Bridge Survey Requirements for InRoads Feature Styles
(All Bridge Data to be Collected with Elevations)



Shots are required at the intersection of the Back Face Paving Rest and Bridge Centerlines and Gutterlines, as shown. Exception: If bridge is on a constant cross slope/superelevation, only the shots on the Gutterlines are required.

For Bridge Widenings, shot are also required at the centerlines of all bents and midspans along centerline of bridge and gutterlines. Exception: If bridge is on a constant cross slope/superelevation, only the shots on the Gutterlines are required.

Note: For Bridges over Railroads: Locations of all existing bridge pilings required as well as tops of rail elevations.

NOTE: This is intended only as a summary to clarify feature styles used for Bridges. See the GDOT Automated Survey Manual for all requirements.

Center of bridge columns should be collected at all bridges. This includes replacement projects and widenings. If a bridge is very large contact SLB for guidance on bridge column collection.

Note: Bottom of Beam elevation shots are required at each cap/end bent.

Chapter 5. Lake Surveys - Contents

Chapter 5. Lake Surveys

When required, Lake Surveys should always be performed as close to the letting of the project as possible. Due to the possibility of having to check the original elevations at a much later date, the survey should be kept on file for retrieval and review.

The following items are needed on a LAKE SURVEY

A. **Baseline Alignment.** Two baselines which are referenced to the State Plane Coordinate System are needed, one for taking cross sections across the lake and the other for taking cross sections across the top of the dam. The stationing for the two baselines should begin where the two lines intersect. The baseline that runs parallel to the lake should extend to show the entrance of the stream into the lake. The baseline across the dam should extend completely across the dam. The edges of the lake and the dam should be shown with plus and offsets from the baselines. A minimum of **5** stations and cross sections are needed across the lake. If the lake is not **500 feet** long, the station interval should be reduced to meet the minimum of **5** cross sections across the lake. The baselines should have iron pins for the beginning and ending stations. The iron pins should be referenced to some permanent feature such as the corner of a building if possible: if not possible, reference control points in an area they won't be disturbed.

B. **Benchmarks.** A benchmark, which is on mean sea level datum, should be established. This benchmark should also be referenced to, or located in an area that won't be disturbed.

C. **Cross Sections**. Cross sections should be taken at right angles to the baseline, which parallels the lake. Elevations are taken at **25 feet** intervals across the lake. Care should be taken when giving the shot on the lake bottom so as not to let the level rod sink below the top of any silt or mud that might be in the bottom of the lake. A rope, marked at **25 feet** intervals and stretched across the lake at each cross section site should be used to determine where shots are needed. On the baseline across the dam, the top of the dam **ONLY** should be cross sectioned.

   AN ELEVATION ON TOP OF THE WATER AND ON TOP OF THE DAM SPILLWAY OR TOP OF THE LAKE RISER PIPE IS ALSO NEEDED.

D. **Sketch.** A sketch, scaled or unscaled, should be drawn in the field book showing the relationship of the baselines, reference points, benchmarks to the lake's boundary, date approved, horizontal datum used, vertical datum used, and the units of the survey.

E. **Photographs.** Pictures of the riser pipe, outfall ditches, and the dam shall be taken with a standalone camera or the built in camera on the TSC3. These pictures shall be stored as .jpeg files and stored in the same job folder as the .job and .csv files. These files will be delivered to the designer.

****Note: If consultants will be utilizing sonar technology to collect lake data, they should follow their equipment manufactures recommendations for the use of their equipment and follow GDOT's collection guidelines in the sonar section of this manual (pg. 5-2 through 5-9).**

5.1 Guidelines for Using the Sonarmite Echosounder for Lake Surveys

Safety

Please be sure to follow all boating safety guidelines and wear life vests. Keep a cell phone in the boat in case of emergency.

Setup

1. Sonar system should be mounted on the side of vessel away from props or other means of interference.
2. The HI should be taken from bottom of transducer to bottom of GPS antenna mount and entered as measured.
3. The transducer should be the lowest point on vessel and at least 10” below bottom of the hull.
4. Boat speed shall not exceed 4.0mph.
5. Data collector should be set up to collect data by distance on 10’ intervals.
6. The Quality Control setting for the Continuous survey style should be set to QC1 and QC2@ 0.15’H and 0.15’V. At any time the GPS precisions exceed these settings, the system will not store a point.
7. Take temperature reading with thermometer at or near middle water column.
8. Use the sound velocity temperature chart to adjust the Sonar unit settings.

Fahrenheit/Meter			
Temp	Speed	Temp	Speed
39.2	1421.62	63.5	1474.38
40.1	1423.9	64.4	1476.01
41	1426.15	65.3	1477.62
41.9	1428.38	66.2	1479.21
42.8	1430.58	67.1	1480.77
43.7	1432.75	68	1482.32
44.6	1434.9	68.9	1483.84
45.5	1437.02	69.8	1485.35
46.4	1439.12	70.7	1486.83
47.3	1441.19	71.6	1488.29
48.2	1443.23	72.5	1489.74
49.1	1445.25	73.4	1491.16
50	1447.25	74.3	1492.56
50.9	1449.22	75.2	1493.95
51.8	1451.17	76.1	1495.32
52.7	1453.09	77	1496.66
53.6	1454.99	77.9	1497.99
54.5	1456.87	78.8	1499.3
55.4	1458.72	79.7	1500.59
56.3	1460.55	80.6	1501.86
57.2	1462.36	81.5	1503.11
58.1	1464.14	82.4	1504.35
59	1465.91	83.3	1505.56
59.9	1467.65	84.2	1506.76
60.8	1469.36	85.1	1507.94
61.7	1471.06	86	1509.1
62.6	1472.73		

Collecting Data

Any pond or lake data that cannot be collected because of GPS limitations or Sonar tolerances will have to be obtained conventionally. Also the edge of water and top of bank chains along with the Dam also has to be collected with the total station. All sonar data should be collected in the calibrated .Job file.

Two base line points should be set and coordinated per GDOT RTK VRS guidelines. These should be set with care as not to be disturbed for the duration of construction. These two points will serve as primary control for the pond survey and baseline. The points should be iron pins receded .40' underground and described with sketches.

Perform the survey with two operators in the boat. One boat operator and one for Data Collector operation and navigation. A pass should be made over the pond to look for any stumps, pipes or other objects that may cause problems. Then follow the next 3 steps. The first pass should be made around the perimeter of the pond as close to the bank as depths allow. Next, make passes 15 feet apart across the width of the pond for the entire length. Finally, make passes 15 feet apart along the length until coverage is achieved. **See image 1 and 2 below.**

At any time the collection operator suspects depth readings are in error stop the survey and click the erroneous points on map screen of collector and delete them. There will be times when the collector will warn that depths are not stored for a point. This is because of a bad return on signal. There will be a large number of points collected, so this will not be an issue. The points with no depths will be deleted in post processing.

*****Always be sure to check for underwater foilage and other items may affect the accuracy of the sonar points. Sonar will pick up top of foilage underwater and not the actual bottom of the stream or pond. This can cause serious issues during final design and construction.**

Grid Pattern Example

Image 1

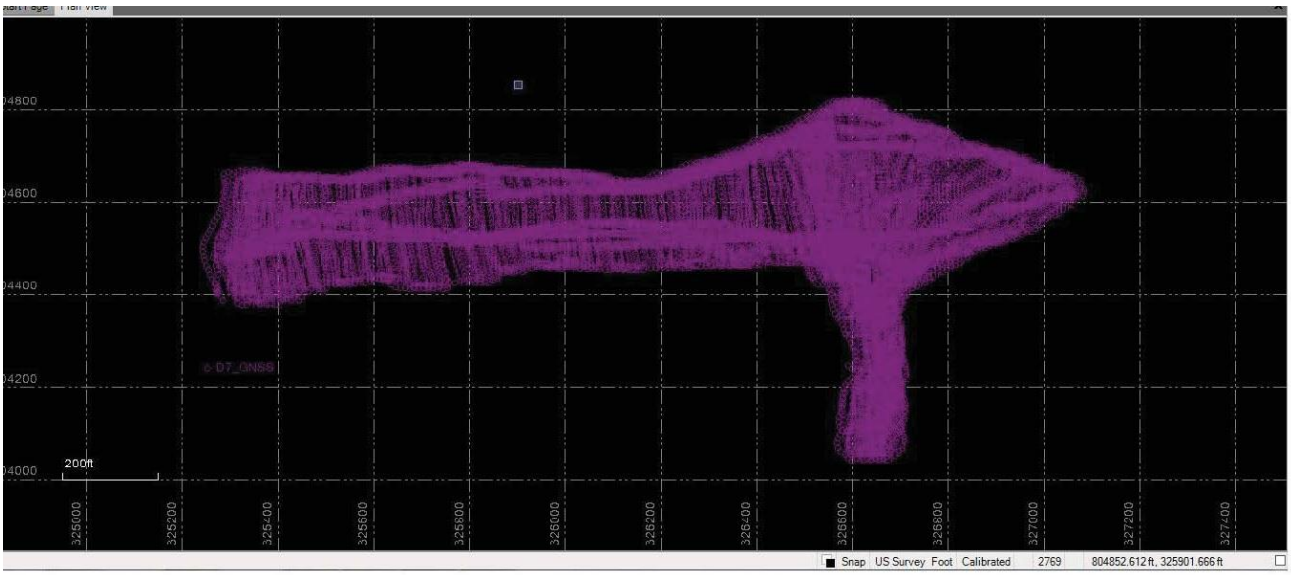
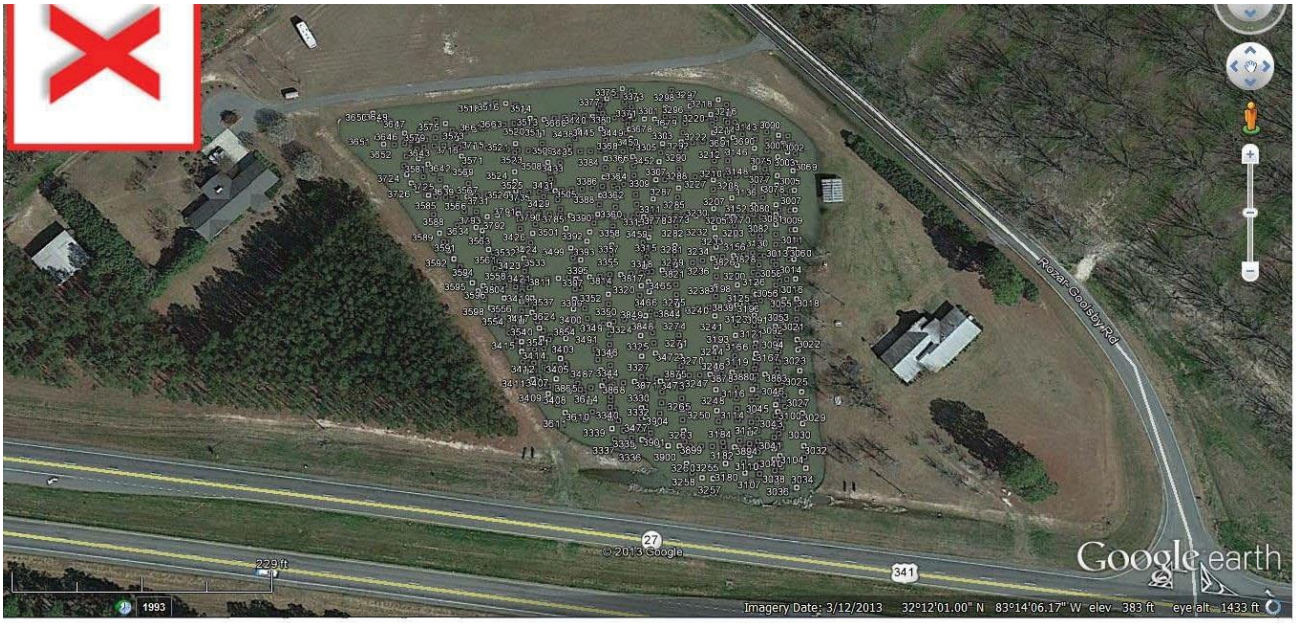


Image 2



Exporting from TSC3

The measured points with depths applied can be directly exported from the data collector, if there are less than 1500 points. This can be done by selecting under the general survey screen of TSC3 and click the following: **job, import/export, export custom format,** and for file format select **comma delimited with depth applied** and check the box ***include points with echosounder depths.*** This will create a .csv file with the bottom of pond elevations. ***Currently exporting to a spreadsheet is the only way to get the depth applied elevations! Importing the .job file in tbc will not give the correct elevations unless exported to a spreadsheet.***

Editing the CSV file

Once the file is saved, it will need to be opened using Microsoft Excel. This is to edit out the points with void elevations. To do this, select the following; ***Highlight the entire elevation column by clicking at the top*** of the column***, then*** on the right of screen select ***sort and filter, sort smallest to largest.*** **See image 3.**

A small screen will pop up to *expand the selection* so all coordinates, elevation, and point numbers will sort together. Be sure ***expand the selection*** is selected and then just select the ***sort*** button. **See image 4.**

Image 3

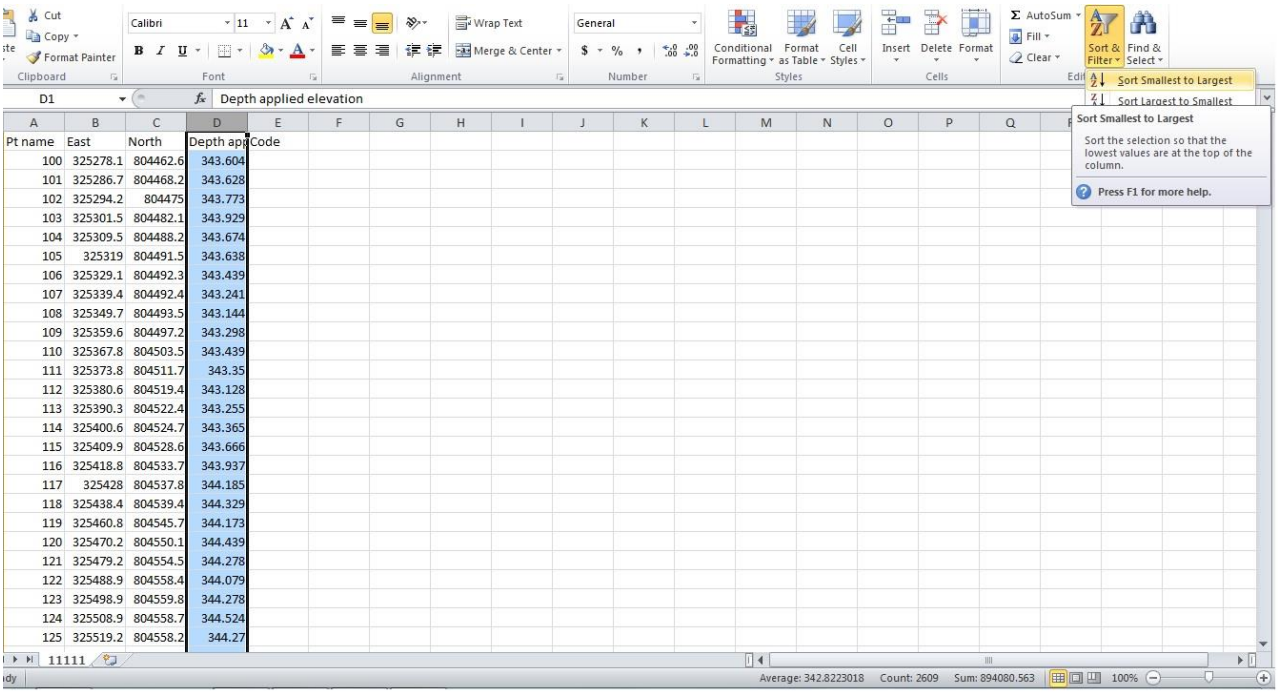
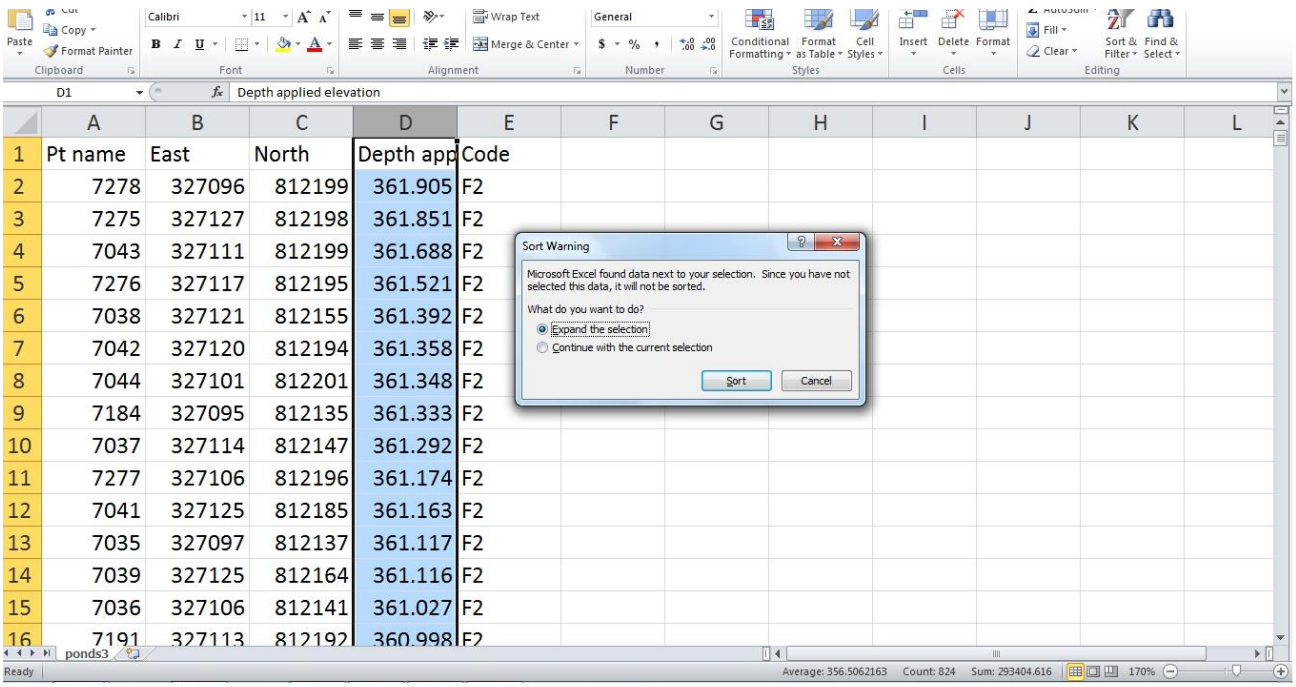
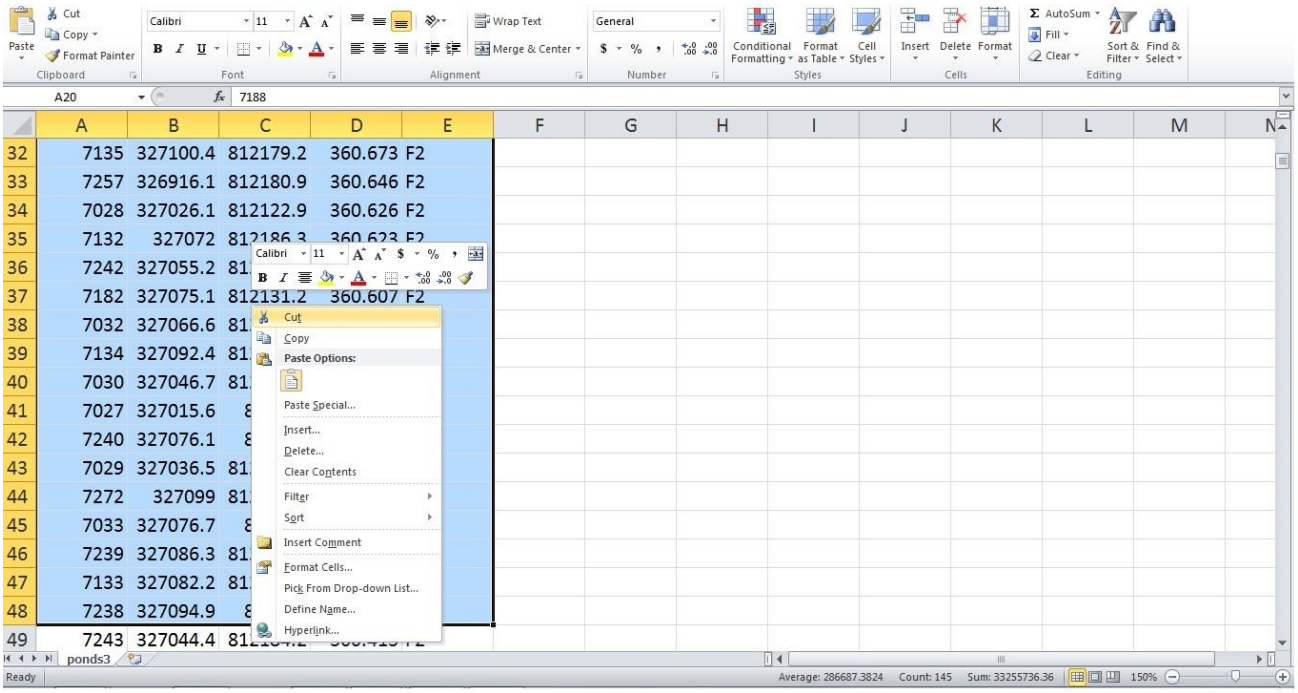


Image 4



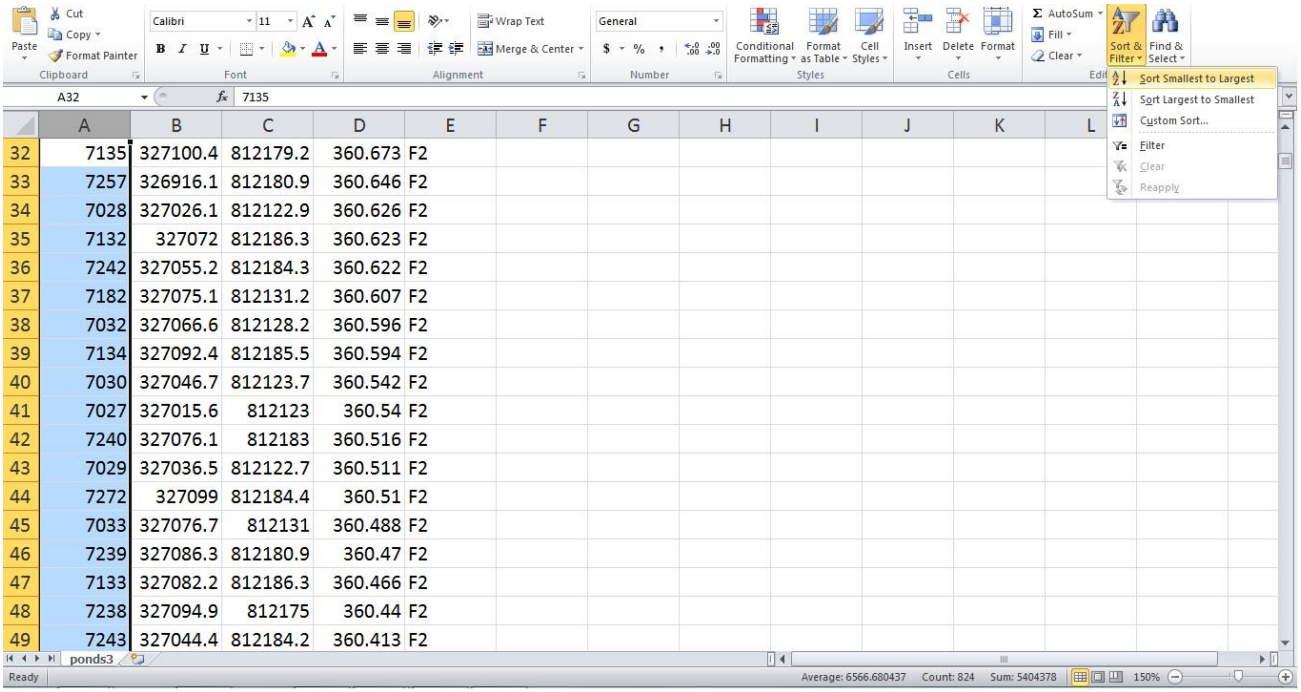
Now tab through the file and highlight all the points with no elevation and ***right mouse click, clear contents.*** This will remove all the bad elevation data from the file. **See image 5.**

Image 5



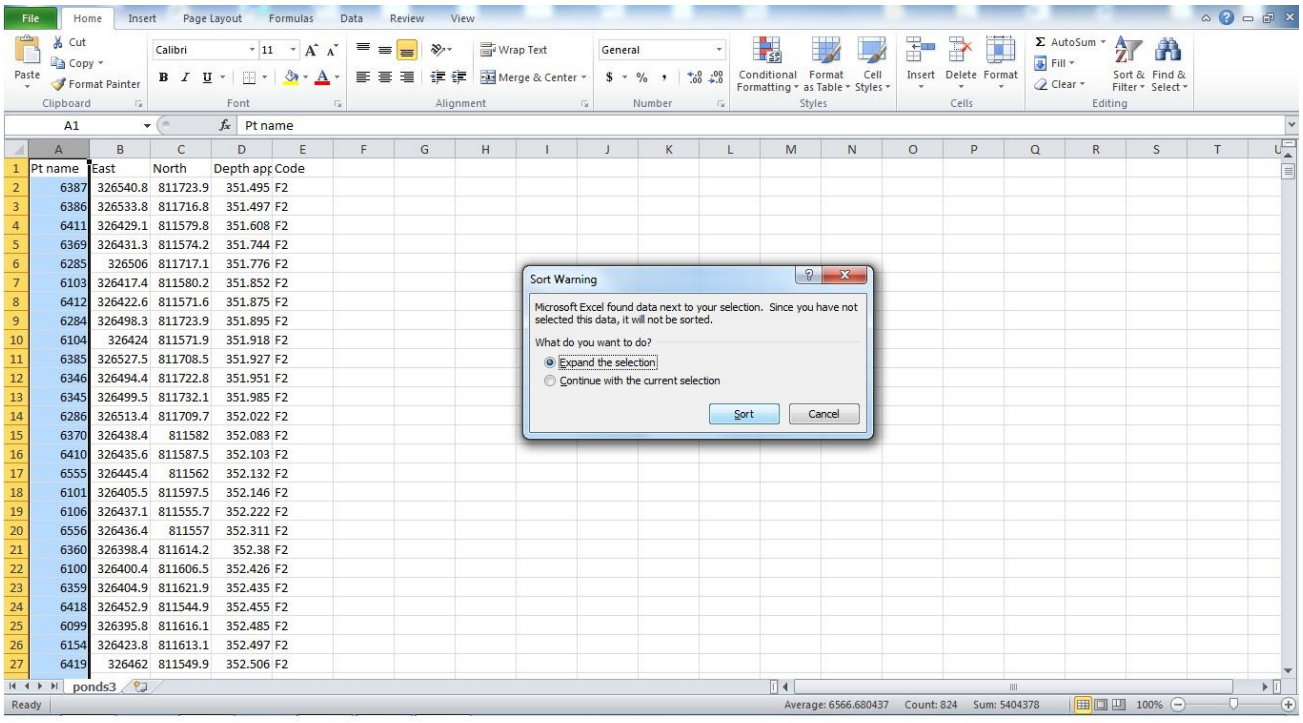
Last highlight the point number column and sort and filter from smallest to largest. Be sure ***expand the selection*** is checked and hit ***sort.*** **See image 6 and 7.** This will put all the points back in order and be sure to save the file. This will be the bottom of pond elevations and the source file to create a surface from to check for errors. See the next section, if the file is larger than 1500 points.

Image 6



	A	B	C	D	E
32	7135	327100.4	812179.2	360.673	F2
33	7257	326916.1	812180.9	360.646	F2
34	7028	327026.1	812122.9	360.626	F2
35	7132	327072	812186.3	360.623	F2
36	7242	327055.2	812184.3	360.622	F2
37	7182	327075.1	812131.2	360.607	F2
38	7032	327066.6	812128.2	360.596	F2
39	7134	327092.4	812185.5	360.594	F2
40	7030	327046.7	812123.7	360.542	F2
41	7027	327015.6	812123	360.54	F2
42	7240	327076.1	812183	360.516	F2
43	7029	327036.5	812122.7	360.511	F2
44	7272	327099	812184.4	360.51	F2
45	7033	327076.7	812131	360.488	F2
46	7239	327086.3	812180.9	360.47	F2
47	7133	327082.2	812186.3	360.466	F2
48	7238	327094.9	812175	360.44	F2
49	7243	327044.4	812184.2	360.413	F2

Image 7



	A	B	C	D	E
1	Pt name	East	North	Depth app	Code
2	6387	326540.8	811723.9	351.495	F2
3	6386	326533.8	811716.8	351.497	F2
4	6411	326429.1	811579.8	351.608	F2
5	6369	326431.3	811574.2	351.744	F2
6	6285	326506	811717.1	351.776	F2
7	6103	326417.4	811580.2	351.852	F2
8	6412	326422.6	811571.6	351.875	F2
9	6284	326498.3	811723.9	351.895	F2
10	6104	326424	811571.9	351.918	F2
11	6385	326527.5	811708.5	351.927	F2
12	6346	326494.4	811722.8	351.951	F2
13	6345	326499.5	811732.1	351.985	F2
14	6286	326513.4	811709.7	352.022	F2
15	6370	326438.4	811582	352.083	F2
16	6410	326435.6	811587.5	352.103	F2
17	6555	326445.4	811562	352.132	F2
18	6101	326405.5	811597.5	352.146	F2
19	6106	326437.1	811555.7	352.222	F2
20	6556	326436.4	811557	352.311	F2
21	6360	326398.4	811614.2	352.38	F2
22	6100	326400.4	811606.5	352.426	F2
23	6359	326404.9	811621.9	352.435	F2
24	6418	326452.9	811544.9	352.455	F2
25	6099	326395.8	811616.1	352.485	F2
26	6154	326423.8	811613.1	352.497	F2
27	6419	326462	811549.9	352.506	F2

Exporting over 1500 sonar points in TBC

Open TBC with Hasp inserted and select ***File, tools and Job report generator*.**

Image 8

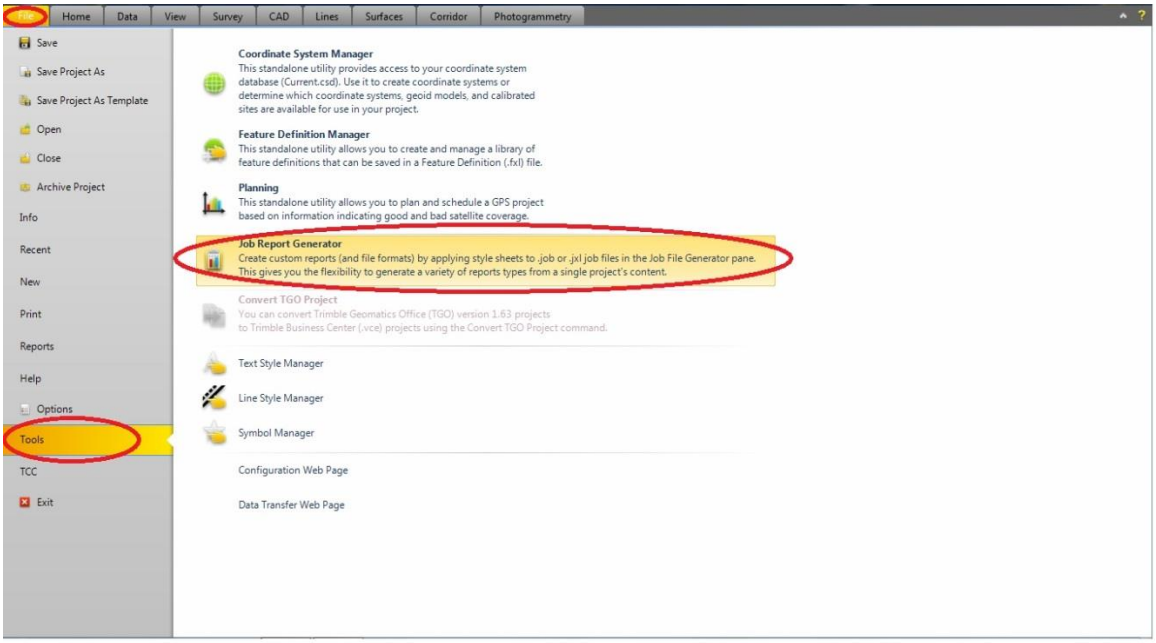
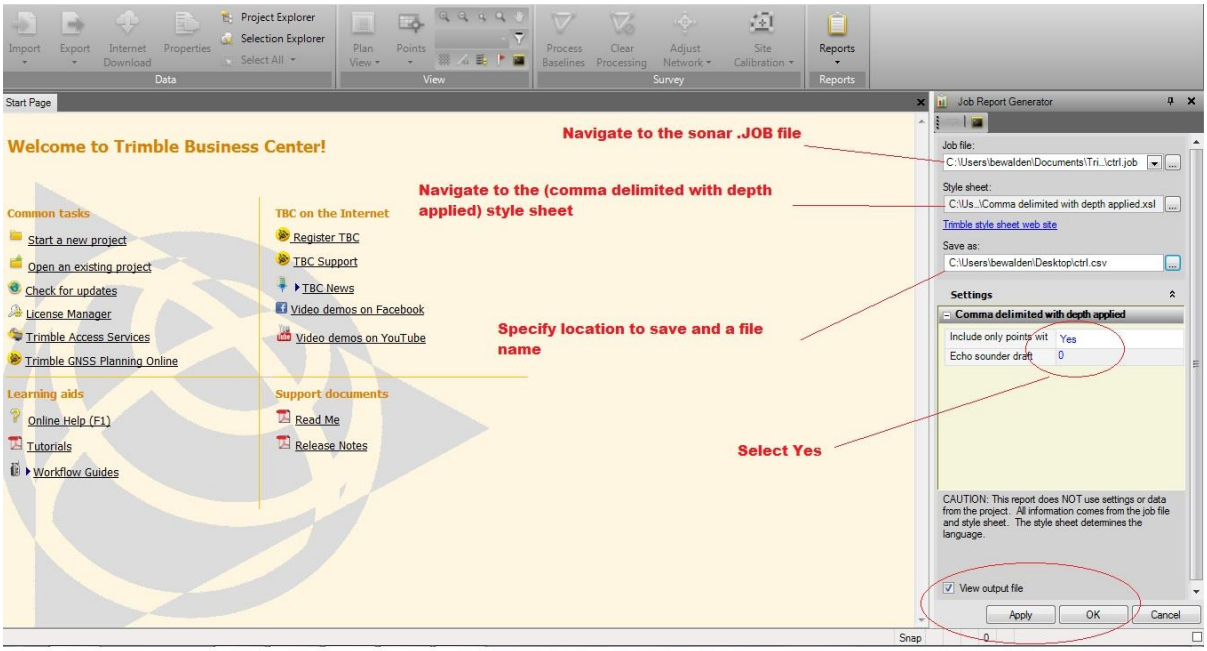


Image 9



Once exported, file can be edited per the above instructions for "**Editing the CSV file".**

The edited .csv can then be imported into TBC and a surface created.

Georgia Department of Transportation

GDOT Publications
Policies & Procedures

Policy: 4465-7- Guidelines for Lake Surveys
Section: Surveys
Office/Department: Statewide Location Bureau

Reports To: Office of Design Policy and Support
Contact: 404-699-4401

The Project Manager, during the preparation of a Project Concept, shall be responsible for locating and preparing a map showing the approximate drainage basin of all identifiable lakes within 500 feet downstream (500 feet from the Right-of-Way limits) on a project, subject to the following conditions. (See *Figure #2 for typical map layouts.) These maps should be transmitted to the Project Manager tasked with the design of the project.

Projects located south of the heavy line shown on the attached map (Figure #1) or projects located anywhere within the State with cut or fills (i.e., all resurfacings, minor widenings, and most intersection improvements), should normally not require lake surveys unless the project is directly adjacent to a lake, the project involves a major channel relocation or modification, or if the project is located in a highly sensitive area.

The appropriate Project Manager shall be responsible for improving the drainage basin map to identify and show exit points from the project to the lake. Locations of known lakes should be marked on the plans. Design should also make a determination as to whether the lake can be properly protected or if it should be used as a sediment retaining structure for the project. Proper erosion control measures, along with the need for additional easements or right-of-way should be considered prior to preparing Right-Of-Way Plans.

A request to perform a lake survey by the District or Design Office should be forwarded to the District preconstruction survey crews at the time the project is submitted for final review (typically 3 to 5 months prior to letting). This will allow time for the survey crews to schedule the work prior to clearing and grubbing. The survey should be performed as close to the letting as possible. A recommended setup for a baseline on a Lake Survey is shown in Figure #3. The baseline needs to be tied down to the centerline of the dam and other available permanent points to insure the relative repeatability of the measurement locations. Existing features (building corners, trees, etc.) should be used if possible. A probable 5 to 7 year life of a survey point should be considered.

Where existing features are not available, iron pins should be used and marked appropriately. Back-up points are recommended. The survey information required includes distances and offsets on the bank locations to allow delineation of the limits of the pond or lake. Survey information, notes, maps, etc., from the preliminary lake survey should be sent to the Geotechnical Engineering Bureau of
the Office Of Materials and Research for review and filing.

The Project Engineer will be responsible for insuring that the lake surveys are completed prior to clearing and grubbing in the area and to note the location of any other ground disturbing work being performed within the drainage basin, above or below the project. Even lakes that are greater than 500 feet from the project may require lake surveys if deemed necessary by the Project Engineer due to one of the following conditions:

1. Lakes downstream of a project where it is evident that construction (by others) upstream of the project is already contributing silt to the stream/lake.
2. Lakes located in a publicly sensitive area.

*See below for Figures 1, 2, and 3.

References:

For Reference Only

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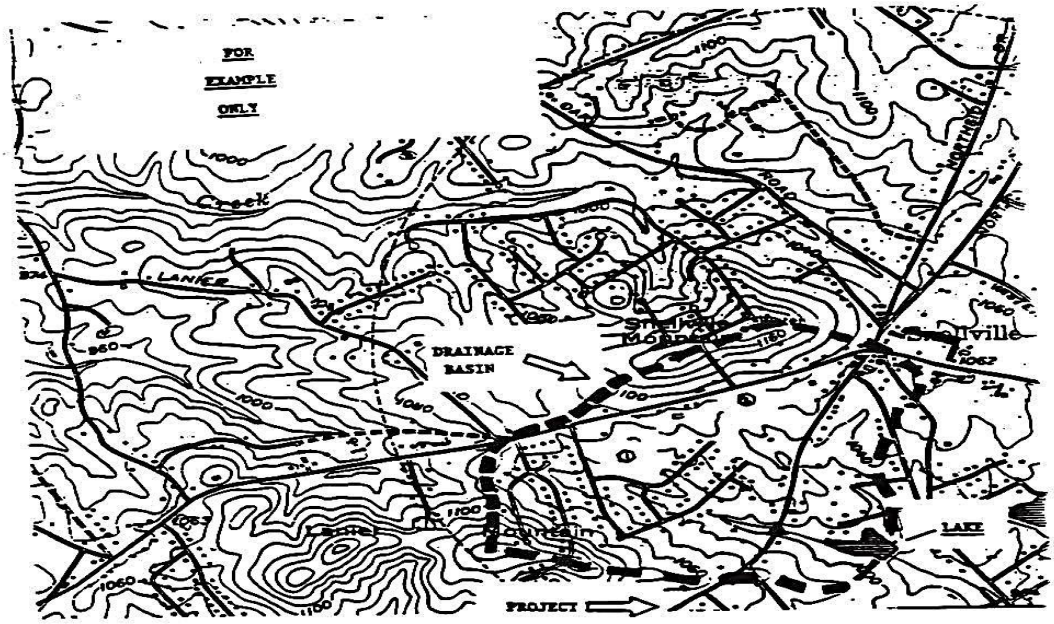
History:

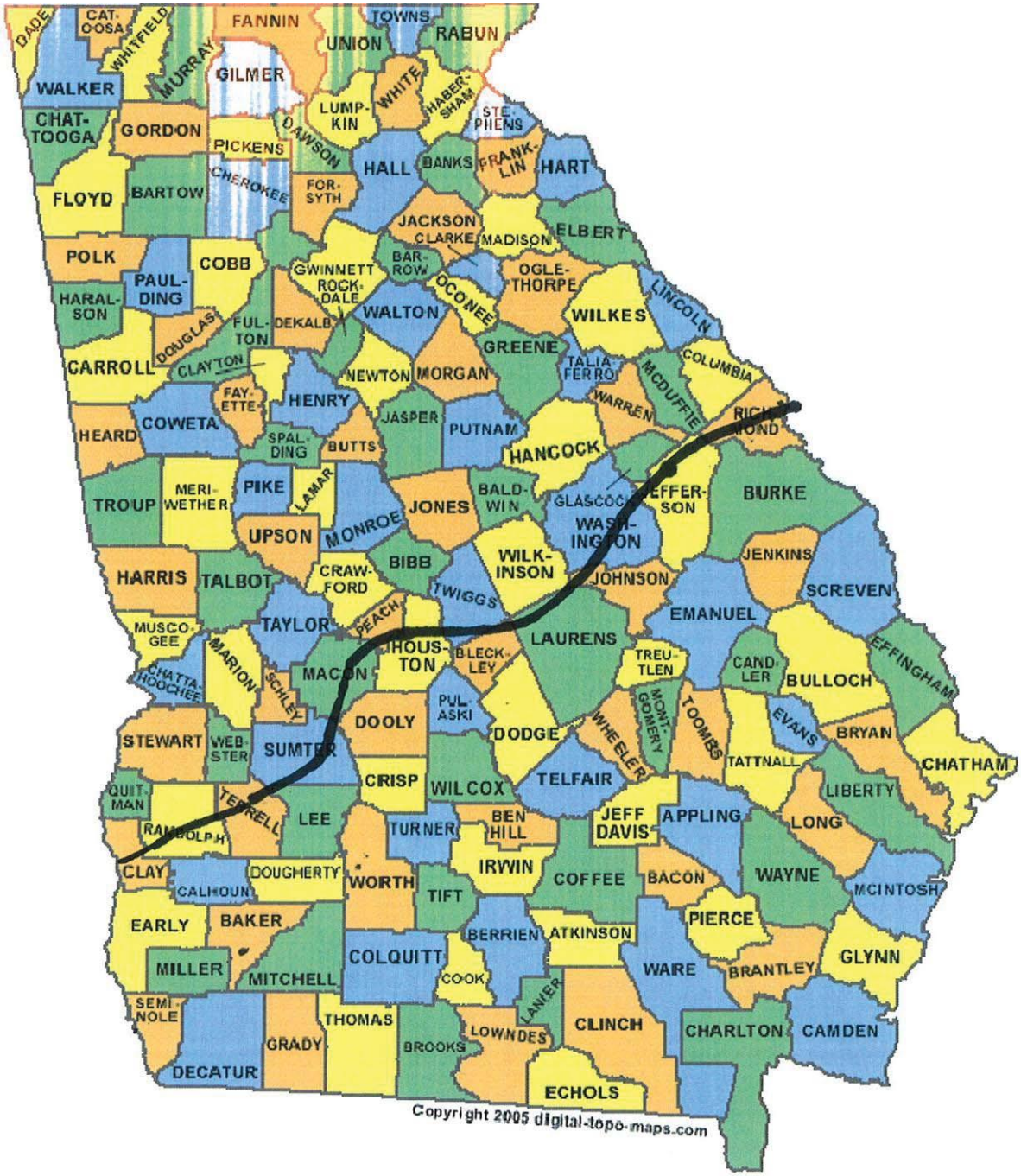
Copied to GDOT Publications v.02.00.00 on 2/21/2012
added to Manual of Guidance: 011/16/92 added to TOPPS: 05/01/96 reviewed: 11/10/06
Revised: 08/14/13
Created at 9/15/2008 4:38:09 PM by Helene Nickey



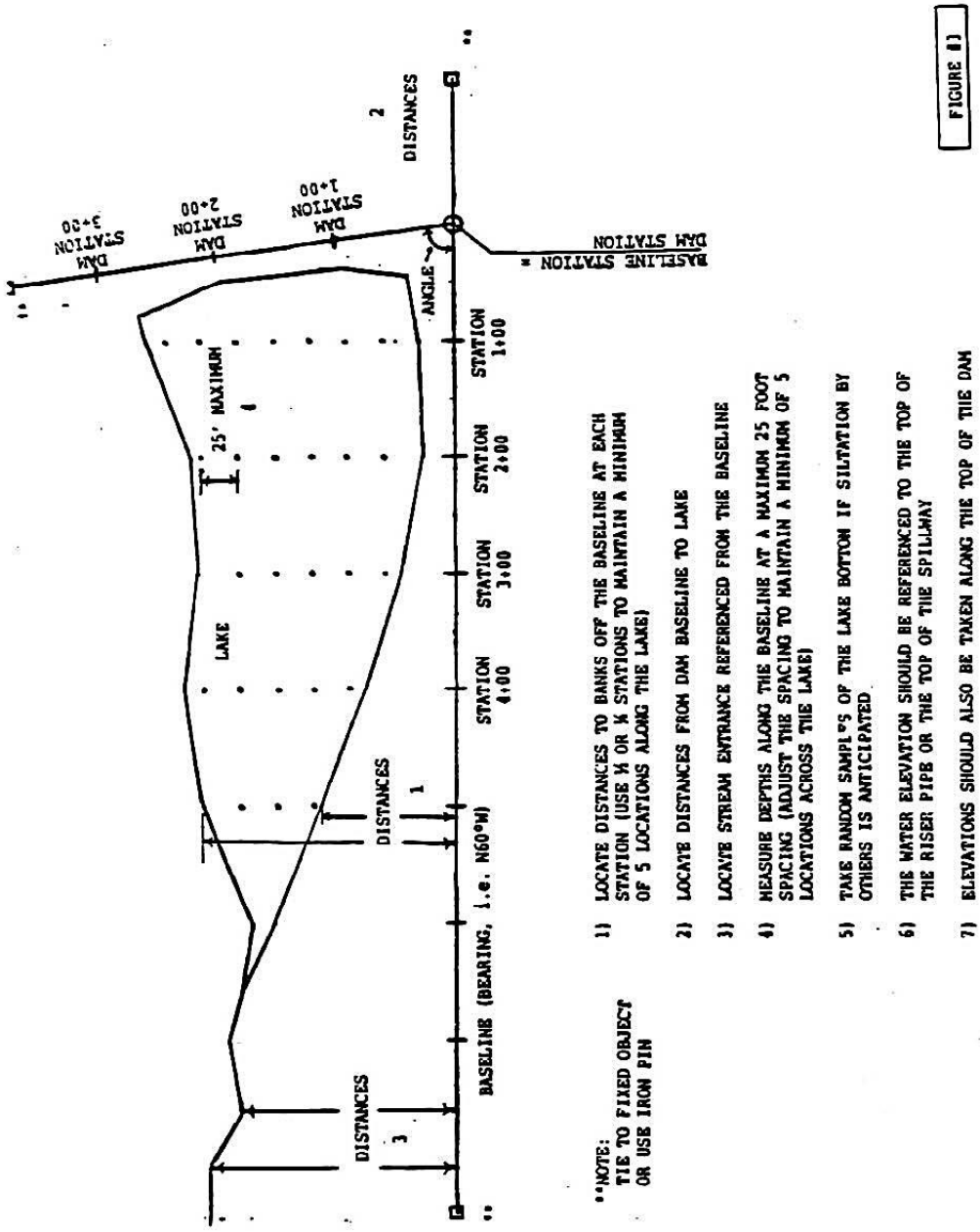
NOTES:
1 ADDITIONAL STREET AND 4 HOUSES BUILT BY DEVELOPER 4/91-6/91
2 SHOPPING CENTER BUILT BY DEVELOPER 7/91-10/91

LEGEND:
= LIMITS OF DRAINAGE BASIN FOR LAKE
= TURBIDITY SAMPLING SITES

For Reference Only



For Reference Only



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Chapter 6. GPS and LIDAR Survey Guidelines - Contents

Chapter 6. GPS and LIDAR Survey Guidelines

6.1 GPS Static Network Guidelines

The CONSULTANT may use Global Positioning System (GPS) Technology as a means of establishing horizontal control pairs which are to be used for controlling the Primary Traverse within the PROJECT. A traditional Cadastral Traverse between these pairs will still be required. The traverse will have the previously described spacing and visibility for the control deltas and must meet the accuracy specifications for Traverse, Second-Order Class II (1:20,000) for rural areas and 1:25,000 in urban areas. The following requirements must be met for GPS applications:

1. The GPS network for the PROJECT must consist of the following minimum requirements:

    a. For Horizontal Control: Opus may be used to establish project control in areas where horizontal control is limited or nonexistent. Adhere to the Opus guidelines for horizontal control in the Opus section of this manual. If local horizontal control exists, it should be verified and used in the survey. Contact the Statewide Location Bureau to ensure the project is a candidate for OPUS.

    b. For Vertical Control: If no vertical control exists on the project, a vertical static network has to be established using the following guidelines. A minimum of 5 Third Order or better control stations shall be used and held fixed. The control stations shall be from the National Geodetic Reference System (NGRS) database or the U.S. Geological Survey database. These stations shall be located in all quadrants (NE, NW, SE and SW) of the PROJECT and they shall encompass the entire PROJECT. The stations shall have a datum classification of NAVD88, unless otherwise specified by the DEPARTMENT. Maintain a schematic showing only the non-trivial (independent) baselines used for the least squares adjustment of the GPS data. If the vertical control for the static network has good coordinates, then horizontal control may also be established with this network.

2. Independent baselines in a network should not exceed 25 miles in length. However, if only L1-code (single-frequency receivers) is being used, then collected baselines cannot exceed 10 miles.

3. Each session's length will depend on how long four or more common (same) SV’s can be tracked simultaneously. If the signal is interrupted significantly or if common satellites are lost, then times must be increased to insure the following minimums with either Static or Fast Static Observations with synch rate of 15 seconds for L1/L2 receivers:

    1.0 miles to 6.0 miles → 30 minutes
    6.1 miles to 12.0 miles → 45 minutes
    12.1 miles to 16 miles → 60 minutes
    16.1 miles to 21 miles → 90 minutes
    21.1 miles to 25 miles → 120 minutes

4. An elevation mask of 15 degrees shall be used when collecting all GPS data.

5. An epoch with a Position Dilution of Precision (PDOP) greater than 6.0 will not be considered as a usable measurement.

6. The Department may request the report that contains the OPUS derived values and CORS stations used in the solution. A RINEX file of GPS raw data for any new points may also be requested.

7. Maintain copies of field notes denoting the stations occupied by GPS receivers and the beginning and ending times of occupation. Also, document the Height of Instrument (HI) for each GPS antenna (specifying whether it is true vertical or uncorrected), type of receiver and antenna used and date of occupation.

8. Maintain a schematic of independent baselines and points occupied for establishing the control.

GUIDELINES FOR PERFORMING ON-LINE POSITIONING USER SERVICE (OPUS)

Opus may be used by the Department and Consultants to establish horizontal control for GDOT projects. This includes road projects that could be several miles and stand-alone projects. However, if no vertical control is on the project, a full vertical static network will need to be run using procedures above in the Static network guidelines for vertical control.

Note: For stand alone, bridge, intersection, safety improvement projects and any other project that require only 2 OPUS control points, only 1 point shall be held vertically and the other point will be elevated using a level following the department's guidelines for establishing vertical control.

A level run is required on all main project control.

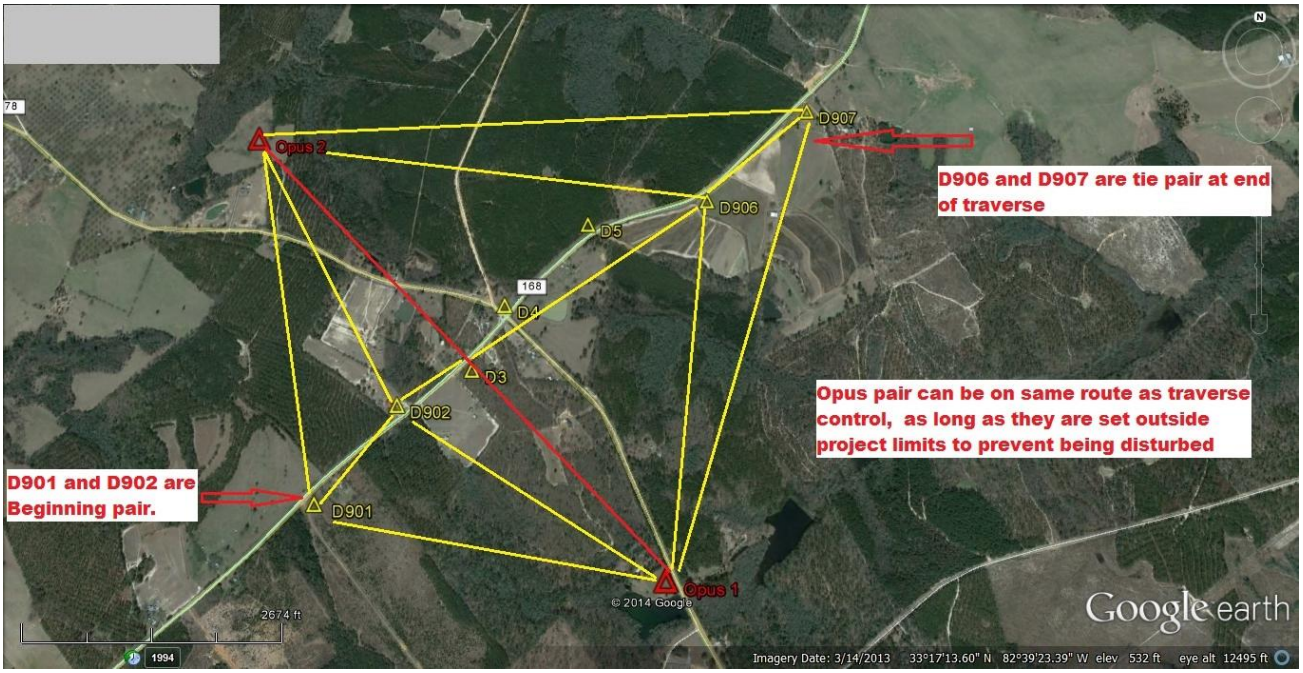
The Department has experienced situations where the use of The National Geodetic Survey's (NGS) On-line Positioning User Service (OPUS) could be utilized as a means to provide GPS user's easier access to the National Spatial Reference System (NSRS). This easier access will result in lower production costs to the Department for survey related information, based on a reduction of post processing time, reconnaissance time required to find suitably precise or accurate control for project origination, and field time presently required to derive survey control information.

OPUS will allow users to submit GPS data files in RINEX or Hatanaka compressed (yyd suffix) format to NGS, where the data will be processed to determine a position using NGS computers and software. Since the NGS software will only process dual-frequency, carrier-phase data (L1 & L2), Single frequency data (L1 only) will not be processed and thus will not be permitted for use with this technology on any Departmental projects.

The Department will reserve the right to apply this service to projects individually and independent of previous or past project use. Each project will be reviewed on an individual basis by the Statewide Location Bureau (SLB) to determine the suitability of the project to apply use of this technology. This is to ensure that no current databases or survey control exist along proposed project or project corridor. A survey request with written permission given by the Department will be required for any project to utilize this technology. This procedure will help ensure that a single

project does not have two separate databases with different values. This request will also ensure documentation to the fact that the originator of the control values will bear full responsibility for provided delta values. There could be a large time lapse between the time the data is collected and the time the Department would receive the data for review meaning there may be no data from CORS to verify or process from since this is an automated process.

HORIZONTAL CONTROL GUIDELINES (OPUS)
Example OPUS derived control.



Two main control points will be set outside the construction limits. They can be set as shown above or they could be set on the actual roadway for construction, as long as the points are off the construction limits. These points will be Iron Rebar set at least .50’ below the surface.

In the example above, a two hour session will be run on OPUS 1 and OPUS 2 for OPUS processing and for a static baseline between the two. Once the results are received, Hold fixed to one of the points in the GPS software and process the baseline to the second Opus point. Compare the coordinates from the static processing to the Opus derived coordinates. They should check within 0.12’. Now hold to the static derived coordinates for the second point. These points will now seed the project for all GPS pairs as shown above. The Opus coordinates for the second point serves as a check for the static processing.

Baselines will need to be observed from each of the two OPUS control points to each point that will be part of a control pair. Also baselines need to be observed between control pairs. Follow the time guidelines above for occupation times and baseline distances. The two OPUS points also need to be described and submitted in the control package.

In the event there is control from previous jobs in the vicinity or on the project, SLB will determine if incorporation is necessary.

HORIZONTAL and VERTICAL CONTROL GUIDELINES (OPUS)

Horizontal and vertical values can be established using OPUS for the following projects:

- Bridge replacement, intersection surveys, safety improvements.

A main or primary control point will be required for the project. This main control point will require a *minimum occupation time of four hours* during peak satellite cover on the day of occupation from a stationary antenna. Two additional 30-minute occupation ties will be required from the main control point to any other control deltas set on project. If azimuth pairs are being utilized on the project, two additional 30-minute occupation ties shall be made between the azimuth pairs. The resulting file type will be formatted in the standard 8.3 RINEX convention with the extension having the 2 digit year and an "o" (oh), e.g. site3650.99o. Each RINEX file that is submitted will be processed with respect to 3 Continuously Operated Reference Stations (CORS) sites. There are approximately 5 tests done for compatibility between the given location and the CORS sites; e.g., if the time block requested is compatible with the CORS site, if there is a high multi-path environment, etc. OPUS starts with the closest site(s) to your given location, and conducts these tests on each site for its compatibility to these five tests, and if the closest site is not compatible, OPUS then continues to search out sites until it is able to find three sites that are compatible, and uses them. OPUS will always report positions back to the user as geocentric Cartesian coordinates (X,Y,Z) and in geodetic coordinates (latitude, longitude, ellipsoid height) in both the North American Datum of 1983 (NAD83) and the International Earth Rotation Service Terrestrial Reference Frame (ITRF). OPUS will also report the Universal Transverse Mercator (UTM) northing and easting values. The Department will only accept the NAD83 state plane coordinates specified as northing and easting values for horizontal project control unless otherwise specified. The Department will only accept the North American Vertical Datum of 1988 (NAVD88) orthometric elevations for vertical project control unless otherwise specified.

Note: For stand alone, bridge, intersection, safety improvement projects and any other project that require only 2 OPUS control points, only 1 point shall be held vertically and the other point will be elevated using a level following the department's guidelines for establishing vertical control.

A level run is required on ALL main project control.

6.2 Guidelines for Performing Conventional GPS Real Time Kinematic System Surveys

This type GPS data collecting technique will be considered a Stationary RTK Radio Base/RTK Rover configuration. Below are the steps that must be performed when this type of data gathering technique takes place.

1. Set up the GPS RTK Stationary Radio Base on a control point which has previously been assigned North, East and Elevation project values. A maximum distance of 5 miles from the base unit will not be exceeded while performing this type data gathering technique.
2. Before data gathering can begin the RTK operator must perform a check shot into another known control point which has previously been assigned North, East and Elevation project values. This must be done before any data gathering can take place. These check shots must not exceed 0.10 feet horizontally and 0.10 feet vertically.
3. If an occupation is performed on a photogrammetric picture point two shots must be taken. After the first shot has been taken the RTK operator must insure a complete loss of satellites has been achieved and a new satellite ambiguity resolution has been acquired. After the new ambiguity resolution has been resolved the second shot can then be taken. After reviewing the two shots to insure that they have meet the accuracy tolerances of 0.10 feet horizontally and 0.10 feet vertically the RTK operator will average the two shots to create one set of point values.
4. One shot on a topographical point will suffice.
5. Before a data gathering session is ended the RTK operator must perform a check shot into a known control point which has previously been assigned North, East and Elevation project values. This must be done before any data gathering session can end. These check shots must not exceed 0.10 feet horizontally and 0.10 feet vertically.

Georgia Department of Transportation

GDOT Publications
Policies & Procedures

Policy: 4465-8- Guidelines for Performing Network Real Time Kinematic Global Positioning System Surveys
Section: Surveys
Office/Department: Office of Design Policy and Support
Reports To: Division of Engineering
Contact: 404-699-4401

The Georgia Department of Transportation (GDOT) and its Consultant's Surveyors may use the service of a Global Positioning System (GPS) Real Time Kinematic (RTK) or Virtual Reference Station (VRS) Reference Network for photogrammetric activities as well as topographical surveys. This method may also be used for stand-alone project control on projects 0.4' miles or less in length. This includes bridge replacement surveys, roundabout, intersection, or small safety improvement surveys. Contact the Statewide Location Bureau @ 404-699-4472 for existing area control to use in a calibration.

This data gathering technique does not supersede any current Department guideline with which it may be in conflict. All current guidelines and accuracies in the Department's Phase II Database Contract and/or Scope of Services contracts must be adhered to.

To use the GPS Reference Network technology, the Department and its Consultant's Surveyors must first perform a confinement (this is known by localization, transformation or calibration based on which GPS vendor is used) to known horizontal and vertical project values to ensure generated values from GPS Reference Network match the existing horizontal and data values established for the project.

A. The process for establishing this confinement will be as follows.

1. Control pairs for each end of the project must first be established following current Department guidelines. This is a minimum of four deltas with position and elevation values for each project area.
2. The confinement will consist of holding a position and elevation tie at one end of the project and holding a position only tie at the opposite end of the project.
3. The same geoid file used during control establishment must be utilized in the solutions obtained when using the GPS Reference Network.
4. After the confinement is performed two check shots will be taken on the two control deltas that were not held to establish the confinement to project values. These check shots will not exceed 0.10 survey feet in position and 0.10 survey feet in elevation. More check shots may be taken inside the area of point collection if the Department and/or Consultant Surveyors wish, but the two shots mentioned previously will be the minimum.
5. This confinement will not exceed five miles in length. If the project exceeds five miles in length, another confinement using the same guidelines as listed above shall be performed. A new pair of control points will be needed for the new confinement. The new pair of control points along with a pair of control points from the previous confinement may be used for the new confinement. Four new control points may be used but the previously mentioned method will be the minimum requirement.
6. A minimum of three points with position and elevation values collected from the preceding confinement shall be collected using the new confinement for a data integrity check between the two confinements. These three data integrity check shots between the two confinements will not exceed 0.10 survey feet in position and 0.10 survey feet in elevation.

B. In addition, a check shot is to be taken each time the GPS unit is powered back on after equipment down time and/or the surveyor has acquired a new ambiguity resolution. More check shots may be taken inside the area of point collection if the Department and/or Consultant Surveyors wish but the previously mentioned method will be the minimum. The check shot(s) can be on any point which has position and elevation values and is inside the area of point collection. This check shot(s) will not be in excess of 0.10 survey feet in position and 0.10 survey feet in elevation.

C. A copy of the confinement report(s) as well as a copy of all check shots performed on the project will be supplied to the Department upon request. If these reports are not available at the time requested the data would be considered suspect and the Department and/or Consultant Surveyors would be required at their expense to perform as many field data checks, as the Department deems necessary to ensure data integrity of the project.

D. The GPS Reference Network will not be used if the control pairs are 11.2 miles beyond the established network coverage area. This means the Department will not accept any data established by GPS Reference Network if the control pairs are 11.3 miles or more from the closest GPS base station and outside of the subscribed network area. This distance only pertains to projects that are outside of an established network. This distance does not pertain to shots taken inside the network area. In addition, GPS Reference Network and/or RTK of any kind will not be allowed to establish project control values on Department projects. The Department currently has guidelines in place for establishing project control which must be adhered to.

E. The Department highly recommends that GDOT and/or Consultant Surveyors perform proper GPS mission planning prior to any fieldwork. This includes but is not limited to satellite availability, PDOP, GDOP, known ellipsoid errors in the work area, multi-path influences, cell phone coverage and base station network reliability. All of these error sources can contribute to poor GPS performance, which can result in the rejection of the data by the Department.

F. Consultant Note: It is important to note that the Consultant will ultimately be held responsible for all of their incoming data. Data found to be in error will be recollected and resubmitted at the Consultants' expense. It is responsibility of the Consultant to build in whatever quality control mechanisms that they deem necessary to ensure the integrity of their data. Failure to do so could result in additional cost to the prime and/or survey Consultant. The Department will recollect any surveys performed by Department Surveyors and found to be in error.

References:

None.

History:

Copied to GDOT Publications v.02.00.00 on 2/21/2012
added to TOPPS: 02/12/07
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6.3 Guidelines for Performing Network Real Time Kinematic Surveys

The Department and its Consultants Surveyors may use the service of a Global Positioning System (GPS) Real Time Kinematic (RTK) or Virtual Reference Station (VRS) Reference Network for photogrammetric activities as well as topographical surveys.

This data gathering technique does not supersede any current Department guidelines, which it may be in conflict with. All current guidelines and accuracies in the Departments Phase II Database Contract and/or Scope of Services contracts must be adhered to.

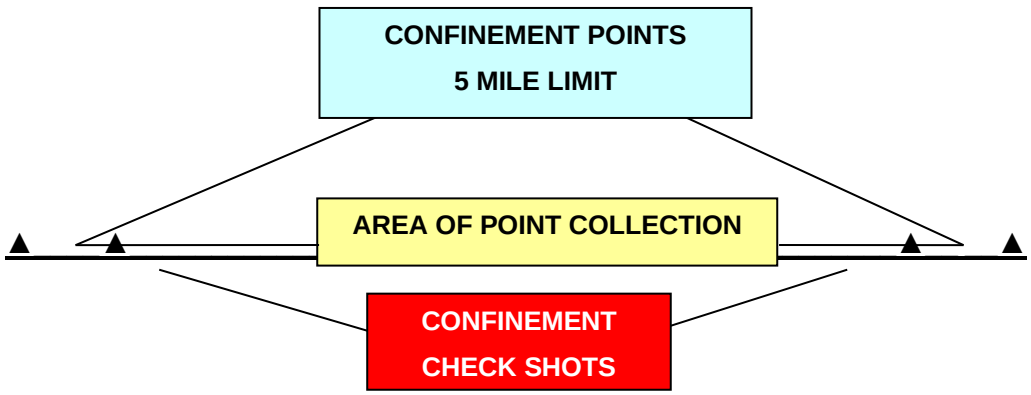
To use the GPS Reference Network technology, the Department and its Consultants Surveyors must first perform a confinement (this is known by localization, transformation or calibration depending on which GPS vendor is used) to known horizontal and vertical project values to ensure generated values from GPS Reference Network match the existing horizontal and vertical data values established for the project. The process for establishing this confinement will be as follows:

1. Control pairs for each end of the project must first be established following current Department guidelines. This is a minimum of four deltas with position and elevation values for each project area.
2. The confinement will consist of holding a position and elevation tie at one end of the project and holding a position only tie at the opposite end of the project.
3. The same geoid file used during control establishment must be utilized in the solutions obtained when using the GPS Reference Network.
4. After the **confinement** is performed two check shots will be taken on the two control deltas that were not held to establish the confinement to project values. These check shots will not exceed 0.10 survey feet in position and 0.10 survey feet in elevation. More check shots may be taken inside the area of point collection if the Department and/or Consultant Surveyors wish, but the two shots mentioned previously will be the minimum.
5. This confinement will not exceed five miles in length. If the project exceeds five miles in length, another confinement using the same guidelines as listed above shall be performed. A new pair of control points will be needed for the new confinement. The new pair of control points along with a pair of control points from the previous confinement may be used for the new confinement. Four new control points may be used but the previously mentioned method will be the minimum requirement.
6. A minimum of three points with position and elevation values collected from the preceding confinement shall be collected using the new confinement for a data integrity check between the two confinements. These three data integrity check shots between the two confinements will not exceed 0.10 survey feet in position and 0.10 survey feet in elevation.
7. In addition, a check shot is to be taken each time the GPS unit is powered back on after equipment down time and/or the surveyor has acquired a new ambiguity resolution. More check shots may be taken inside the area of point collection if the Department and/or Consultant Surveyors wish but the previously mentioned method will be the minimum. The check shot(s) can be on any point which has position and elevation values and is inside the

area of point collection. This check shot(s) will not be in excess of 0.10 survey feet in position and 0.10 survey feet in elevation.

8. A copy of the confinement report(s) as well as a copy of all check shots performed on the project will be supplied to the Department upon request. If these reports are not available at the time requested the data would be considered suspect and the Department and/or Consultant Surveyors would be required at their expense to perform as many field data checks, as the Department deems necessary to ensure data integrity of the project.
9. The GPS Reference Network will not be used if the control pairs are 11.2 miles beyond the established network coverage area. This means the Department will not accept any data established by GPS Reference Network if the control pairs are 11.3 miles or more from the closest GPS base station and outside of the subscribed network area. This distance only pertains to projects that are outside of an established network. This distance does not pertain to shots taken inside the network area. In addition, GPS Reference Network and/or RTK of any kind will not be allowed to establish project control values on Department projects. The Department currently has guidelines in place for establishing project control which must be adhered to.
10. The Department highly recommends that the Department and/or Consultant Surveyors perform proper GPS mission planning prior to any fieldwork. This includes but is not limited to satellite availability, PDOP, GDOP, known ellipsoid errors in the work area, multi-path influences, cell phone coverage and base station network reliability. All of these error sources can contribute to poor GPS performance, which can result in the rejection of the data by the Department.
11. Consultant Note: It is important to note that the Consultant will ultimately be held responsible for all of their incoming data. Data found to be in error will be re-collected and resubmitted at the Consultants' expense. It is the responsibility of the Consultant to build in whatever quality control mechanisms that they deem necessary to ensure the integrity of their data. Failure to do so could result in additional cost to the prime and/or survey Consultant. The Department will re-collect any surveys performed by Department Surveyors and found to be in error.

Confinement Example



6.4 Guidelines for Performing On-Line Positioning User Service (OPUS)

The Department has experienced situations where the use of The National Geodetic Survey's (NGS) On-line Positioning User Service (OPUS) could be utilized as a means to provide GPS user's easier access to the National Spatial Reference System (NSRS). This easier access will result in lower production costs to the Department for survey related information, based on a reduction of post processing time, reconnaissance time required to find suitably precise or accurate control for project origination, and field time presently required to derive survey control information.

OPUS will allow users to submit GPS data files in RINEX or Hatanaka compressed (yyd suffix) format to NGS, where the data will be processed to determine a position using NGS computers and software. Since the NGS software will only process dual-frequency, carrier-phase data (L1 & L2), Single frequency data (L1 only) will not be processed and thus will not be permitted for use with this technology on any Departmental projects. This standard will ensure that the post processing is done uniformly and accurately from project to project independent of the equipment brand utilized or the survey ability of the user. **The following guidelines are to be considered the minimum requirements which should be adhered to when utilizing this new technology and the Department reserves the right to revise or change these minimum guidelines at any time.**

Design Projects which have the following stated project type will be eligible to use the Online Positioning User Service (OPUS) provided by NGS for the establishment of survey control.

- Intersection Improvements
- Grade Crossings
- Safety Improvement projects equaling up to or less than 0.50 miles in length
- Stand Alone Bridge replacement projects which are not part of an existing mapping database

Note: For projects that require only 2 OPUS control points, only 1 point shall be held vertically and the other point will be elevated using a level following the department's guidelines for establishing vertical control.

A level run is required on all main project control.

The Department will reserve the right to classify or state each project type individually and independent of previous or past project classifications. Each project will be reviewed on an individual basis by the Statewide Location Bureau (SLB) to determine the suitability of the project to apply use of this technology. This is to ensure that no current databases or survey control exist along proposed project or project corridor. A survey request with written permission given by the Department will be required for any project to utilize this technology. This procedure will help ensure that a single project does not have two separate databases with different values. This request will also ensure documentation to the fact that the originator of the control values will bear full responsibility for provided delta values. There could be a large time lapse between the time the data is collected and the time the Department would receive the data for review meaning there may be no data from CORS to verify or process from since this is an automated process.

HORIZONTAL CONTROL GUIDELINES (OPUS)

A main or primary control point will be required for the project. This main control point will require a *minimum occupation time of two hours* during peak satellite cover on the day of occupation from a stationary antenna. Two additional 30-minute occupation ties will be required from the main control point to any other control deltas set on project. If azimuth pairs are being utilized on the project, two additional 30-minute occupation ties shall be made between the azimuth pairs. The resulting file type will be formatted in the standard 8.3 RINEX convention with the extension having the 2 digit year and an "o" (oh), e.g. site3650.99o. Each RINEX file that is submitted will be processed with respect to 3 Continuously Operated Reference Stations (CORS) sites. There are approximately 5 tests done for compatibility between the given location and the CORS sites; e.g., if the time block requested is compatible with the CORS site, if there is a high multi-path environment, etc. OPUS starts with the closest site(s) to your given location, and conducts these tests on each site for its compatibility to these 5 tests, and if the closest site is not compatible, OPUS then continues to search out sites until it is able to find 3 sites that are compatible, and uses them. OPUS will always report positions back to the user as geocentric Cartesian coordinates (X,Y,Z) and in geodetic coordinates (latitude, longitude, ellipsoid height) in both the North American Datum of 1983 (NAD83) and the International Earth Rotation Service Terrestrial Reference Frame (ITRF). OPUS will also report the Universal Transverse Mercator (UTM) northing and easting values. The Department will only accept the NAD83 state plane coordinates specified as northing and easting values for horizontal project control unless otherwise specified.

HORIZONTAL and VERTICAL CONTROL GUIDELINES (OPUS)

A main or primary control point will be required for the project. This main control point will require a *minimum occupation time of four hours* during peak satellite cover on the day of occupation from a stationary antenna. Two additional 30-minute occupation ties will be required from the main control point to any other control deltas set on project. If azimuth pairs are being utilized on the project, two additional 30-minute occupation ties shall be made between the azimuth pairs. The resulting file type will be formatted in the standard 8.3 RINEX convention with the extension having the 2 digit year and an "o" (oh), e.g. site3650.99o. Each RINEX file that is submitted will be processed with respect to 3 Continuously Operated Reference Stations (CORS) sites. There are approximately 5 tests done for compatibility between the given location and the CORS sites; e.g., if the time block requested is compatible with the CORS site, if there is a high multi-path environment, etc. OPUS starts with the closest site(s) to your given location, and conducts these tests on each site for its compatibility to these 5 tests, and if the closest site is not compatible, OPUS then continues to search out sites until it is able to find 3 sites that are compatible, and uses them. OPUS will always report positions back to the user as geocentric Cartesian coordinates (X,Y,Z) and in geodetic coordinates (latitude, longitude, ellipsoid height) in both the North American Datum of 1983 (NAD83) and the International Earth Rotation Service Terrestrial Reference Frame (ITRF). OPUS will also report the Universal Transverse Mercator (UTM) northing and easting values. The Department will only accept the NAD83 state plane coordinates specified as northing and easting values for horizontal project control unless otherwise specified. The Department will only accept the North American Vertical Datum of 1988 (NAVD88) orthometric elevations for vertical project control unless otherwise specified.

Note: For projects that require only 2 OPUS control points, only 1 point shall be held vertically and the other point will be elevated using a level following the department's guidelines for establishing vertical control.

A level run is required on all main project control.

6.5 Guidelines for Utilizing LIDAR on State Projects

The Department allows the use of LIDAR (Light Detection and Ranging) for survey on many types of projects. Terrestrial, Aerial and Mobile LIDAR can all be utilized on GDOT projects.

When utilizing LIDAR equipment to perform Department surveys, all deliverables to the Department will remain the same as they are currently, *.asc or .csv files and Design databases. The Department will also require a calibrated, cleaned and registered final .LAS file of the point cloud data as a deliverable.

All LIDAR collected data will be localized to project control and verified.

All currently established Department guidelines for Survey and Design activities must be adhered to. The introduction of different types of equipment will not affect what the Department currently requires and accepts. The Department will require in the final submitted database that the point cloud will be decimated to 5 points per square meter.

Contact your equipment vendor for the most up to date procedures on how to be the most accurate and productive with the LIDAR equipment. Consultants utilizing LIDAR should ensure robust checks and procedures are incorporated to ensure the accuracy of the data.

The Department reserves the right to update this section in the future.

6.6 Guidelines for UAS / Drone LIDAR Use for Survey

The Department allows the use of LIDAR and camera equipped drone aircraft for survey use on certain types of projects. The consultant will be fully responsible for the accuracy of the data.

A. The following requisites must be met in order to utilize Drone LIDAR for survey projects:

1. The consultant firm must be pre-qualified by the Department in Area Class 5.06 – Topographic Remote Sensing for LIDAR and Area Class 5.04, 5.05, 5.06 and 5.07 for photogrammetric Mapping utilizing drones with cameras.
2. The consultant firm and individual pilots for the drone aircraft must adhere to the guidelines in the Departments Drone Policy # 3545-1. (Please use the hyperlink below for the latest updated policy:

   http://mydocs.dot.ga.gov/info/gdotpubs/Publications/3545-1.pdf

3. The individual pilots must be registered and approved by the Department's UAS Program Manager. (404)631-1311
4. The consultant and/or pilot must adhere to **FAA Part 107** rules.
5. To be pre-qualified for drone photogrammetry use, consultants must fly and pass a drone test site located in Jefferson County Georgia. This test is to ensure the unit and operator are capable of design grade collection and processing/extraction. The test may be required for LIDAR equipped drones also if deemed necessary by the

Statewide Location Bureau Chief. This test will be observed and checked by the Statewide Location Bureau in the same manner as the consultant's wo

B. The Department will only allow Drone LIDAR for survey on the following types of projects:
1. Projects that are less than 1 mile in length and can benefit from the technology.
2. Stand-alone projects such as intersections, bridge, and round-a-bout projects.

C. The Department requires the following as deliverables on all projects utilizing LIDAR technology. For drones utilizing cameras for mapping only number 1 and 3 applies:
1. Deliverables to the Department will be exactly the same as they are currently, *.asc or .csv files and Design databases.
2. The Department will also require a calibrated and registered final .LAS file of the point cloud data used for extraction of survey data.
3. The Department will require line work for all data typically collected as such per standard survey procedures set forth in this manual.
4. The Department will require in the final submitted database that the point cloud will be decimated to 5 points per square meter.

D. For In-House use of Drones for the purpose of collecting design grade data, the GDOT operator of the drone must pass the test site in Jefferson County Georgia to ensure the unit and operator are capable of design grade collection and processing/extraction. This test will be observed and checked by the Statewide Location Bureau for accuracy

The Department will not allow bridge decks to be surveyed utilizing LIDAR equipped drones. This will need to be picked up by field surveyors traditionally for accuracy requirements.

All data that is utilized by drones must meet the accuracy standards set forth by the Department: (0.1' for pavement and 0.5' for ground). All data collected using drones will be localized to project control and verified by traditional means. The consultant will be responsible for any data that does not meet these standards.

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Chapter 7. Consultants Checks and Notices - Contents

Chapter 7. Consultant Checks and Notices

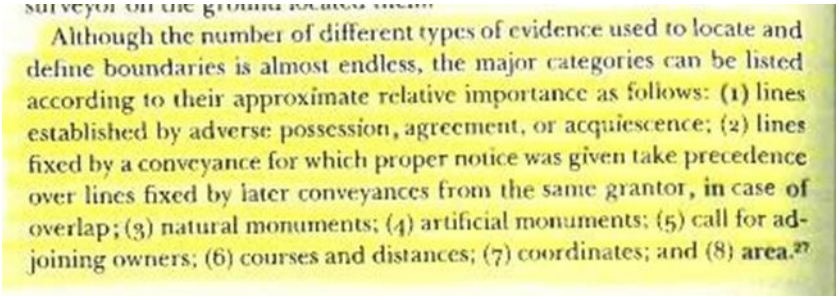
7.1 Property Resolution on GDOT Projects and GDOT Sponsored Projects

GDOT's practice to prevent conflicts, disputes and to insure accurate property databases is to hold to property pins in the resolution.

This section applies to consultants and GDOT in-house personnel who perform property and right of way resolution on GDOT sponsored projects. It has always been GDOT's in-house procedure to hold to field located monumentation that reasonably fits the deeds, plats and ROW information of the corridor parcels unless senior rights or another contrary intent indicated by a deed dictates it should not. The term "reasonably fits" would be the tolerance that a competent Georgia Registered Land Surveyor would use based on his experience and professional judgment.

With this in mind, most property owners can point out their property corners or other monumentation as it relates to their property. Neighbors often agree that a monument is their dividing corner even though it may be off 2 tenths of a foot from the deed measurement.

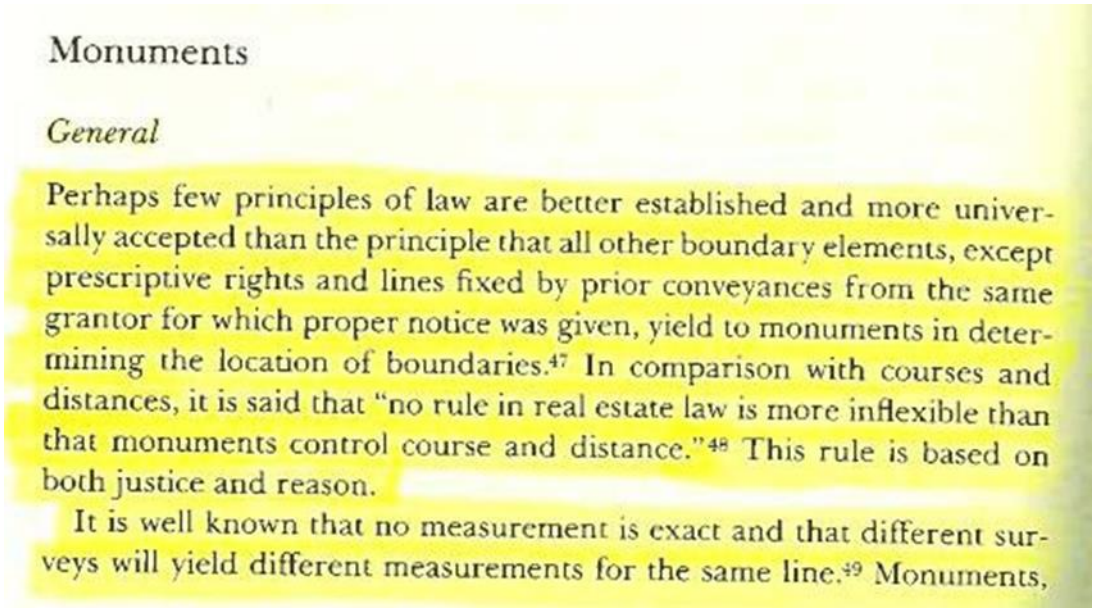
Below are excerpts from the *Georgia Land Surveying History and Law* publication written by Farris W. Cadle. Be mindful these excerpts are not ***law***, but principles for good surveys.



surveyor on the ground located them.

Although the number of different types of evidence used to locate and define boundaries is almost endless, the major categories can be listed according to their approximate relative importance as follows: (1) lines established by adverse possession, agreement, or acquiescence; (2) lines fixed by a conveyance for which proper notice was given take precedence over lines fixed by later conveyances from the same grantor, in case of overlap; (3) natural monuments; (4) artificial monuments; (5) call for adjoining owners; (6) courses and distances; (7) coordinates; and (8) area.[27]

(Page 398- Georgia Land Surveying History and Law, Farris W. Cadle, 1991 University of Georgia Press)

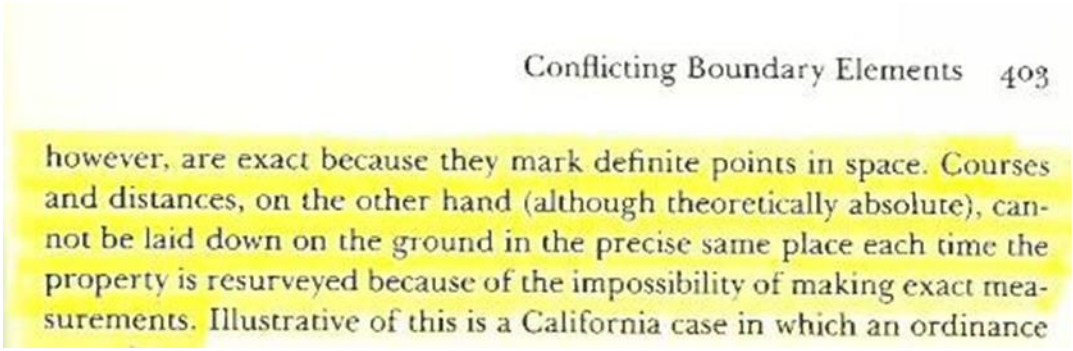


Monuments

General

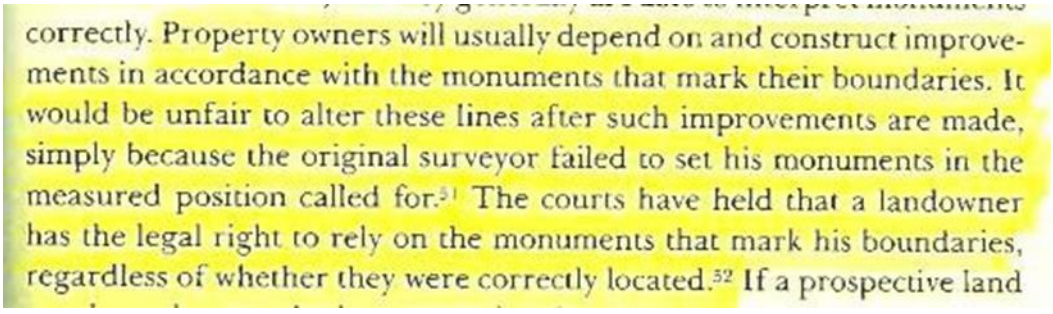
Perhaps few principles of law are better established and more universally accepted than the principle that all other boundary elements, except prescriptive rights and lines fixed by prior conveyances from the same grantor for which proper notice was given, yield to monuments in determining the location of boundaries.[47] In comparison with courses and distances, it is said that "no rule in real estate law is more inflexible than that monuments control course and distance."[48] This rule is based on both justice and reason.

It is well known that no measurement is exact and that different surveys will yield different measurements for the same line.[49] Monuments,



however, are exact because they mark definite points in space. Courses and distances, on the other hand (although theoretically absolute), cannot be laid down on the ground in the precise same place each time the property is resurveyed because of the impossibility of making exact measurements. Illustrative of this is a California case in which an ordinance

(Page 402-403 Georgia Land Surveying History and Law, Farris W. Cadle, 1991 University of Georgia Press)



correctly. Property owners will usually depend on and construct improvements in accordance with the monuments that mark their boundaries. It would be unfair to alter these lines after such improvements are made, simply because the original surveyor failed to set his monuments in the measured position called for.[51] The courts have held that a landowner has the legal right to rely on the monuments that mark his boundaries, regardless of whether they were correctly located.[52] If a prospective land

(Page 403- Georgia Land Surveying History and Law, Farris W. Cadle, 1991 University of Georgia Press)

Rotated Property Geometry

All GDOT projects are surveyed on the state plane coordinate system. With this in mind, all parcels should be individually rotated from magnetic north to grid north for the best possible property resolution.

For future in-house and consultant database checks, GDOT will be assessing if field located monuments are being held in property resolution. If a marker is not held to, GDOT may require an explanation. Checks will also be made to verify if the parcels have been rotated.

If you have any questions on this matter please contact:

GDOT Statewide Consultant Compliance Supervisor 404-699-4449

GDOT Statewide Survey Data Specialist 404-699-4446

7.2 Consultant Database and Consultant Check Deliverables

PROJECT NO: _____ P.I. NO: _____

FIELD ENHANCEMENTS BY: _____ DATE: _____

MAPPING FILES PRODUCED BY: _____ GDOT PROJECTMANAGER _____

Note: All Consultant Surveys must be submitted through the GDOT Project Manager to the Statewide Location Bureau for Quality Assurance checks.

ITEMS REQUIRED FOR SURVEY DATABASE AND EXISTING PROPERTY OR REQUIRED R/W CHECK:

☐ Survey Control Packet (Sketch of Primary Geodetic Control Deltas & Bench Marks). A sketch of side traverse deltas or intermediate deltas are not needed.

☐ Two plots of the prop.dgn Microstation file. This file will be a plot of the resolved parcel chains and the points. The point descriptions will be turned on describing if the point was field located or computed. All of the points that make up the parcel chains should appear on zone 50 in CAiCE. The plot will also show the existing Right-of-Way chains, Required Right-of-Way chains, Survey Centerline or Existing Centerline used for resolution of the property and points and curves that make up these chains. The Microstation file can be extracted from CAiCE using the prop.cmd which is available in the Default command table in CAiCE. See **Survey Processing Guidelines page 48** for references for this command. Approved Right-of-Way plans are acceptable for this deliverable if the project has preceded that far into the design phase and checks have not been required.

If GPS was used on the project to collect data the following items will also be required deliverables.

☐ The primary traverse shall be established by conventional survey methods from existing control, or by setting and observing GPS pairs and traversing between them. All subsequent survey data shall be collected from the adjusted primary traverse values and reduced to State Plane.

☐ A printed or plotted schematic of the GPS network design. This schematic shall only show the non-trivial (independent) baselines used for the least squares adjustment of the GPS data.

☐ A Receiver Independent Exchange (RINEX) format file of the raw data and control station data used in the GPS network. A copy of the NGS Data Sheet for each GPS Control point used should accompany the RINEX data for verification of control.

Please see the links below for access to the Department's Survey Data Processing InRoads QA Checklist and a review guide:

Survey Data Processing InRoads QA Checklist

InRoads Survey QA Review Guide for Consultants

InRoads Data set should consist of the following items:

1. ALG file (Geometry files) (PI#---SDE.alg)
2. DTM
3. TOPO, PROP, and ULTE.DGN'S
4. PI#----_PSR.XLS (Property Statistics Report)
5. All deeds and plats used to build the property shall be scanned into .pdf format.
6. A LandXML file and a DGN file containing any proposed alignments. (Naming of files should be PI#---_ALIGNMENT.dgn and .xml.)

All deeds, plats, and property cards used to build property shall be scanned into one .PDF in the following order: Property card, Deed, Plat. This shall be done for each parcel. If a document is too large to be scanned, submit a hard copy with parcel number and deed book written on it. If a large document must be scanned separately into a .PDF, name the file the parcel number. See link for example.

http://www.dot.ga.gov/PartnerSmart/DesignManuals/SurveyManual/03-12903%20(4).pdf

These files should be named with proper file structure such as PI#---_SDE.DTM and PI# ----_SDE.ALG. The DGN names are PI# --- _TOPO.DGN, PI#--- _*PROP.DGN & PI*#----_UTLE.DGN. The **InRoads Survey Data Processing Guidelines** and the new **July 2010 EDG (Electronic Design Guidelines)** has to be used to meet these standards. No data should have to be processed by GDOT personnel to make the data bases usable. The Survey Package along with the GPS and Scan Data should be the same as CAICE Deliverable.

The following is a general overview of the items needed and the steps taken in completing a field check of a Consultant's mapping and existing property database:

Items needed:

- Hard copy of Consultant's survey control pack.
- Roll plots of the Consultant's mapping with the survey control, property corners (found and computed) and alignment shown.
- Asc. file containing all survey points collected in the field.
- Chain file compiled from the alignment points in the asc. file.

Things to check before starting the fieldwork:

- Check the calibration of the total station, tribrachs and prism poles.
- Download the asc. and chain file into the Allegro, or the .csv/.job file to the TSC3.
- Load a grid factor from the survey control pack into the data collector or compute a grid factor.
- Perform a few inverse and station and offset routines to make sure everything looks okay.

Field Procedures:

- Before starting the field work, it is usually best to find all the survey control and mark the location with paint on the edge of pavement.
- A check of the survey control should be made while checking the mapping and property database. This is accomplished by placing a target set on the backsight control point and foresight control point. A control re-shot for check (244) should be made on the backsight point. The forsight control point should be located as a sideshot using a closed set of angles.
- A level run should be made from a published consultant point through at least 2 other consultant control points and tie to a 4th consultant point and adjusted to verify elevations. If a BM is available, at least 1 BM should be included in the run. If the project is longer than 1.5 miles, a

small run should be made as mentioned above every 2 miles. If a bridge is on the project, one of the level runs should include control at the bridge if possible.

- Existing property corners should be staked out and then located as a sideshot.
- Computed property corners should be staked out to see if they fit well with fence lines, etc.
- From each control point ground shots and edge of pavement shots should be gathered randomly. These shots should be coded as either (160-MPCKGRD) or (161-MPCKPAV). The cross section method of gathering check shots is no longer needed.
- **Always remember, we are checking the Consultant's work, so care should be taken to ensure the check shots are taken on undisturbed ground and rod heights are checked.**

After the field checks are completed, the asc. or .csv file and raw data file should be sent to Statewide Consultant Compliance Supervisor at the Statewide Location Bureau, Engineering Management section.

7.3 Contractor Certified Cross Section Verifications

In 2019, the Office of Construction implemented Contractor Certified Cross Sections in their Contracts. Survey's role is to field verify at least three sections per mile. If errors are found, it is recommended to verify more sections in the area of concern.

The following is the workflow for the data:

1. The Consultant will submit the deliverables to the Area Construction Office.
2. The Construction Office will submit a request for a field Check to Statewide Location Bureau (SLB).
3. The SLB will submit checks to either District or SLB crews. Checks must be completed and submitted back to SLB within 20 working days.

Remember our duty here is to duplicate their work. Try to use the same control to stake the points as they used to collect the data. We are trying to follow their footsteps and shots exactly to verify accuracy.

Recommended Field Procedures

1. Perform all work with a Total Station and Rod.
2. Do not take shots over 800' from the instrument.
3. Randomly select three stations per mile to verify
4. The Consultant's shots at each station should be staked horizontally to within 0.10' and measured for a check.
5. The As-Staked report will be submitted back to SLB.
6. SLB will archive and submit back to the Construction Area Office.

DEPARTMENT OF TRANSPORTATION

STATE OF GEORGIA

SPECIAL PROVISION

Section 149 – Construction Layout

Add the following to SubSection 149.3.05:

L. Contractor Certified Cross Sections

Provide original cross sections on all areas where grading is required (including both cut and fill sections) to the Right of Way or 30 ft. (9.14 m) beyond the Construction Limits, whichever is the lesser. Initially check the main control on each setup by comparing distances and angles to ensure the control is sound and not disturbed. Cross sections are to be obtained by using Manual or Robotic Total stations or Localized GPS using localization/confinement methods per the GDOT survey manual section 6.3 for confinements. Total stations may be used for shots on pavement and ground not to exceed 800' from the instrument on any shot. GPS may be used on ground shots, only after a confinement has been properly locked in to project main survey control. No pavement should be collected with GPS. Cuts of a Digital Terrain Models (DTM) will not be allowed.

Cross sections should be taken at c/l, crowns, edge of pavements, gutters, top of curb, top of shoulder, toe of slope, ditch, and every break in terrain out to the limits. Shots shall not exceed 50' between any x-section shots regardless of terrain. When taking shots on pavement, mark the shots with a paint mark to assist GDOT with exact checks.

Obtain the cross sections after the area has been cleared and grubbed in accordance with Section 201. The cross sections may be obtained prior to clearing and grubbing if approved by the Engineer.

Submit contractor certified cross sections, at a minimum, in three separate stages. The cross sections will be field verified by the Department within 20 available working days after Contractor provides submittals and all controls used by the Contractor have been initially verified. GDOT will check 3 sections per mile initially unless errors are found. GDOT will check more as needed in event of errors. The Engineer will notify the Contractor within twenty available working days whether or not the cross sections are approved or whether any discrepancies need to be resolved.

The Contractor shall not perform any grading activity in an area until the cross sections for that area have been approved. The Engineer may approve portions of the cross sections. The Contractor may begin grading work only in the areas where the cross sections have been approved. If grading

activities begin prior to receiving approval, the effected area will be resurveyed, at no additional cost to the Department and will become the new original groundline.

In the event discrepancies are found, the 20 available day notification process will start over after the discrepancies have been resolved.

Provide cross sections that meet the following accuracy requirements:

Horizontal:	0.10 ft (30.5 mm) or less urban, 0.50 ft (153 mm) or less rural
Vertical:	0.10 ft (30.5 mm) or less paved surface, 0.50 ft (153 mm) or less ground terrain

Cross sections are to be provided at a maximum of 50-foot (20 meter) intervals along the roadway sections.

Record cross section information in formats approved by the Engineer. Provide survey field book data containing all the controls used along with the ties for both the horizontal and vertical data. Provide a comma delineated text file and paper plot of point number, Northing, Easting, Elevation, and Description on the State Grid Plane. Provide raw data of all collected information to include, Occupied station, Back Sight, x-sect shots taken, Control tie-in check shot before setup is completed and instrument picked up to move to next station.

With either survey method used, cross-section data is to be additionally submitted in an electronic format, using a standard text editor file in the format of Station – Offset – Elevation:

Station	Offset	Elevation
0.000	-25.00	274.35
0.000	-16.00	274.54
0.000	0.00	274.45
0.000	8.15	270.41
0.000	25.00	270.45

Submit an affidavit, signed and stamped by a Registered Land Surveyor, attesting to the fact that the cross sections accurately represent the terrain, and that they meet the Department's accuracy standards. Submit completed form DOT 205 SP (Contractor Certified Cross Section Form).

Checklist for each submittal:

1-Field Book of Survey control used (Control package)

2-Field Book of Control Points Used + Landxml file of the alignments

3-Plotted Points

4-Comma Delineated .CSV File of Point #, Northing, Easting, Elevation, and Description

5-Text File listing Stations-Offsets-Elevations

6-Affidavit and Certification Forms

Add the following to 149.4:

Contractor Certified Cross Sections will not be measured separately for payment.

Add the following to 149.5:

Payment for Contractor Certified Cross Sections, completed and accepted, will be made at the lump sum price bid. The payment will be full compensation for all work specified in this Special Provision.

Payment will be made under:

Item No. 149	Contractor Certified Cross Sections	Per lump sum

OFFICE OF CONSTRUCTION

7.4 Note to Consultants

FIELD SURVEYS

Database preparation shall consist of establishing survey control and gathering and processing all necessary topographic data required to design the project, which has not already been compiled by the DEPARTMENT. This information is to include, but not be limited to, planimetric, terrain, drainage, property, right-of-way and easement data. The database and survey control shall be of sufficient quality and completeness as to allow for the design, acquisition of right-of-way and easements, and construction of the PROJECT. All information in the database shall be compiled and stored in accordance with the DEPARTMENT'S Survey Processing Guidelines (feature codes, zones, attributes, cell files) and Electronic Data Guidelines (levels, line weights, colors, classifications, text sizes and fonts). The data shall be gathered by remote sensing or field surveying processes that are acceptable to the DEPARTMENT. The survey limits shall be defined as those required to design the PROJECT. All survey control for DEPARTMENT projects shall be submitted to the Statewide Location Bureau for archiving. The CONSULTANT shall check any data or information furnished by the DEPARTMENT for accuracy to determine that it is sufficient to meet the requirements and needs of the PROJECT. The Consultant shall be fully liable for the accuracy and quality of the survey and mapping data base and all accuracy standards set forth by the Department must be adhered to. Any quality checks that are performed by the Department are done so as a partial check of the project and the check shots are taken at random locations throughout the project corridor. Under no circumstances does a QC/QA review by GDOT release the Consultant from their contractual responsibilities involving QC/QA or from their professional liabilities involving the survey and engineering work for the project. Nor does it preclude them from recovery of damages during construction that results from errors and omissions in the plans. Also the CONSULTANT shall supply, update, or expand the mapping database throughout the entire contract term as required to design the PROJECT.

PHOTOGRAMMETRIC MAPPING ACTIVITIES

Photogrammetric mapping is an acceptable remote sensing technology for compiling topographic (planimetric and terrain) data. However, only data that can meet the accuracy standards as defined in the "Field Surveys", Section of this Phase can be gathered photogrammetrically. The mapping limits shall be defined as those required to design the PROJECT. The mapping scale for this PROJECT is described in Standard Specifications for the Preparation of Roadway Construction Plans.

The primary horizontal and vertical control traverses established for the PROJECT are to be used as the principal control for all field and photogrammetric survey activities. Real-Time Kinematic, Rapid Static or Static GPS surveys may be used for positioning photo control points.

All photogrammetric data must be compiled and processed in accordance with the DEPARTMENT'S Electronic Data Guidelines and Survey Processing Guidelines.

The CONSULTANT shall furnish electronic mapping of the PROJECT(S) identified by this agreement. The CONSULTANT will also furnish any other electronic topographic data required for the design process, i.e., digital terrain modeling, cross sections and relevant field survey data.

> The coordinate datums used by the CONSULTANT for the mapping shall be the State Plane, Georgia Coordinate System of 1985 - NAD 83/94 adjustment and the North American Vertical Datum (NAVD) of 1988.

When compiling data in the PLANIMETRIC/DTM method all planimetric features will be gathered except flow arrows, ridgelines, and spot elevation. Tree lines will be gathered to aid the field crew in locating OBSCURED AREAS. Planimetric mapping of all cultural features whether natural or manmade shall be gathered and compiled into a 2-D MicroStation dgn.

The CONSULTANT shall provide the following planimetric map data:

1. The State Plane Coordinate Grid System shall be included and properly oriented in the map database. Approximately twenty-five (25) percent of the grid ticks shall be labeled with their coordinate value.
2. All primary survey control points (horizontal and vertical) shall be included and identified in the map file.
3. The map shall contain all planimetric features. This includes all land use features, such as buildings, lakes, rivers, streams, canals, ditches, reservoirs, trails, roads (highways), railroads, quarries, borrow pits, cemeteries and orchards. Also included shall be the type of telephone, telegraph, and electric power transmission lines and their poles and towers, fence lines, tree lines, billboards, walls, bridges, tunnels, piers, retaining walls, dams, power plant transformers and other substations, transportation terminals, airfields and storage tanks.
4. An adequate number of spot elevations shall be provided to define all Terrain slopes and grades. These elevations should be placed on existing roads, streets, bridges, railroads and any other paved areas within the mapping corridor. Elevations shall also be shown on hilltops, in saddles, at the bottom of depressions, and at 50 foot intervals along streamlines, ridgelines and drain lines. Water level elevations shall be shown in the center of small lakes, small reservoirs and ponds. Terrain that is obscured by vegetation, water or under construction shall be identified with a polygon and labeled in accordance with the DEPARTMENTS Electronic Data Guidelines.
5. All drainage areas included within the mapping limits shall be delineated by ridgelines, flow arrows and drain lines. Spot elevations shall be provided at least every 50 feet along all ditches and drain lines. Symbols, names and line fonts used to define planimetric and topographic features shall be in accordance with symbols designated by the DEPARTMENT. Each drainage way shall be located on the map and their courses defined as they meander along the ground. Streams or drainage ditches averaging more than 0.003 foot in width on the map shall be shown by two symbolized lines. Other streams and ditches shall be shown as a single symbolized line. All line-like features, such as highways, railroads, telephone and electric power transmission lines, fences, curb and sidewalk lines and so forth shall be gathered. The names of State and Federal highways, paved and unpaved roads, rivers, streams, railroads and other features of importance shall be included in the map database. The font type and size for all labeling shall be defined by the DEPARTMENT and shall not interfere with any map features.

The CONSULTANT shall provide the following Digital Terrain Model (DTM) Map Data:

1. Terrain elevations (X, Y, Z coordinates) in the amount necessary to produce an electronic map which meets American Society of Photogrammetry and Remote Sensing (ASPRS) CLASS I standards. The vertical accuracy requirements of points shall meet ASPRS Standard Class I for a 1 foot contour map. Data gathered for a DTM must include lines of discontinuity that define all terrain breaks and the database must also be densified with random elevations that do not exceed a 150 foot grid. The DTM shall not be created from cross sections.
2. Terrain areas which cannot be gathered photogrammetrically shall be defined in the DTM file and in the Planimetric file with a closed polygon. In the DTM file this polygon shall be collected in a manner that creates a profile of the terrain which encompasses the obscured area. Text will be placed in each polygon, in the Planimetric file, to identify the area as obscured. This will aid field crews in locating and enhancing these areas in order to provide a complete DTM database.
3. All photogrammetric terrain mapping files must be encompassed with a limit line that is a 2-Dimensional “BORDER” feature limit line survey chain. It is essential that this “BORDER” chain be

closed and positioned to where it can be draped directly onto the DTM surface in CAiCE. Points on this chain cannot fall outside of the DTM surface.

The CONSULTANT shall compile all electronic photogrammetric data in accordance with, and meet, the ASPRS ACCURACY STANDARDS FOR LARGE SCALE MAPS-CLASS I. The aerial photography scale that shall be used for photogrammetric data collection will be 1:3000, unless otherwise approved by the DEPARTMENT.

The CONSULTANT shall perform field survey checks of horizontal and vertical points to insure the mapping data meets ASPRS CLASS I standards. These check points are only to be used as a measure of accuracy and are not to be used as a part of the mapping control. The check survey data and notes are to be provided to the DEPARTMENT.

The CONSULTANT shall deliver electronic mapping and related data that is formatted to be compatible with the DEPARTMENT'S design software. The finished maps and all related items or products shall become the property of the Department of Transportation and shall be delivered in accordance with the terms of this agreement. All information and material provided to the CONSULTANT by the DEPARTMENT shall also be returned at the completion of the agreement. The CONSULTANT shall also be prohibited from retaining, either for their own use or sale to others, copies of mapping produced or any related data produced or obtained as a result of this agreement. All mapping and terrain data shall be delivered to the DEPARTMENT on compact disks (CD).

AERIAL PHOTOGRAPHY

All aerial photography used by the CONSULTANT for collection of design related data on DEPARTMENT projects must meet the following minimum standards, unless otherwise approved by the DEPARTMENT:

1. Traditional roll film cameras must come equipped with a 6" focal length lens that has been calibrated within the past three (3) years. A current calibration report shall be provided.
    a. Imagery captured using traditional roll film cameras, with the intention of scanning for the softcopy application, must be photographed with a lens cone AWAR (Area-weighted average resolution) no less than 95.
2. Roll film imagery must be photographed with KODAK Double X Aerographic (#2405) film or equivalent, as approved by the DEPARTMENT.
3. Be flown at a scale of 1:3000 (1” = 250’), unless otherwise approved by the DEPARTMENT.
4. Meet the same aerial photography standards as defined in the U.S. Department of Transportation, Federal Highway Administration, Surveying and Mapping Manual dated November, 1985.
5. All aerial photography, diapositives, bridging data and photo control created as part of the project record shall be the property of the DEPARTMENT.
6. Each photograph shall be numbered with the following information: date, scale, and county code – route number, flight and photo number. All numbering shall be done with materials that are permanent.

7.5 Photogrammetric Services

Georgia Department of Transportation

GDOT Publications
Policies & Procedures

Policy: 4455-1 - Policy Procedure--Photogrammetric Services
Section: Reimbursable Services
Office/Department: Office of Design Policy and Support
Reports To: Division of Engineering
Contact: 404-699-4401

Purpose: This memorandum is to establish policies concerning photogrammetric services which may be performed for governmental agencies outside of the Department of Transportation.

General: The Department of Transportation will cooperate with other governmental agencies in the acquisition of photogrammetric material on a cost reimbursable basis. Assistance will normally include such activities as coordinating flying of aerial photography by consultants; preparing copies of photographs; producing topographic maps; or accomplishing other related work. The photogrammetric material is to be used for public service projects only and is not to be made available for private use.

Priorities: Photogrammetric work needed by the Department of Transportation will be accomplished on a first priority basis. Assistance for other state departments, federal agencies, and local governments will be accomplished on a second priority basis. Additional work for other agencies will not be accepted when the completion of current transportation projects will be adversely affected.

Reimbursement: The cost of accomplishing the work will be determined by the Department of Transportation and agreed upon by the requesting agency. Cost data is available upon request and will be updated annually.

Procedures: Inquiries and requests for photogrammetric services are to be sent to the Location Bureau Chief, Statewide Location Bureau, 3993 Aviation Circle, Atlanta, Georgia 30336-1593. Telephone: (404) 699-4401.

References:

None.

History:

Copied to GDOT Publications v.02.00.00 on 2/21/2012.
added to Manual of Guidance: 03/01/88 revised: 09/01/95 added to TOPPS: 05/01/96 reviewed: 11/10/06
Created at 9/15/2008 4:24:41 PM by Helene Nickey

Georgia Department of Transportation

GDOT Publications
Policies & Procedures

Policy: 4455-2- Reimbursable Cost Schedule
Section: Reimbursable Services
Office/Department: Office of Design Policy and Support
Reports To: Division of Engineering
Contact: (404) 699-4401

Details

Reimbursable Cost Schedule
for Photogrammetric, Photographic, Field Survey Services

Georgia Department of Transportation

This information is provided as a reliable source for estimating the funds that will be necessary to reimburse the Georgia Department of Transportation for work performed at the request of other State of Georgia Agencies.

This information is provided as a reliable source for estimating the funds that will be necessary to reimburse the Georgia Department of Transportation for work performed at the request of other State of Georgia Agencies.

This information should give accurate data as to estimated costs incurred by DOT. The Department does have the responsibility to insure that the actual charge is reimbursed and will bill the requesting agency. The requesting agency should estimate the amount of charges and if more than $300.00 should ask for an estimate prepared by the Statewide Location Bureau.

Inquiries concerning the compilation of these costs should be directed to the Location Bureau Chief at (404) 699-4401 or the Bureau of Photogrammetry and Surveys at (404) 699- 4450.

REIMBURSABLE COST SCHEDULES:	
See 4455-2a	See 4455-2b

References:

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History:

Copied to GDOT Publications v.02.00.00 on 2/21/2012
written by: David E. Studstill, P.E., State Environment/Location Engineer added to Manual of Guidance: 03/01/88
revised: 09/01/95 added to TOPPS: 05/01/96 revised: 02/24/97 revised: 03/02/99
Created at 9/15/2008 4:27:54 PM by Helene Nickey

Georgia Department of Transportation

GDOT Publications
Policies & Procedures

Form Word: 4455-2a - Policy 4455-2 Reimbursable Cost Schedule - Photographic Products
Section: Reimbursable Services **Reports To:** Division of Engineering
Office/Department: Office of Design Policy and Support **Contact:** 404-699-4401

Reimbursable Cost Schedule--Photographic Products

1.	**Administrative charge**	$11.60/ hr.
2.	**Machine Processed Contact Prints (B & W 1594 kind) Paper**	
	a. Contact print	$5.00
	b. Fixed cost initial setup	$20.00
3.	**Enlargements - Saltzman Projector**	
	Machine processed (1594 kind) paper	$5.00 /sq. ft.
	Machine processed film:	
	a. Projection positives	$6.50 /sq. ft.
	b. High speed duplicating	$6.50 /sq. ft.
	c. Projection negative	$6.50 /sq. ft.
	Fixed cost initial setup - black and white	$19.00
	Fixed cost initial setup - color	$30.00
4.	**Lanston Monotype Precision Calibrated Reproduction**	
	Camera copy work (Flat Work)	
	Machine processed (1594 kind) paper	$5.00 /sq. ft.
	Machine processed film:	
	a. Projection positives	$6.50 /sq. ft.
	b. High speed duplicating	$6.50 /sq. ft.
	c. Projection negative	$6.50 /sq. ft.
	Setup cost - black and white	$30.00
	Setup cost - color	$40.00
5.	**Saltzman - Color Enlargements**	
	Fixed cost initial setup	$32.00
	Color enlargement/sq. ft.	$7.00
	Setup cost for each new negative	$20.00
	Mounting	$8.50 /sq. ft.
6.	**Color Contact Prints**	
	Color contact 9 x 9 first print	$27.00
	Color prints on same flight line	$7.00
7.	**Slides 35 MM**	
	Copy work and setup	$25.00
	Film and processing (24 exposures - outside processing)	$16.00

8.	**Color Infrared Photographic Prints**	
	The Statewide Location Bureau must have an inter-negative made from the positive film before color infrared photographs can be produced. The cost of production on inter-negatives is as follows:	
	Color inter-negative	$20.00
9.	**Cibachrome Print**	
	Direct print on I.R. color	$33.00
	Additional prints	$8.50
10.	**Color Photographs from Inter-Negatives**	
	Contact prints	
	First print	$27.00
	2-50 prints (each)	$7.00
11.	**Film Diapositives (Black & White)**	
	Film diapositive (9.25" x 9.25" x 0.007")	$9.50
	Duplicate negative	$9.50
12.	**Acquisition of Aerial Negative**	
	Flying time	$435.00 /hr.
	Minimum flying time	$435.00
	Cost per black and white aerial negative	$14.50 /neg.
	Cost per color positive aerial negative	$15.50 /neg.
	Cost per color negative aerial negative	$17.50 /neg.
	Cost per infrared false color aerial negative	$15.50 /neg.
	Cost per black and white infrared aerial negative	$6.25 /neg.

References:

None.

History:

Copied to GDOT Publications v.02.00.00 on 3/21/2012

Georgia Department of Transportation

GDOT Publications
Policies & Procedures

Form Word: 4455-2b - Policy 4455-2 Reimbursable Cost Schedule - Other Services
Section: Reimbursable Services **Reports To:** Division of Engineering
Office/Department: Office of Design Policy and Support **Contact:** 404-699-4401

Reimbursable Cost Schedule–Other Services

13. Labor and Expenses

Estimated labor charge per hour	$24.00

Expenses will be a direct reimbursement

14. Field Survey:

Horizontal and Vertical Control Acquisition (20 hours)	$1550.00 /mile
Computing	$150.00 /day

15. Photogrammetric Processes

1. Planimetric and Topographic Map Compilation	$1657.60 /mile
2. Map Editing	$370.00 /mile
3. Digital Terrain Modeling (DTM)	$1832.60 /mile
4. Design Cross Sections	$308.00 /mile
5. Original Pay Quantity Cross Sections	$553.00 /mile
6. Final Pay Quantity Cross Sections	$499.80 /mile

The following criteria was used in calculating the above figures:

A. Medium urban area.

B. Corridor width of 800 feet for planimetric, topographic and DTM work.

C. Measurement of 50 foot stations for cross section work.

D. Photographic scale of 1 inch = 250 feet.

E. Labor charge of $14.00/hour.

The above prices include picking the location of field control on the photography,
control bridging, bridged control editing and data processing. They do not include
the acquisition of aerial photography or field control.

16. Microstation Paper Plots

1. Microstation plot of regular size mapping sheet.	$4.00 /each
2. Blueline copy of regular size mapping sheet.	$3.00 /each

These figures are for estimating purposes only, the actual charge will be reimbursed.

17. Photogrammetric Survey Measurements

Analytical Aerial Triangulation

1. Cost per stereoscopic model	$25.00

This cost includes marking, measurement and computation.

Note: At a photography scale of 1"=250', 6.5 models=1 mile.

References:

None.

History:

Copied to GDOT Publications v.02.00.00 on 3/21/2012

7.6 Consultant Ownership of Existing Survey Database

On occasion GDOT may ask a consultant to update an existing database done by others. To clear up any areas where ownership is in question, the following will take place:

- GDOT will allow hours for the consultant to QAQC the database. The hours allowed will follow the same amount as the Department's current QAQC consultant teams. Three setups per mile should be made. Random shots should be taken in all directions from each setup. Shots should be stored using GDOT feature codes MPCKPAV for pavement data and MPCKGRD for ground data.
- DTM, Pavement, and Property shots will be taken from each Setup. Shots should not exceed 600' in either direction from the instrument for DTM and Pavement checks.
- The consultant will take checks shots between random control points using conventional means to check distance and angle. These should check 0.04'
- An electronic level run will be made between random control points for elevation checks. The errors should not exceed 0.03' between any control points
- Random Property corners (pins/rebar) and computed points will be checked. Hard corners should meet 0.20' tolerance/ computed points 0.25-0.50'. These will be analyzed based on each property specifics as each project is different.
- Random Pavement and ground shots will be taken throughout the project for DTM check. This DTM area should meet 0.10' on pavement on 85% of check shots and 0.50' on ground on 85% of check shots.
- The raw data and a .CSV file of the check shots, with point number, North, East, Elevation, and Feature code will be submitted to GDOT SLB for archiving.

The consultant will be responsible for all new updates. They will also be responsible for all areas checked by the QAQC phase. In the event errors arise during construction or other phases, SLB will analyze the supplied checks .CSV file to determine if the location with errors is the consultant responsibility.

If the errors fall outside the database update scope and the QAQC checks, GDOT will notify the previous consultant to correct the errors if feasible. If this is not feasible, GDOT will allow the current consultant to survey for corrections through another task order or supplemental agreement, assuming the contract has not expired.

Consultant should submit a document (word, pdf, etc.) listing the date that the property database is completed and accurate. The consultant can also state any other notes, issues, findings with the survey database in this document.

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Chapter 8. Safety - Contents

Chapter 8. Safety

8.1 Guidelines for Surveyor Safety

This section will be dedicated to the memory of Danny Wilbanks, Survey Resident Engineer of District 6 and Tommy Hudson, Survey Party Chief of District 4. Both men were killed while performing their survey duties for the Georgia Department of Transportation. These men were killed through no fault of their own and while following all Department safety guidelines. Remember that while we are along the roadway or in the woods we must help lookout for one another. We, the survey field crews and the survey supervisors, must be on the lookout for all potential areas of possible danger. We must help each other remain safe in a dangerous environment.

First and foremost it is the responsibility of all survey section supervisors to know all the safety regulations related to personnel under their charge. In addition it is also the survey section supervisors' responsibility to insure that all crews under their direction have every required piece of safety equipment needed to meet those regulations and create a work site that is as safe as possible. It is the responsibility of all crew members to insure that the survey supervisor knows what equipment may be needed to help insure their safety either through oral or written communication. Safety is not a one way street. It will take everyone working together to create the safe work environment we all desire.

Any ideas anyone has on creating a safer work environment for surveyors may contact your supervisor or the Statewide Cadastral Engineering Supervisor at the Statewide Location Bureau. This contact number is 404-699-4442. The SCES will be happy to hear any and all valid safety suggestions and follow through on them. If appropriate they will be included into this portion of our survey manual.

8.2 Safety Vest

A beginning in staying safe along a publically traveled roadway is to be as highly visible as possible. The Department has guidelines in place which will help us do so with TOPPS policies (number 7180-7, 7180-8, 7130-6, and 7130-8). These policies have been placed on the following pages for your convenience. It also can be found on the Departments web site. Remember, these are Department guidelines which must be adhered to. This does not mean we cannot go beyond these guidelines and enhance our work area. Anytime you have a chance to be more highly visible along the roadway which does not hinder the traveling public bring it to your supervisors' attention for consideration. It could be the one idea which saves fellow coworkers or your own life.

8.3 Policy # 7180-7 and 7108-8

Policy: 7180-7- Personal Protective Equipment Policy - Safety Vests-Garments
Section: General Personnel Policies
Office/Department: Human Resources
Reports To: Human Resources
Contact: 404-631-1000

The goal of the Department of Transportation is to ensure the safety of all employees. In keeping with this goal the following policy has been adopted.

All Department employees shall be required to wear a GDOT approved ANSI Class III (3) high visibility safety vest/garment while working within the rights of way of interstate highways, U.S. highways, state roads, any other public roads or any maintenance/construction project, hereafter referred to as a "recognized DOT work site". This is to include the loading and unloading of materials and/or the operation of equipment at any DOT facility or yard.

All visitors shall be required to wear an approved ANSI Class III (3) safety garment while visiting recognized DOT work sites as described above.

It shall be the responsibility of each employee to ensure that his/her safety vest/garment is kept clean/laundered to maintain the reflectivity and visibility the garment is designed to provide. The safety vest/garment shall be worn on top of all other clothing, jackets or garments. No employee shall be allowed to work at a DOT work site without the approved safety garment.

All employees subject to this policy shall be issued an approved safety vest/garment and will be required to sign the Issuing of Personal Protective Equipment Agreement, DOT 1200.

The only exceptions to this policy are:

- Use of an approved Class III ANSI jacket, rain pants, long or short sleeve tee shirt or short sleeve polo shirt in orange or lime green is acceptable and available for employee purchase from the Employees Association.

  NOTE: The jacket, rain pants, long or short sleeve tee shirt or short sleeve polo shirt may be purchased at your discretion and used in place of the approved GDOT issued safety garment but its use is not mandated under any circumstances.

- The operation of any ride vehicle while in transit.
- Fueling a ride vehicle at a DOT facility or yard.
- An employee making repairs and/or performing service to equipment inside a DOT facility or yard.
- GDOT approved ANSI/ISEA 207 Public Safety Vest for the HERO unit.

For purposes of this policy, a ride vehicle is DOT equipment with a prefix of 124, 125, 126, 127, 128, 400, 401, 402 and 404.

Violation of this policy shall be grounds for disciplinary action.

The process used to select and approve the vests/garments and other safety equipment may be read in Procedure 14-2 and replacement procedures may also be read in Procedure 14-1.

References:

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History:

approved ANSI Class III info added, 5th bullet under exceptions added: 11/20/15; added to TOPPS: 01/24/01

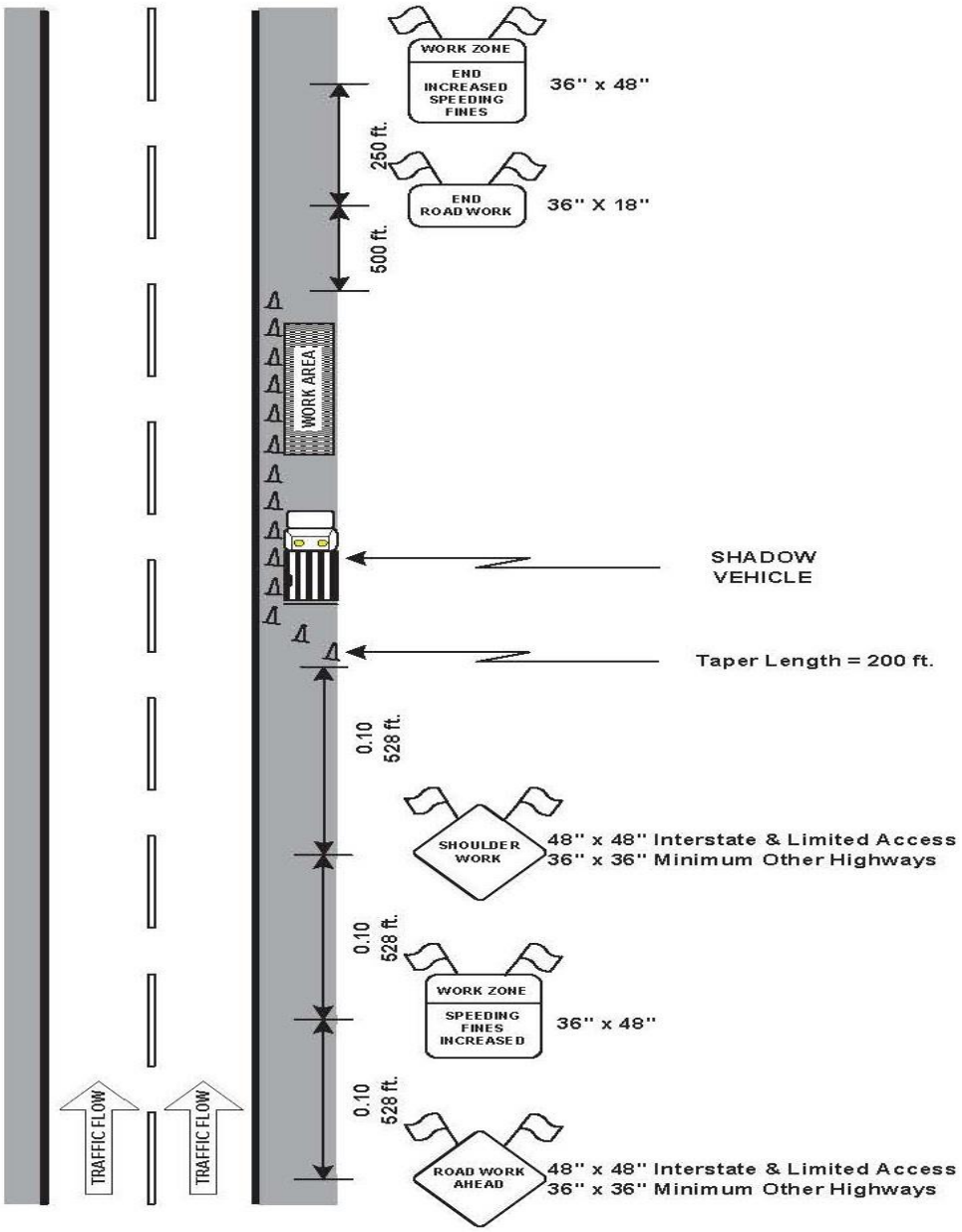
Reviewed: 11/20/2015

SAFETY SIGNS

To help enhance our visibility along the roadways each crew must have a minimum of two “SURVEY CREW” or “SURVEY CREW AHEAD” safety signs. These signs must be a minimum of 36” x 36” in dimension, 48” X 48” minimum for Interstate work, and be orange with black lettering. An example is shown below for your convenience. These signs are to be placed no less than 528’ (0.10 mile) before entrance of the intended work area. One sign is required on each end of the daily work zone facing in the direction of oncoming traffic entering the work zone.

Please see the document on the following page for information of when lane closures are required:

Shoulder Maintenance



Georgia Department Of Transportation Operations
Work Zone Traffic Control

Paved Shoulder Maintenance

Notes:
1) If work is within 3 feet of travel lane, single lane closure standard is required and shall not exceed two miles.
2) For short duration operations of 30 minutes or less, (i.e. Debris removal, Litter Pick-up, etc.) all signs and channelizing devices may be eliminated if a vehicle with activated rotating lights or strobe lights is used.

HARD HAT/SOFT CAP PROTECTIVE HEADGEAR

Make sure you follow the guidelines listed below. Policy number 7180-8 was written with your safety and welfare in mind. If anyone has any questions regarding this policy see you supervisor or contact the Statewide Cadastral Engineer at the Statewide Location Bureau for clarification. The contact number for the SCE is 404-699-4442.

Policy: 7180-8- Personal Protective Equipment Policy - Head Gear
Section: General Personnel Policies
Office/Department: HR - Employment Relations - Safety
Reports To: HR - Employment Relations
Contact: [Department Phone Number]

The goal of the Department of Transportation is to ensure the safety of all employees. In keeping with this goal the following policy has been adopted.

An official GDOT hardhat, GDOT approved soft ball cap, GDOT approved boonie hat or GDOT approved winter knit cap shall be worn at all times for the following conditions:

1. Working within State or County owned Rights of way, any other public roads or any maintenance/construction or survey project, hereafter referred to as a "recognized DOT work site".
2. Performing physical labor. Examples of such would include work around a maintenance headquarters, facility maintenance, asphalt plant operation, etc. Minor labor in an office type environment, such as moving files or furniture would be excluded.

A hardhat SHALL be worn at all times for the following operations:

A. Mowing Operations
B. RPM's lay down person
C. Trenching/Ditching
D. Vegetation Removal/Clearing
E. Bridge Construction/Maintenance/Inspection
F. In or around lift type equipment such as a basket, bucket, crane and snooper trucks
G. Geotechnical drilling work
H. Pile/Post driving
I. Any/All overhead work or hazards
J. Other activities as directed by a department manager or supervisor in charge of the work where the manager or supervisor deems it necessary to require a hardhat for safety purposes.

The approved ball cap is allowed to be used in place of the approved GDOT hardhat except in the areas identified above; however, it is understood that use of the approved ball cap offered by the Department is the employee's personal choice. The approved ball cap must be worn with the sun visor facing forward so that the GDOT logo is visible to anyone facing the GDOT employee. This will identify our employees when working with the police and emergency personnel and reflect a positive image for the Department.

The only exception to this policy is: Use of the Department approved boonie hat and winter knit cap (winter knit cap is authorized for wear during inclement weather) which is available for employee purchase from the Engineers Association as an acceptable substitution to the approved ball cap. All caps and hats shall have the GDOT logo and can only be worn with the logo facing forward. All caps and hats shall meet or exceed State and Federal regulations.

NOTE: The boonie hat and winter knit cap may be purchased at your discretion and used in place of the approved GDOT issued ball cap but its use is not mandated under any circumstances.

The hardhat may still be used in all job activities as has always been the Department's policy. An approved hardhat or an approved ball cap will be provided to all GDOT personnel. Those persons performing the job functions listed above or involved in an operation designated by Department management as a hardhat area shall be issued an approved hardhat. The suggested guideline/motto to make this determination would be: IF IN DOUBT WEAR THE HARDHAT.

All employees subject to this policy shall be issued approved head gear and will be required to sign the Issuing of Personal Protective Equipment Agreement, DOT 1200.

Violation of this policy shall be grounds for progressive discipline.

The process used to select and approve the head gear and other safety equipment may be read in 14-2 replacement procedures may be read in 14-1.

References:

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History:

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added to TOPPS: 06/02/03 revised: 09/26/03 reviewed: 09/29/06 revised: 04/13/09 added new hats Reviewed: 4/20/2009 Reviewed: 4/21/2009 Reviewed: 7/6/2010 Reviewed: 7/6/2010

Created at 10/2/2008 2:31:54 PM by Rebecca Stephens

8.4 Vehicle Lighting and Policy 7130-8

Vehicle Lighting

Vehicle lighting is also a very important part of making the survey crew as visible as possible. The Department has a policy in place which gives us guidance on the lighting needed for the many different type of vehicles and machinery in the Departments inventory. Department policy 7130-6 has a “Matrix for Minimum Strobe Light Installation” which states the type, color and location of the strobe light(s). This policy has been placed below for your convenience.

In addition to the minimum policy we recommend that flashing strobe lights or a wig wag warning lights system be put in the front section of the survey vehicle as well as in the tail light section. Permission from the District Engineer or Office Head will be required for these lights to be installed. The State Equipment Management Administrator must be notified of the number and color of the additional strobe lights either by letter or email.

Standards for Strobe Light Installations

The safety of the traveling public and Department employees is one of the Department's primary goals. In order to make our equipment more visible, the installation of strobe lights has been adopted by the Department.

For further information on current policies for strobe lights on vehicles, contact the Office of Equipment Management at **770-484-3201**.

Vehicle Conspicuity Tape

In addition to the vehicle lighting the conspicuity tape will help make our vehicles as visible as possible. The conspicuity tape will insure our vehicles are highly visible during dawn, dusk or night time operations. The conspicuity tape reflects the lights of other vehicles when shown upon the vehicle outfitted with this highly reflective tape. The Departments policy 7180-8 covers this safety issue. This policy has been placed on the next page for your convenience.

Policy: 7130-8- Conspicuity Tape Policy
Section: DOT Numbered Equipment
Office/Department: Office of Maintenance
Reports To: Division of Permits & Operations
Contact: 404-631-1000

The Department is committed to following the Code of Federal Regulations, Title 49 Part 571.108, regarding conspicuity marking tape on specified equipment. In order to further enhance the safety of GDOT employees traveling on the state's transportation system, rolling stock equipment and additional designated vehicles will require conspicuity tape markings as outlined in this policy.

All new vehicles and equipment ordered by the Office of Equipment Management (OEM) with the prefixes listed below shall be marked with the correct color conspicuity tape prior to being issued to the Districts or Offices.

In the event of an accident resulting in damages to a vehicle or a piece of equipment that requires replacement of conspicuity tape, district shops shall refer to the guide located on the OEM web site for actual marking locations of the tape for each vehicle and equipment type. The conspicuity tape marking shall be red and white on equipment types such as mechanic/flatbed trucks and up. Pickups, vans, and Suburbans shall be color coordinated, i.e. yellow on yellow, or white on white. Additionally, all doors will have a white strip of reflective conspicuity tape (6") added that will be reflective when opening the doors.

OEM inspectors, during their normal cycle of PM inspections, will check each vehicle and piece of equipment for these markings to insure compliance with stated policy.

The following is a list of all DOT prefixes required to be taped:

007	400
008 - Same as 430 prefix	401
020 - (**Stinger Trucks Only**) Same as 050 prefix	402
035 - Same as 049 prefix	403
039 - Same as 050 prefix	404
040 - Same as 050 prefix	405, 406, 407
041 - Same as 050 prefix	409
048	410, 411
049	415
050	420,421,422, 423,424
053 - Same as 054 prefix	416,430
054	431
056	436
082	437
083 - Same as 082 prefix	449, 451
084 - Same as 406 prefix	450
087	452 - Same as 2 Wheel Drive version
111	

For further information, contact the Office of Equipment Management.

References:

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History:

moved to Office of Maintenance to reflect location of Equipment Management: 06/23/14; added to TOPPS: 03/21/03:

Defensive Driving Course

Anyone driving a Department vehicle is required to have had the defensive driving course. This course is taught by the Department and can be scheduled through you supervisor and/or the safety officer. It is a highly informative class and will be very helpful to you and your coworkers during the daily commute to and from the project area.

Weekly Safety Meetings

To help make our crews more aware of personal and survey safety issues weekly safety meetings are required. Monday mornings are an excellent opportunity to inform our crews of any safety related issues that might occur during the week.

There may be specific safety issues related to special projects which fall outside of the current norm of operations that will have to be addressed. There are also areas of concern that a surveyor is also always going to be exposed to. These areas can be addressed on a continuous basis. These normal areas of concern are, but not limited to, seasonal, conditional and/or occupational safety issues.

Some seasonal safety issues are, but not limited to, working in extreme heat or working in bitter cold environments. Our survey crews will need to know how best to protect themselves, and their coworkers, in these harsh conditions.

Some conditional safety issues are, but not limited to, working along interstate highways, urban areas or any other areas where high traffic volume is a concern. Surveying in and around rivers and streams, still or running is another area where safety will have to be practiced diligently.

Some occupational safety issues would include, but not be limited to, snakes, west Nile virus Lyme disease, sharpening bush axe or machete, working near power lines, etc.

Don't limit yourself to just the weekly meeting. If you see something while on the job site **STOP**, address the issue right then and proceed surveying only after everyone on the crew understands the issue.

Centerline of Roadway Surveying

For safety reasons it is highly recommended that if at all possible surveyors not be in the centerline of any roadway. If work has to be performed in the centerline of the roadway it will require a lane closure and traffic flow management. Have your survey supervisor schedule with the Maintenance Department for a lane closure. The Maintenance Department has the equipment, training, certification and experience in performing these operations efficiently, effectively and safely.

The lane closure will be a last resort. Something to consider before requesting a lane closure is the use of a reflectorless survey instrument, or a High Definition Scanner that will prevent putting survey personnel in the centerline of the roadway. This could be requested by contacting the Statewide Location Bureau (SLB) Engineering Management Group (EMG) and ask for assistance. The SLB/EMG has crews trained on this equipment which will prevent survey personnel from having to stand in the centerline of any roadway. Contact the SLB Engineering Management Operations Manager (EMOM) or SLB Statewide Cadastral Engineering Supervisor (SCES) for

scheduling of SLB survey personnel to collect the necessary data. If you need the data before the SLB office work scheduled permits then the lane closure and traffic flow management will be required.

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Appendix A. Monitoring Wells

Flush Mount Monitoring Wells (Usually found near gas stations and underground storage tanks)

Below are some examples of flush mount monitoring wells:

Above Ground Monitoring Wells (Can be located anywhere ground water issues are present)
Below are some examples of above ground monitoring wells: