AUTOMATED SURVEY MANUAL

Georgia Department of Transportation

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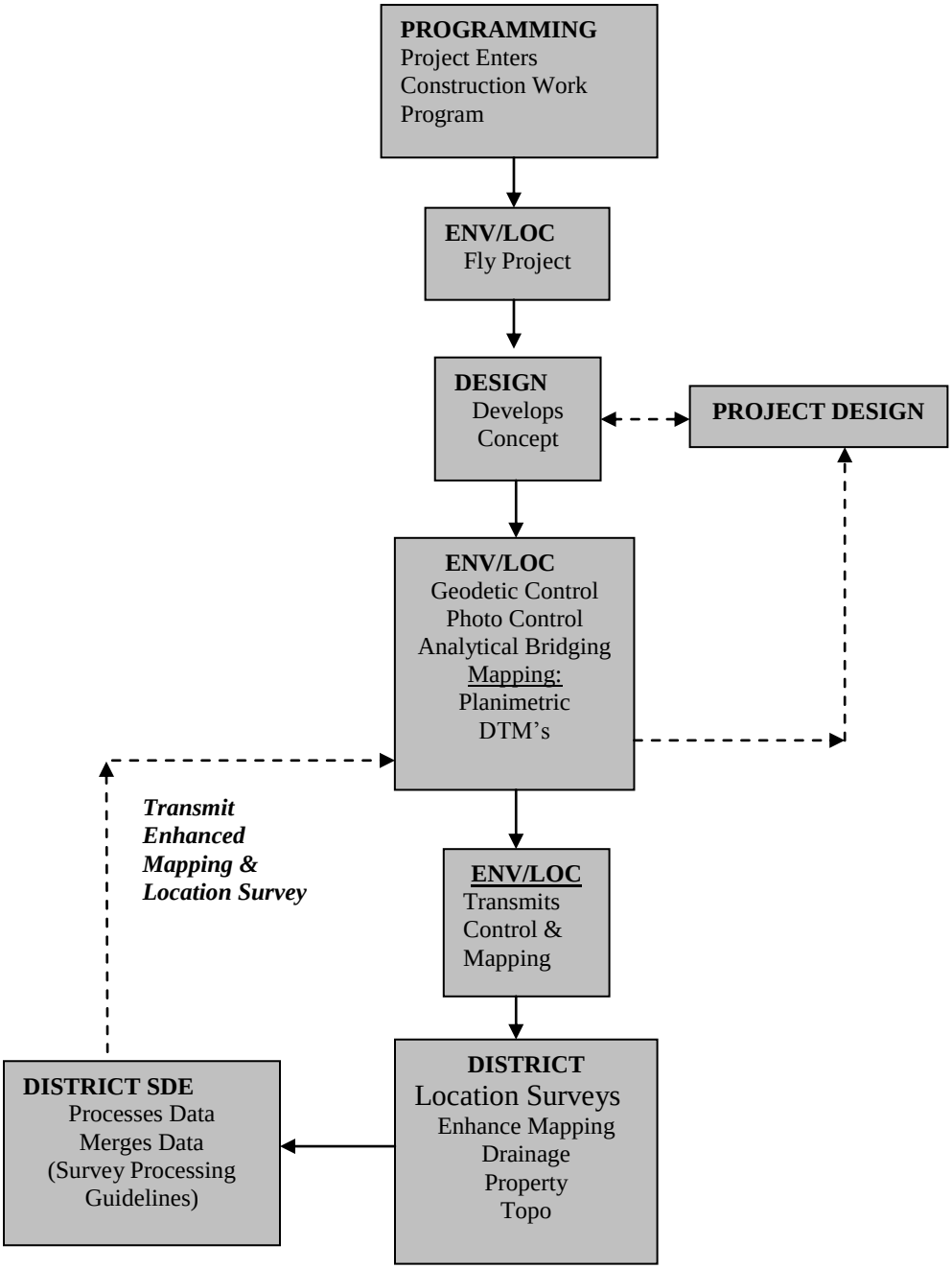
Sequence of Operations for Data Collection on internal Projects



SURVEY CHECK LIST

PROJECT NO._____P.I. NO._____

SURVEYED BY_____DATE_____

DATA COLLECTOR FILE NAME_____

COMPUTER FILE NAME_____

1. 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)***

11. 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

111. TOPO AND MAPPING ENHANCEMENT

[ ] 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

1V. 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

V1. 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 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
[ ] Bridge sketches completed for bridges within floodplain and required upstream and downstream bridges
[ ] 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
[ ] Bridge sketch

D. BRIDGES OVER ROADWAYS

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

V11. FILE DATA TRANSFER

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

SURVEY and MAPPING CONTROL

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 four different sets of coordinates listed, there are actually just three with four 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.

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]

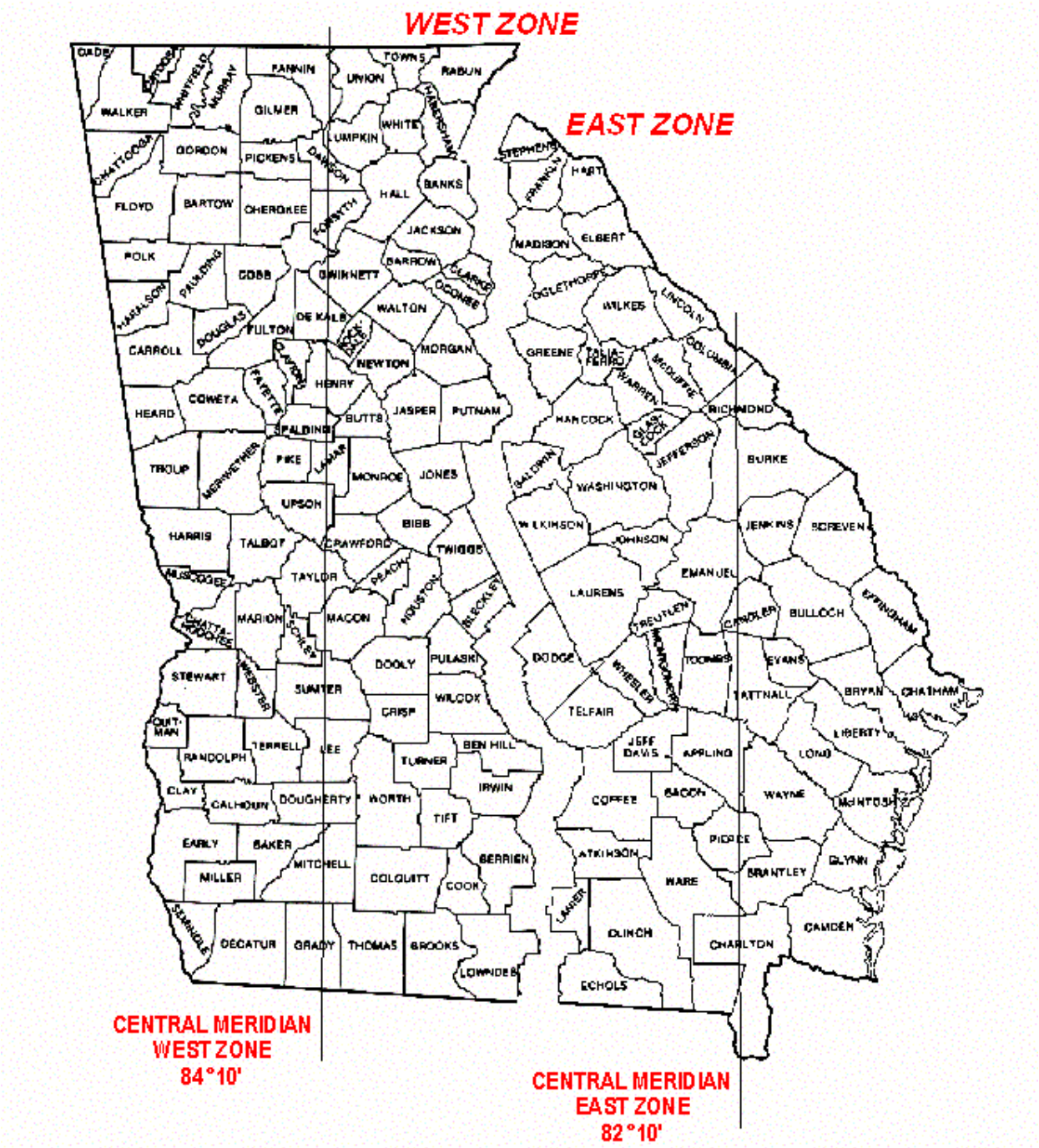
B. Vertical Datum:

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



4420-2
Georgia Coordinate System of 1985

See document history

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 re-computation 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 re-computation 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 Office of Environment/Location 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 Office of Environment/Location 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.

It will be the policy of the Office of Environment/Location 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 Office of Environment/Location, Bureau of Photogrammetry and Surveys.

Authored by the Office of Environment/Location, 404-699-4401

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http://wwwb.dot.state.ga.us/topps/pre/env/4420-2.htm

4420-1

Georgia State Plane Coordinate System

See document history

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 84º 10' West Longitude and 82º 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.**

The impression from a cursory review of the reference material is that the use of the State Plane Coordinate System involves very complex Procedures. Such is not really the case. In the final analysis, State plane coordinates are really nothing more than an adaptation of the latitude and departure practices which have been in use for centuries.

Numerous reasons have been given during the last 40 years for not employing the State Plane Coordinate Systems. Some are quite valid, e.g., a lack of national network control; but others, especially those related to scale factors, are irrelevant. The application of a scale factor is arithmetical, not an involved mathematical procedure. In those higher elevation sections of the country, the reasons given for not using the system include the reduction to sea level in addition to scale factors. The sea level reduction is also arithmetical. In fact, the two factors can often be combined, thus resulting in a single computation to reduce each measured distance.

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

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http://wwwb.dot.state.ga.us/topps/pre/env/4420-1.htm

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.

2. HORIZONTAL CONTROL

A. Control Location

A control packet will be compiled at the Office of Environment/Location 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. Traverse Staking

A **horizontal mainline control traverse** should originate from published NGS control and tie to published NGS control. Accurate **C**ontrol **L**ocation **D**eltas **(CLD's)** shall be established over the entire project length, and described for future reference. The maximum distance between CLD's should be **3000 feet** and a minimum distance of **1500 feet** where possible**.** 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. 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 or parking lots, only if other suitable locations are not available. These CLD's should be a punch hole **0.01feet** 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 have a precision no less than **1/20,000.** The traverse shall be angle adjusted and have a precision of no less than **1:20,000** in rural areas and **1:25,000** for urban areas. The traverse shall be **Compass Rule Adjusted** to complete the adjustment.

3. VERTICAL CONTROL

A. Control Location

A control packet will be compiled at the Office of Location 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 Verniers (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 OEL 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′ *** square root of 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′ *** square root of miles ran.

D. 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.

4. SURVEY CONTROL PACKAGE GUIDELINES

A Survey Control Package shall be provided to the Office of Environment/Location (OEL) for all Department and Consultant performed surveys. All control packages should be submitted to the Consultant Compliance Supervisor (CCS) headquartered at OEL 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 OEL.

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 Office of Environment/Location 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 coordinated, 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 Engineer (SCE) 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://wwwb.dot.state.ga.us/topps/pre/env/4420-1.htm

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 OEL for filing and need not be a part of the survey control package. The CET contact number is 404-699-4471.

AUTOMATED SURVEYING

1. PRE-SURVEY FIELD REVIEW

Before field survey work begins the Party Leader should:

a. Hold a Pre-Survey Field Review 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 and marked on a copy of blueline mapping.

2. 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 (drainage, utility, right-of-way, etc.).
9. Tax Maps in sequence of the survey.
10. Plats and Deeds in sequence of the survey.

Department of Transportation

State of Georgia
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BUDDY GRATTON,
DEPUTY
(404) 656-5212

EARL L. MAHFUZ
TREASURER
(404) 656-5224

Dear Property Owner,

We wish to request your cooperation in our continuing effort to provide a safe and efficient transportation system for the people of Georgia.

Field surveys are scheduled to begin soon in the vicinity of your property for the purpose of gathering the information necessary to design **[Project # PI # and description]**.

During the course of our engineering studies, it may become necessary for our survey personnel to enter upon your property. This entry is provided for and regulated by Georgia Law, Code 32-2-2(9) which states that "The Department and its authorized agents and employees shall have the authority to enter upon any lands in the State for the purpose of making such surveys, soundings, drillings and examinations as the Department may deem necessary or desirable to accomplish the purpose of this title, and such entry shall not be deemed a trespass, nor shall it be deemed an entry which would constitute a taking in a condemnation proceeding provided that reasonable notice is given the owner or occupant of the property to be entered and that such entry shall be done in a reasonable manner with as little inconvenience as possible to the owner or occupant of the property."

It may be necessary that some stakes be driven in the ground and some small trees and undergrowth be cleared to provide for the work; however there will be no damage to fruit or nut trees, shrubs, flowers or crops by our personnel during the progress of this work. Please be assured that this work will be done in a professional manner with as little inconvenience to you as possible.

If you have any questions concerning this, please contact **[Location Engineer name and phone #].**

I sincerely appreciate your cooperation in this cause.

Very truly yours,

[District Pre-Construction Engineer]

3. 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).

4. 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 ON PAGES 85 thru 90.**

If you are carrying elevations, the published guidelines for trigonometric leveling **(Page 83)** and carrying elevations with the Side-shot Program **(Page 84)** 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).

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, first check for an acceptable position tie minimal of **1/20,000** in rural areas and minimal of **1/25,000** in urban areas; then transfer the data to the **Adjust File** and run the **Transform Program** to scale the traverse, and then run the **Adjust Program.**

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 **(See Page 24)** 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.
(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 your 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.**

5. 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. Calculate and set temporary points, small nails or stakes, for corners of property on which no monuments could be found. On these, check adjacent plats to see if distances correspond.

3. Locate all back corners that can be conveniently shot.

4. 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.

5. Locate all deeded easement lines and corners and mark with small nail for reference points to collect when tying down property and easements.

6. After collecting easement and property features, pull up all temporary points that have been set.

6. 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, 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.

7. PRESCRIPTIVE RIGHT-OF-WAY

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.**

8. 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.

9. 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 the **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 upload data collectors to the PC after each day of data collecting and especially on last day of the work week.

10. CENTERLINE STAKING

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.

F. With the flexibility of CAiCE, the process of producing a stakeout **.ASC** file for a centerline alignment and Right-of-Way staking has become quite automated. To reiterate, the SDE should provide the surveyor with the electronic file containing the information needed to be staked.

PREPARING A STAKING FILE FOR LOCATION

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 pulldown 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

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 29,** 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 30)** 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.

11. MAPPING UPDATE

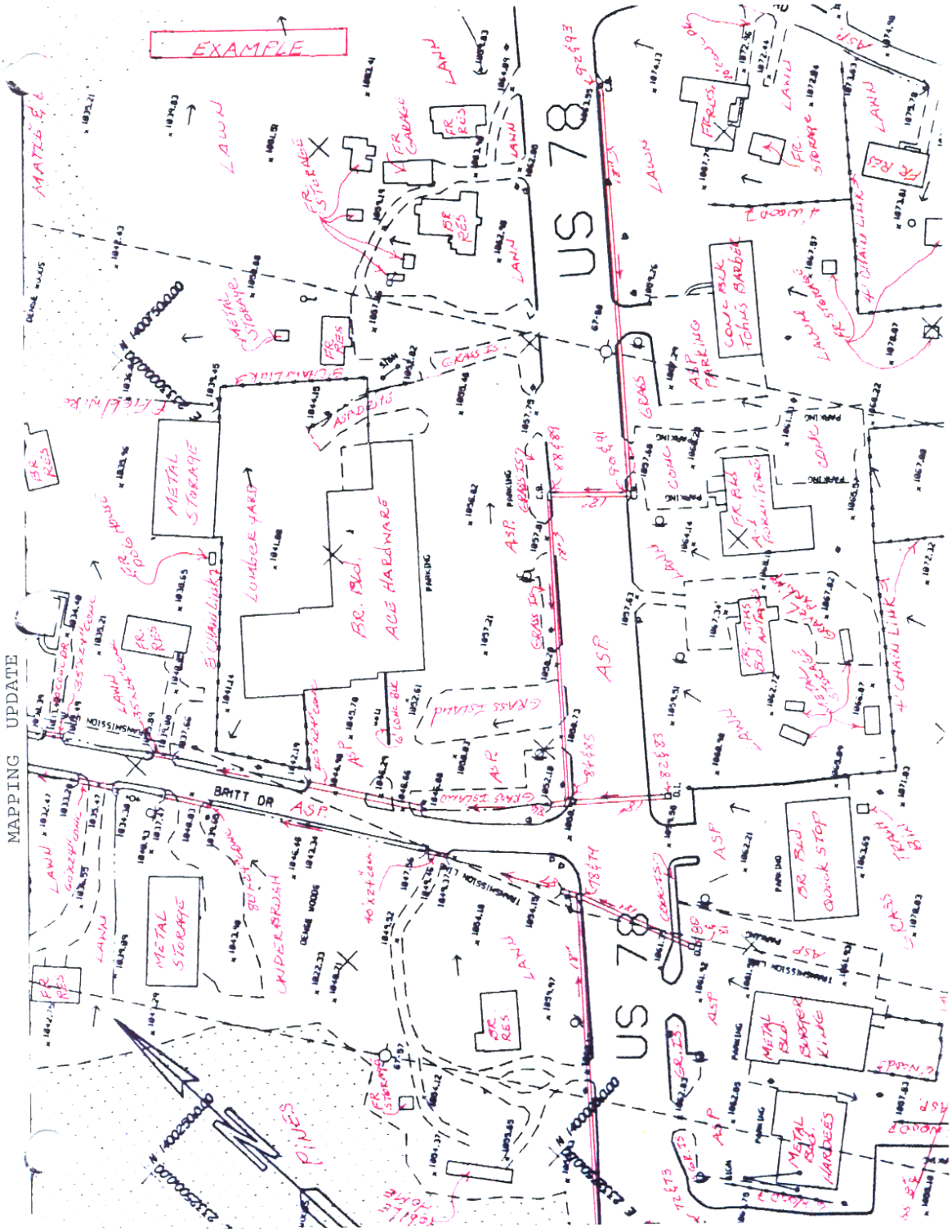
A. If possible, the mapping update should be done on days when the weather or crew size doesn't permit normal survey activities.

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 32** 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).
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.



12. 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** (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** (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).

5. **Major electrical boxes,** high voltage transmission power poles, and 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.

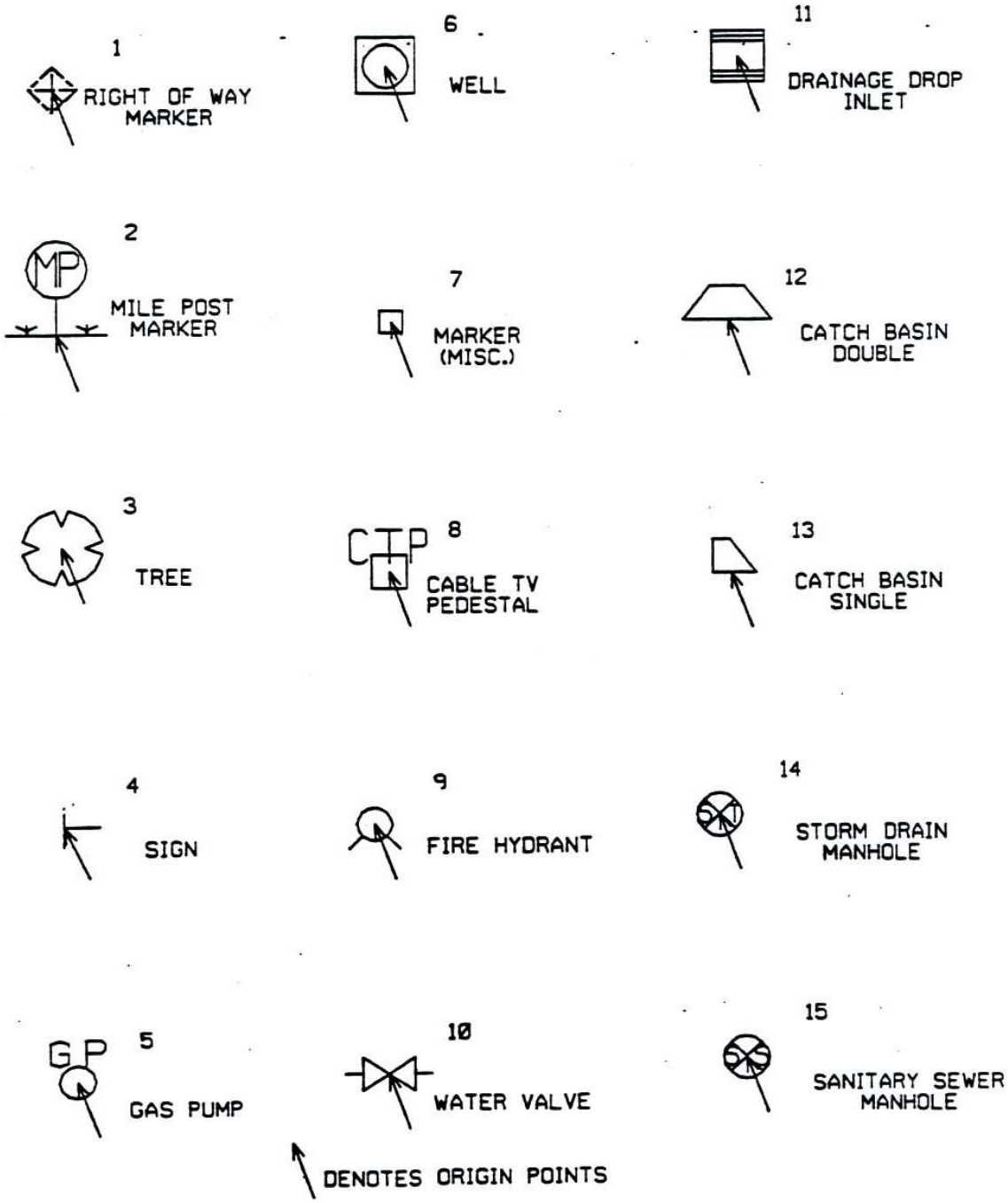
7. **Driveways** (on dirt driveways coordinate the centerline of the drive and show the width in the note field. On paved driveways, coordinate the outside edges of the pavement).

8. **Storage tanks** (coordinate each end if possible. If the ends cannot be located, coordinate the filler cap).

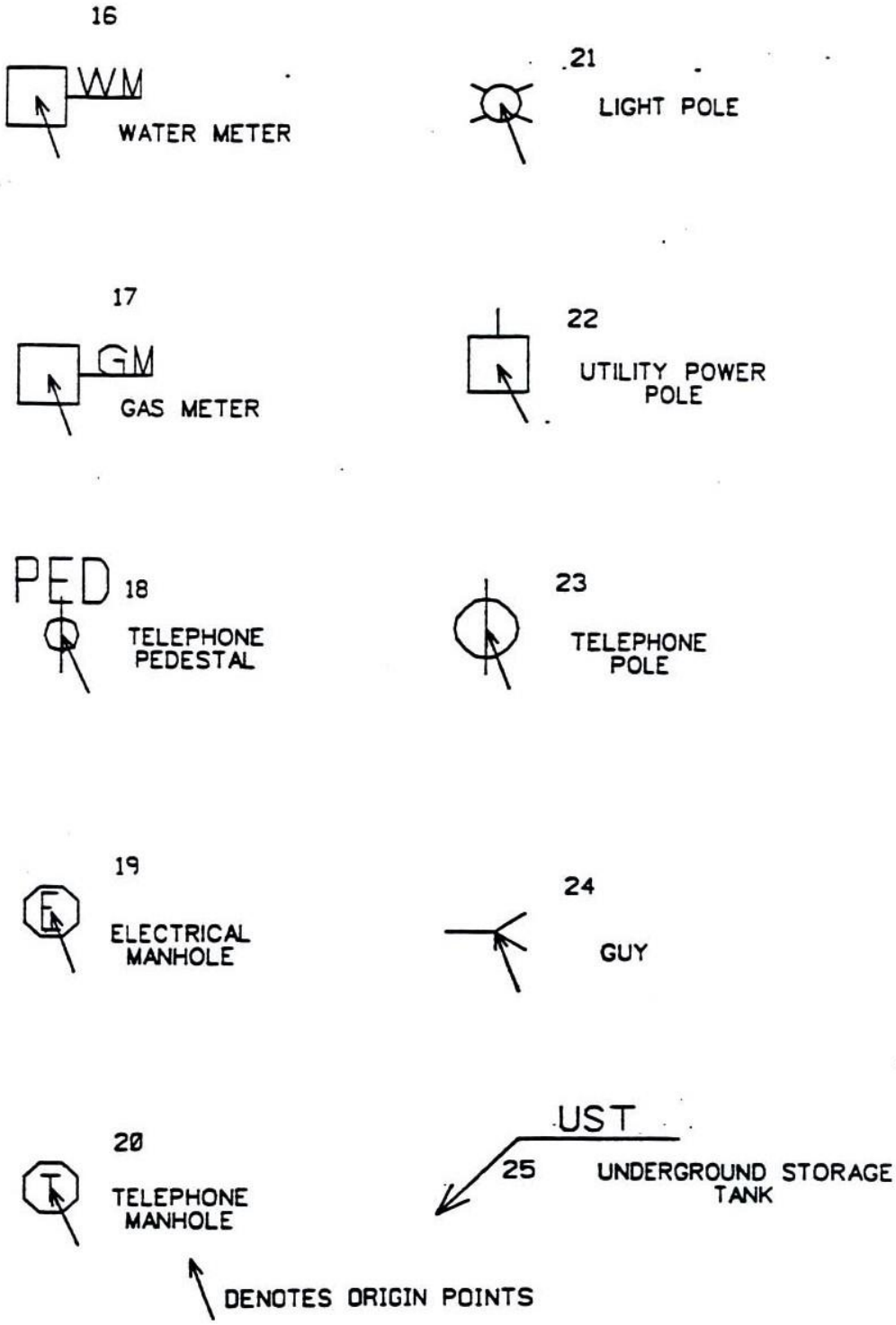
9. **Landfills and hazardous waste sites** (coordinate the boundaries).

NOTE: Water meters, gas meters, telephone pedestals, telephone poles and low voltage power poles do **not** need to be shown.

SYMBOLS


1
RIGHT OF WAY MARKER
2
MP
MILE POST MARKER
3
TREE
4
SIGN
5
GP
GAS PUMP
6
WELL
7
MARKER (MISC.)
8
CTP
CABLE TV PEDESTAL
9
FIRE HYDRANT
10
WATER VALVE
11
DRAINAGE DROP INLET
12
CATCH BASIN DOUBLE
13
CATCH BASIN SINGLE
14
STORM DRAIN MANHOLE
15
SANITARY SEWER MANHOLE
DENOTES ORIGIN POINTS

SYMBOLS


16
WM
WATER METER
17
GM
GAS METER
PED
18
TELEPHONE PEDESTAL
19
E
ELECTRICAL MANHOLE
20
T
TELEPHONE MANHOLE
21
LIGHT POLE
22
UTILITY POWER POLE
23
TELEPHONE POLE
24
GUY
UST
25
UNDERGROUND STORAGE TANK
DENOTES ORIGIN POINTS

4465-1

Preconstruction Survey Procedures - Utilities

See document history

The following is a general procedure that each District should follow for obtaining utility information. This applies to both above ground and underground utilities. Above ground utilities will continue to be shown by the Photogrammetry section on mapping projects; however, these utilities will not be enhanced or missing utilities shown as part of the Location survey. Minor electrical transmission poles, telephone poles or pedestals, water meters or valves, gas meters or valves and sanitary sewer will not be collected as part of the Location Survey process. Exceptions will be substations, high tension power poles or towers, or other special items that will affect the alignment of the proposed project.

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 or photographs 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 will be furnished as follows:

    a. *Projects that are mapped by photogrammetric methods.* The State Environment/ Location Engineer 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 that have existing plans that are not to be mapped.* The District Preconstruction Engineer shall obtain reproducible copies and furnish sufficient blueline copies 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 blueline copies 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 State Environment/Location Engineer.

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 State Environment/Location Engineer 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 State Environment/Location Engineer 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 State Environment/Location Engineer.

Authored by the Office of Environment/Location, 404-699-4401

Document History:

- added to Manual of Guidance: 06/01/93
- revised: 09/01/95
- added to TOPPS: 05/01/96
- reivewed: 11/10/06

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Return to TOPPS home page

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http://wwwb.dot.state.ga.us/topps/pre/env/4465-1.htm

13. 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 **(Page 85-90).**

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 **Page 20**.

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. **(See Page 36 for examples of obscured areas). 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 Page 41).**

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 Page 41).**

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 **not** exceed **300 feet.** Even on flat not sloping terrain due to software limitations with our existing Design Software.

B. DTM Surface

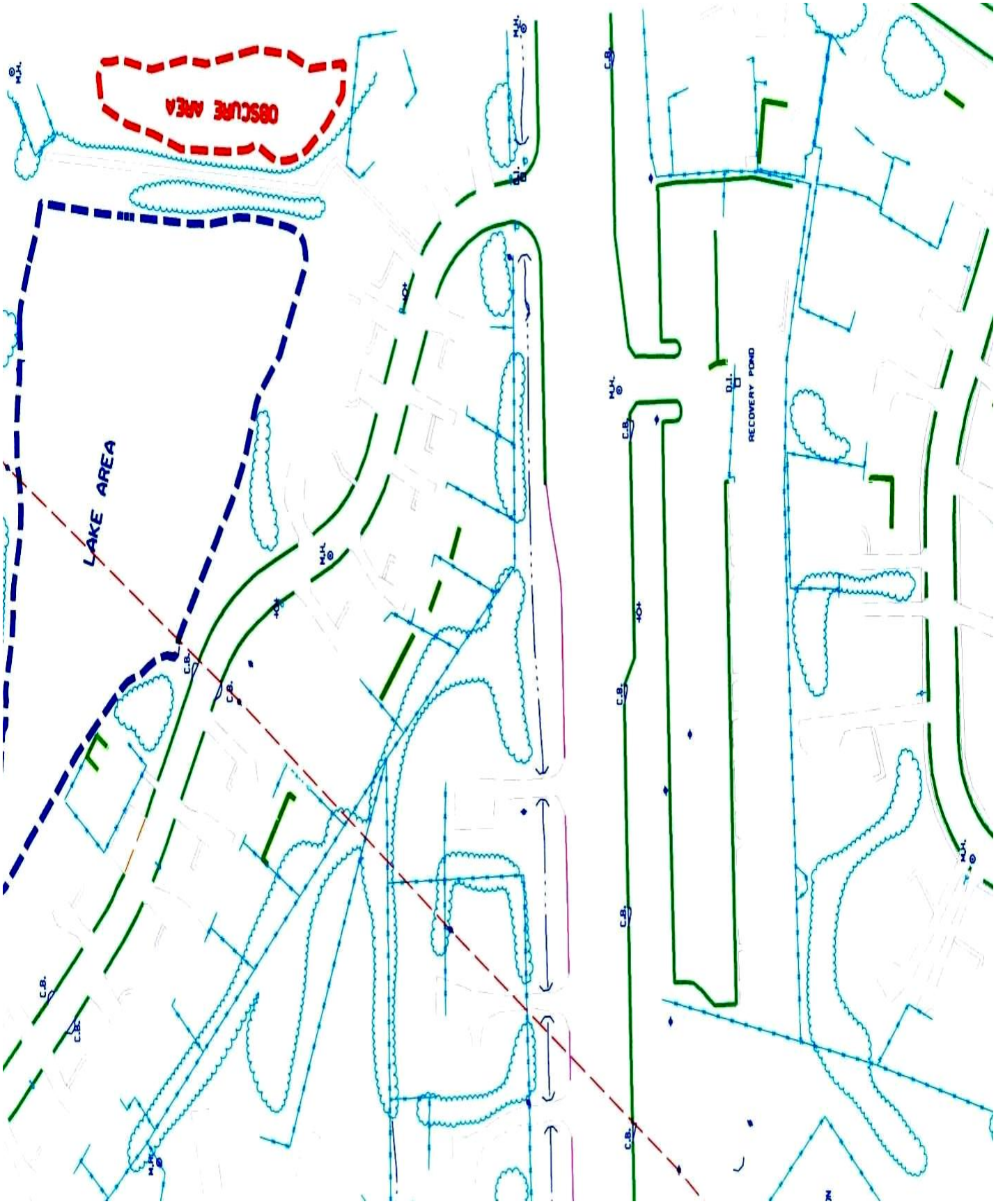
1. ***The surveyor will need to download daily, the field data stored in the data collector*** to the computer using a transfer program and use **CAiCE** to visually inspect the fieldwork. The purpose of this is for the surveyor to check the collected data for accuracy and completeness before submitting 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.

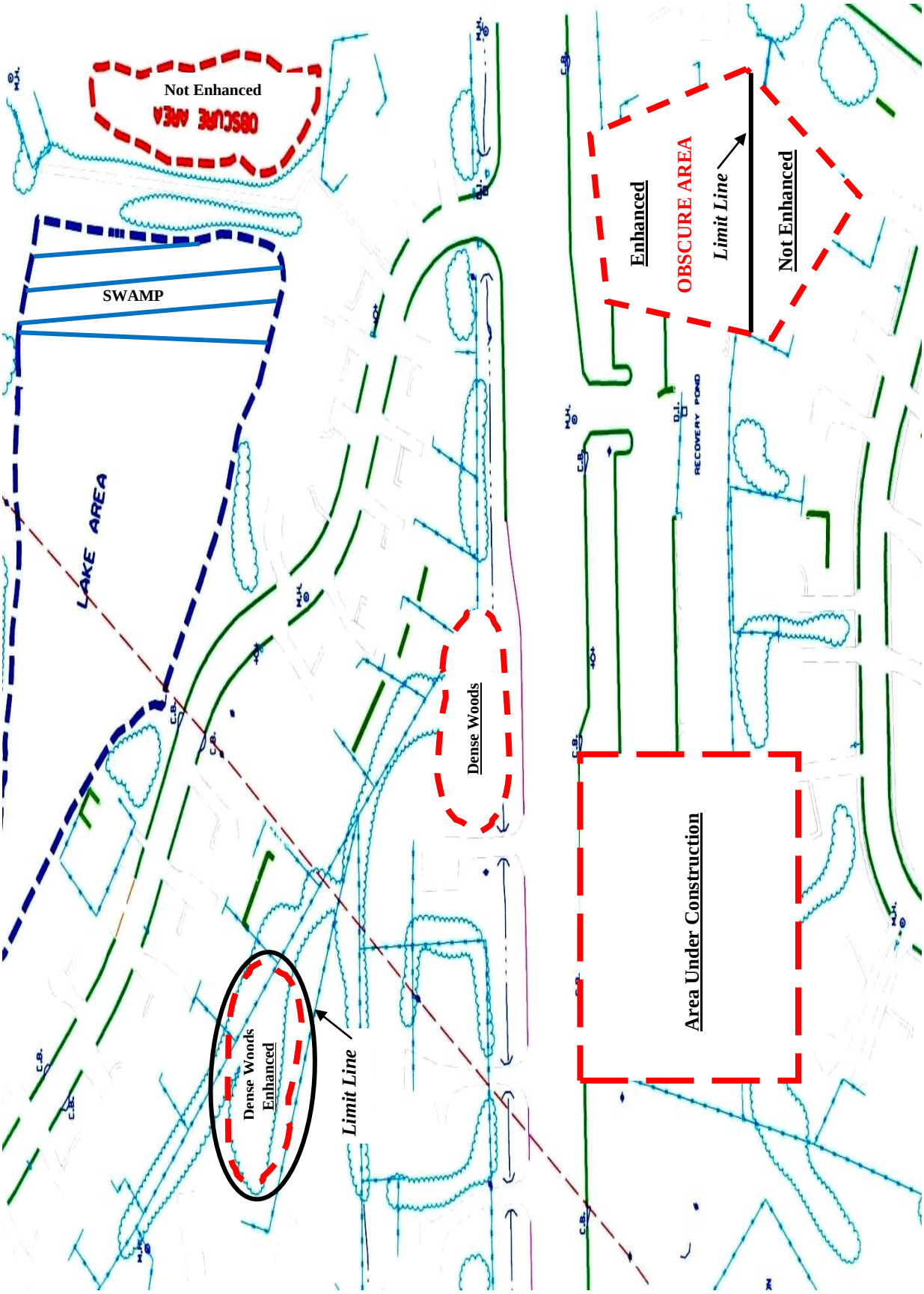
2. **Remember,** you must edit your .ASC file to reflect any changes you have made in CAiCE when resolving string crossings or mistakes in your data. A VBA Macro has been developed to handle this operation of correction your .ASC file and is now available. It can be found under **Tools ⇒ Custom Tools ⇒ 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.

3. After the surveyor provides the Survey Data Engineer (SDE) with a corrected **.ASC** 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.**

SAMPLE MAPPING WITH OBSCURED AREA SHOWN



SAMPLE MAP OF TYPES OF OBSCURED AREAS



14. FIELD CROSS SECTIONS

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 (**PAGE 29)** for more information concerning this file.

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

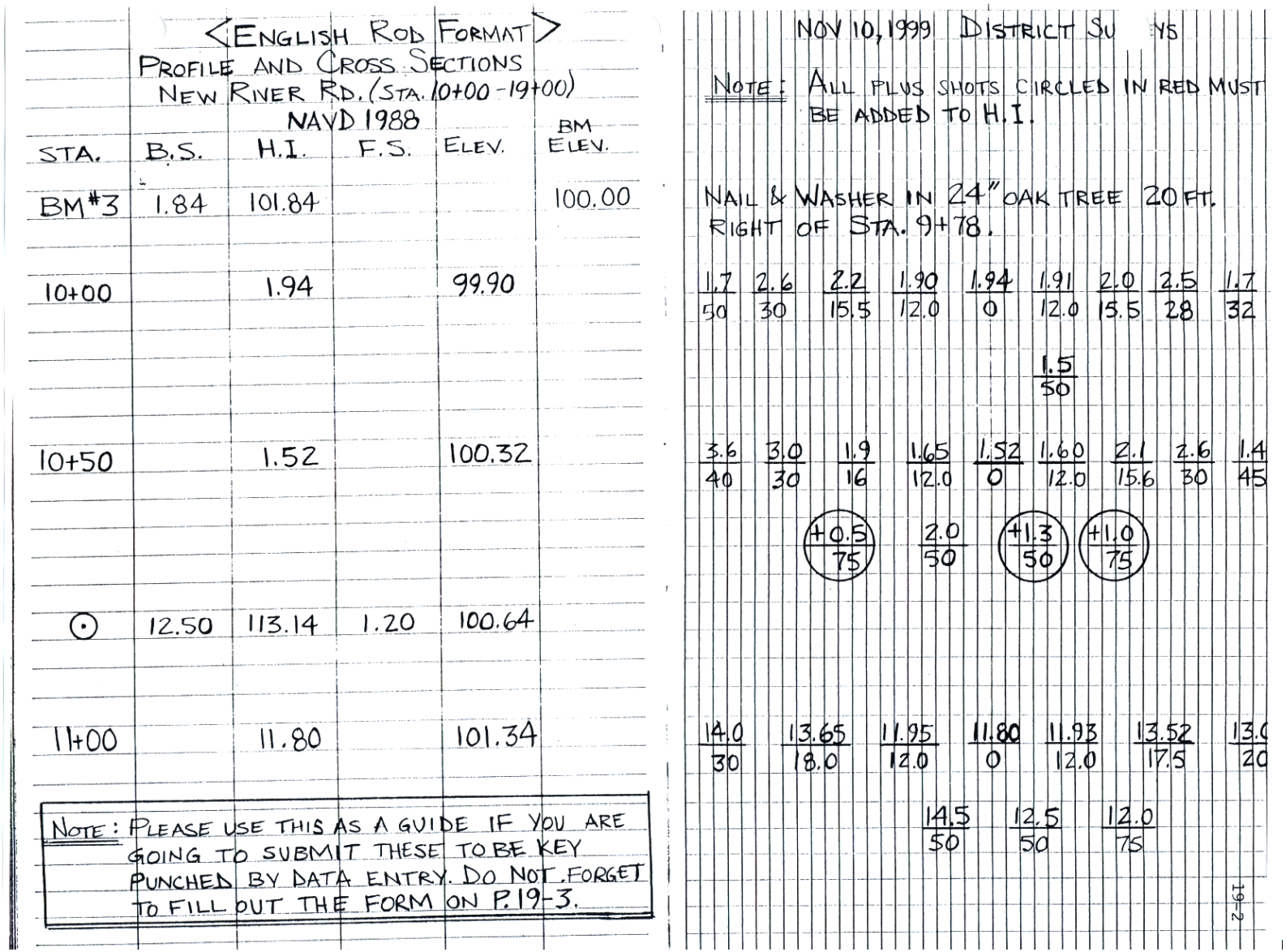
The format of the data entered in the cross section book depends on which type of instrument was used.

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



<ENGLISH ROD FORMAT>
PROFILE AND CROSS SECTIONS
NEW RIVER RD. (STA. 10+00 - 19+00)
NAVD 1988

STA.	B.S.	H.I.	F.S.	ELEV.	BM ELEV.
BM#3	1.84	101.84			100.00
10+00		1.94		99.90	
10+50		1.52		100.32	
⊙	12.50	113.14	1.20	100.64	
11+00		11.80		101.34	

NOTE: PLEASE USE THIS AS A GUIDE IF YOU ARE GOING TO SUBMIT THESE TO BE KEY PUNCHED BY DATA ENTRY. DO NOT FORGET TO FILL OUT THE FORM ON P. 19-3.

NOV 10, 1999 DISTRICT SU YS

NOTE: ALL PLUS SHOTS CIRCLED IN RED MUST BE ADDED TO H.I.

NAIL & WASHER IN 24" OAK TREE 20 FT. RIGHT OF STA. 9+78.

1.7 / 50	2.6 / 30	2.2 / 15.5	1.90 / 12.0	1.94 / 0	1.91 / 12.0	2.0 / 15.5	2.5 / 28	1.7 / 32
					1.5 / 50			
3.6 / 40	3.0 / 30	1.9 / 16	1.65 / 12.0	1.52 / 0	1.60 / 12.0	2.1 / 15.6	2.6 / 30	1.4 / 45
		+0.5 / 75	2.0 / 50		+1.3 / 50	+1.0 / 75		
14.0 / 30	13.65 / 18.0	11.95 / 12.0	11.80 / 0	11.93 / 12.0	13.52 / 17.5	13.0 / 20		
			14.5 / 50	12.5 / 50	12.0 / 75			

19-2

15. 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 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.**

Drainage

1. FLOWING STREAMS

All flowing streams that are crossed by the survey centerline require a stream traverse. **SEE ATTACHED MOG ON PAGE 46.**

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).
   5. **FIELD SKETCH** (A field sketch showing the chain/strings or point numbers of the stream survey alignment, topo, profile and cross sections or **DTM** data shall be submitted for each flowing stream traverse).

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).
   4. **Field Sketch** (A field sketch showing the chains/strings or point numbers of the ditch alignment, topo and profile or **DTM** data shall be submitted for each ditch).

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

4465-5

Stream Traverse Surveys

Document last updated 2-May-1996
See document history

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

Streamline Survey Procedures for Flowing Streams

The Location Survey Crew (LCS) will, during the course of the location 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 LCS 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 Office of Environment/Location, Bureau of Photogrammetry and Surveys at (404) 699-4453.

End of document: 4465-5

Document History:

- added to Manual of Guidance: 09/16/88
- added to TOPPS: 05/02/96

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BRIDGE SURVEYS

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.

4. **TOPO.** Topo should be taken to at least **10 feet** beyond the existing right-of-way, except for the area **500 feet** before the beginning of the bridge to **500 feet** beyond the end of the bridge. The coverage in this area normally should be **200 feet** left and right of the centerline of the existing road.

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 49.** 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.

8. **Floodplain Cross Sections.** 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. 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. 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.

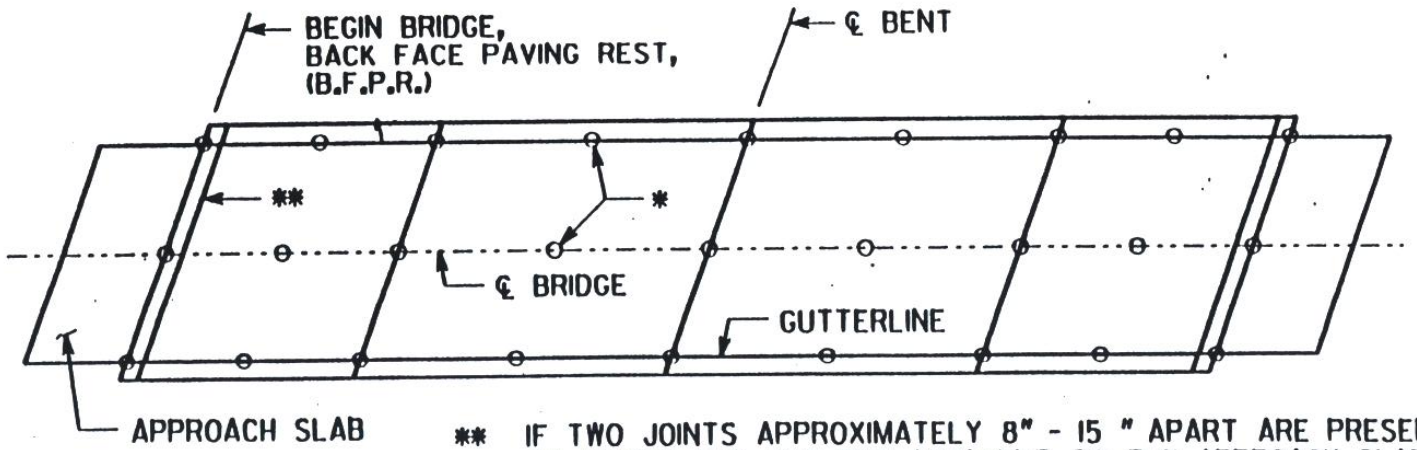
9. **Bridge Sketch.** Bridge sketches shall be drawn showing the elevation and centerline plus of the bottom of the bridge beam at each cap. This sketch also shows the centerline station plus and elevation on all terrain breaks beneath the bridges. The stationing used to show elevations on the bottom of the beam and the profile of the ground beneath the lowest bridge beam shall be the same as the stationing for the alignment of the bridge deck. On mapping surveys, which have no alignment, the stationing for the bridge sketch shall begin with **station 0+00. SEE PAGE 50.** The profile of the bottom of the bridge beam and the profile of the terrain beneath the bridge shall reflect the minimum opening under the bridge. For structures located upstream or downstream that could have an adverse affect of the bridge at the survey site, a sketch is required. This distance could be as much as **2000 feet.** For upstream drainage structures beyond this limit, the size and type should be plotted on a quadrangle map or county map. **SEE PAGE 51.**

10. **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 flowline elevation.

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.



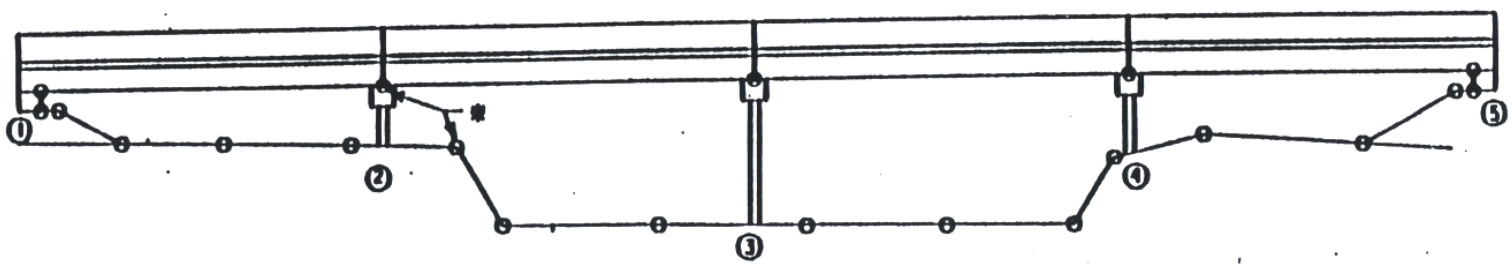
** IF TWO JOINTS APPROXIMATELY 8" - 15 " APART ARE PRESENT AT BRIDGE END, THE ONE ADJACENT TO THE APPROACH SLAB IS THE B.F.P.R.

BRIDGE DATA FOR WIDENINGS

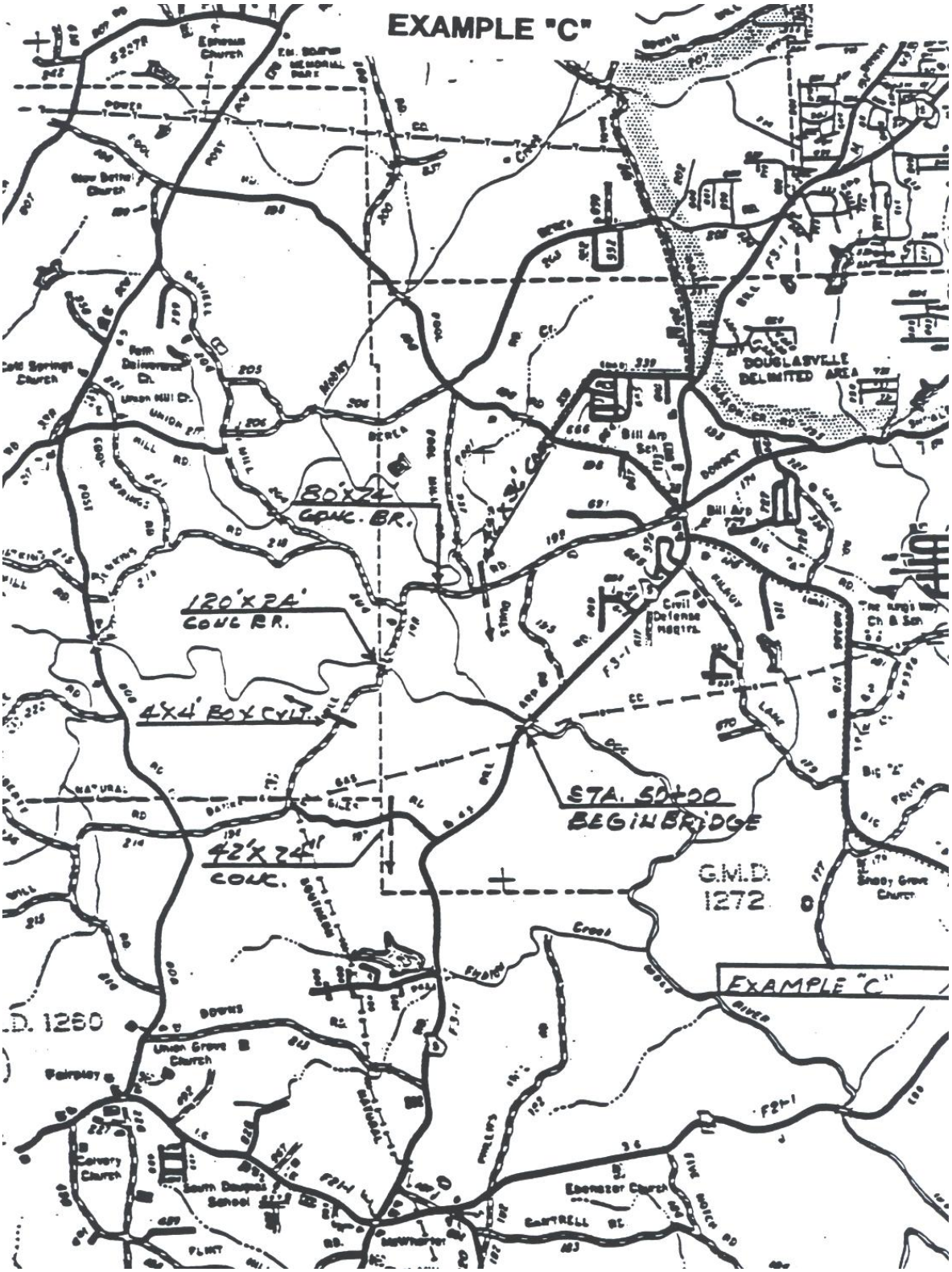
(4 SPAN BRIDGE SHOWN)

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


EXAMPLE "C"
DOUGLASVILLE DELIMITED AREA
80'X24' CONC. BR.
120'X24' CONC BR.
4'X4' BOX CVLT.
STA. 50+00 BEGIN BRIDGE
42'X24' CONC.
G.M.D. 1272
EXAMPLE "C"
Bill Arp Sch
Civil Defense Hdqtrs.
Union Grove Church
Fairplay
Calvary Church
South Douglas School
Ebenezer Church
Shady Grove Church
Cold Springs Church
Faith Deliverance Ch.
Union Hill Ch.
Bill Arp

B. IN SUMMARY, the following items are needed for a **BRIDGE SURVEY OVER AN EXISTING ROAD.**

1. **Property Surveys** (Same as A-1; Page 47).

2. **Alignment of Existing Bridge and Roadway** (Same as A-2; Page 47).

3. **Topo** (Same as A-4; Page 47).

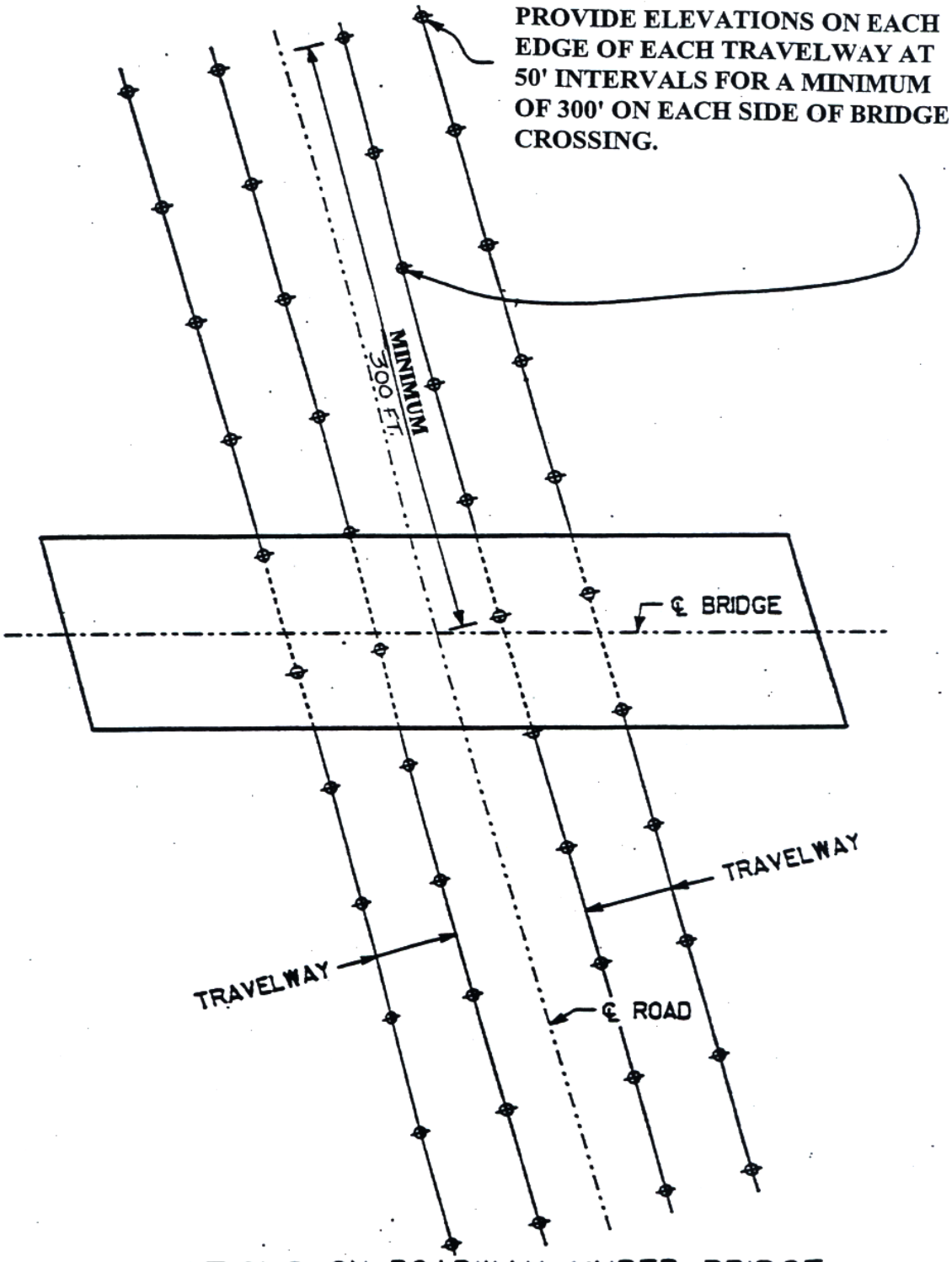
4. **Benchmarks** (Same as A-5; Page 47).

5. **Profile and Cross Sections or DTM coverage should have the same limits as the Topo limits. SEE EXAMPLE ON PAGE NO. 50 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 Page 53).

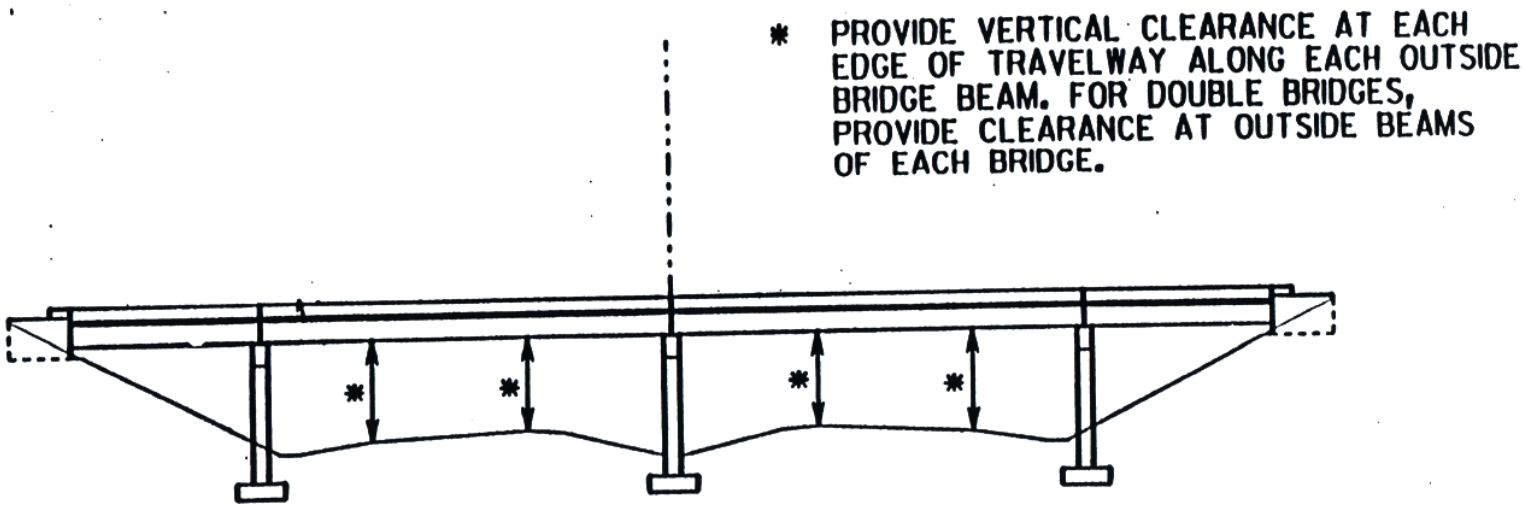
7. **Bridge Sketch** (A bridge sketch is required. On this sketch it is important to show the vertical clearance from the bottom of the outside bridge beams to the roadway pavement at the centerline of the road and at each edge of pavement of the road). **SEE EXAMPLES ON PAGES 53-56.**

EXAMPLE — ROADWAY BENEATH BRIDGE



ELEVATIONS ON ROADWAY UNDER BRIDGE
(NEW BRIDGE OR BRIDGE TO BE WIDENED)

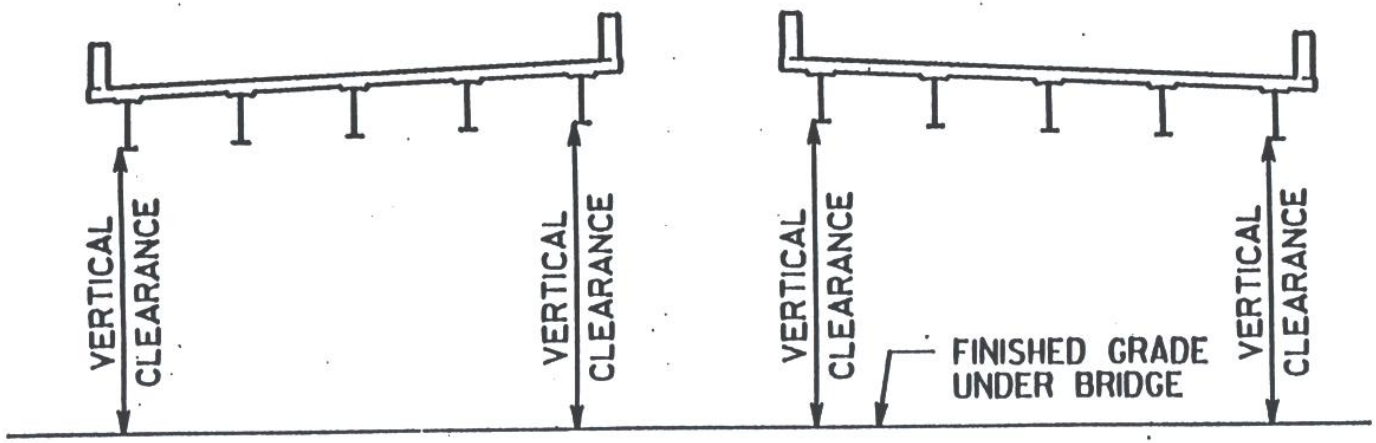
EXAMPLE OF
BRIDGE OVER HIGHWAY



ELEVATION

VERTICAL CLEARANCE - BRIDGE OVER HIGHWAY

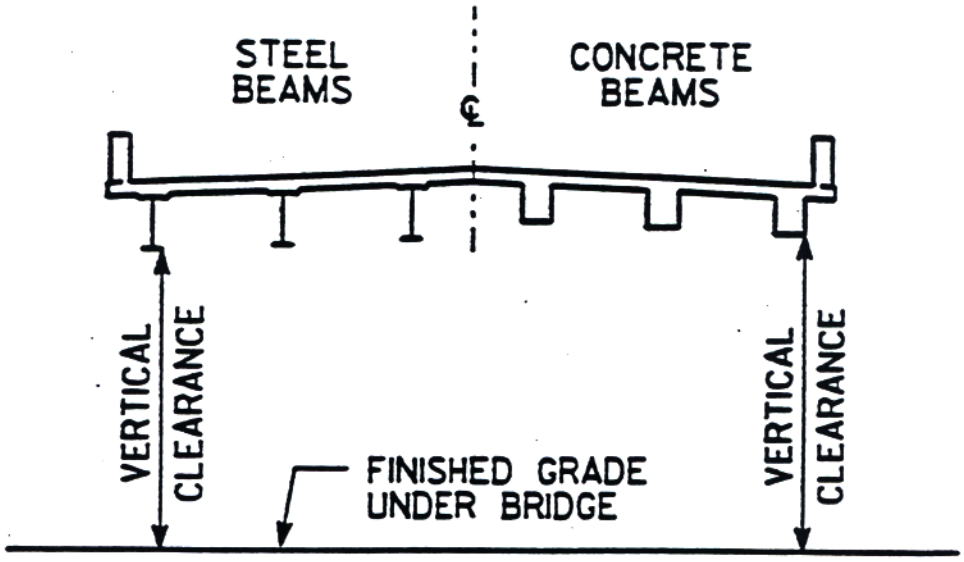
EXAMPLE OF
DOUBLE BRIDGES OVER HIGHWAY



DOUBLE BRIDGES

EXAMPLE OF

BRIDGE OVER HIGHWAY



SINGLE BRIDGE

C. BRIDGE SURVEY OVER AN EXISTING RAILROAD:

1. **Property Surveys** (Same as A-1; Page 47).

2. **Alignment of Existing Bridge and Roadway** (Same as A-2; Page 47).

3. **Topo** (Same as A-4; Page 47).

4. **Benchmarks** (Same as A-5; Page 47).

5. **Profile and Cross Sections or DTM coverage should have the same limits as the Topo limits. SEE EXAMPLE ON PAGE NO. 50 for the location of needed elevation on bridge deck.**

6. **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:

7. **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.

8. **Property.** (Same as A-1; Page 47).

9. **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.

10. **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.

11. **Drainage.** All drainage structures and features within the **1000 feet** Railroad Survey shall be provided.

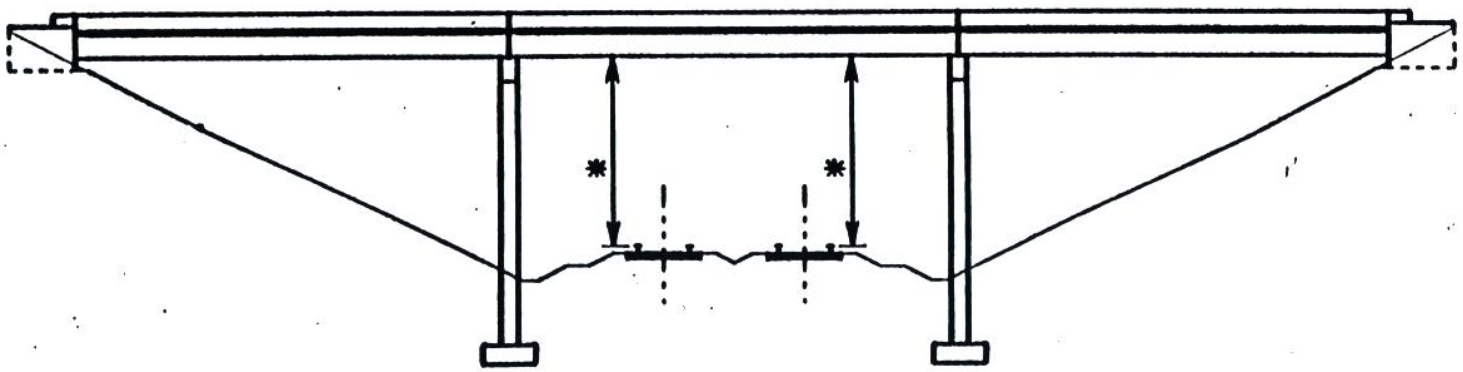
    Bridge Sketch. A bridge sketch is required**.** On this sketch it is important to show the vertical clearance from the bottom of the outer most bridge beams to the top of the railroad rail for each rail beneath the bridge. For a complete overview of what is needed **SEE PAGE NO. 58.**

Link to locate Railroad Mileposts:

http://safetydata.fra.dot.gov/OfficeofSafety/publicsite/crossing/crossing.aspx

EXAMPLE OF
BRIDGE SKETCH

* FOR EACH TRACK, PROVIDE VERTICAL CLEARANCE ALONG EACH OUTSIDE BRIDGE BEAM. FOR DOUBLE BRIDGES, PROVIDE CLEARANCE AT OUTSIDE BEAMS OF EACH BRIDGE. MEASURE CLEARANCE TO HIGHER RAIL AT EACH TRACK.



ELEVATION

VERTICAL CLEARANCE - BRIDGE OVER RAILROAD

EXAMPLES of INVENTORY NUMBERS

EXAMPLES of INVENTORY NUMBERS

D. BRIDGE STAKEOUT

Bridge Design Field Verification:

All bridge sites are to be staked out by representatives of the District Engineer. Two prints of the preliminary layout along with a copy of the typical section are sent with a request letter to the District Engineer to the attention of the District Preconstruction Engineer. The request will include the following at a minimum:

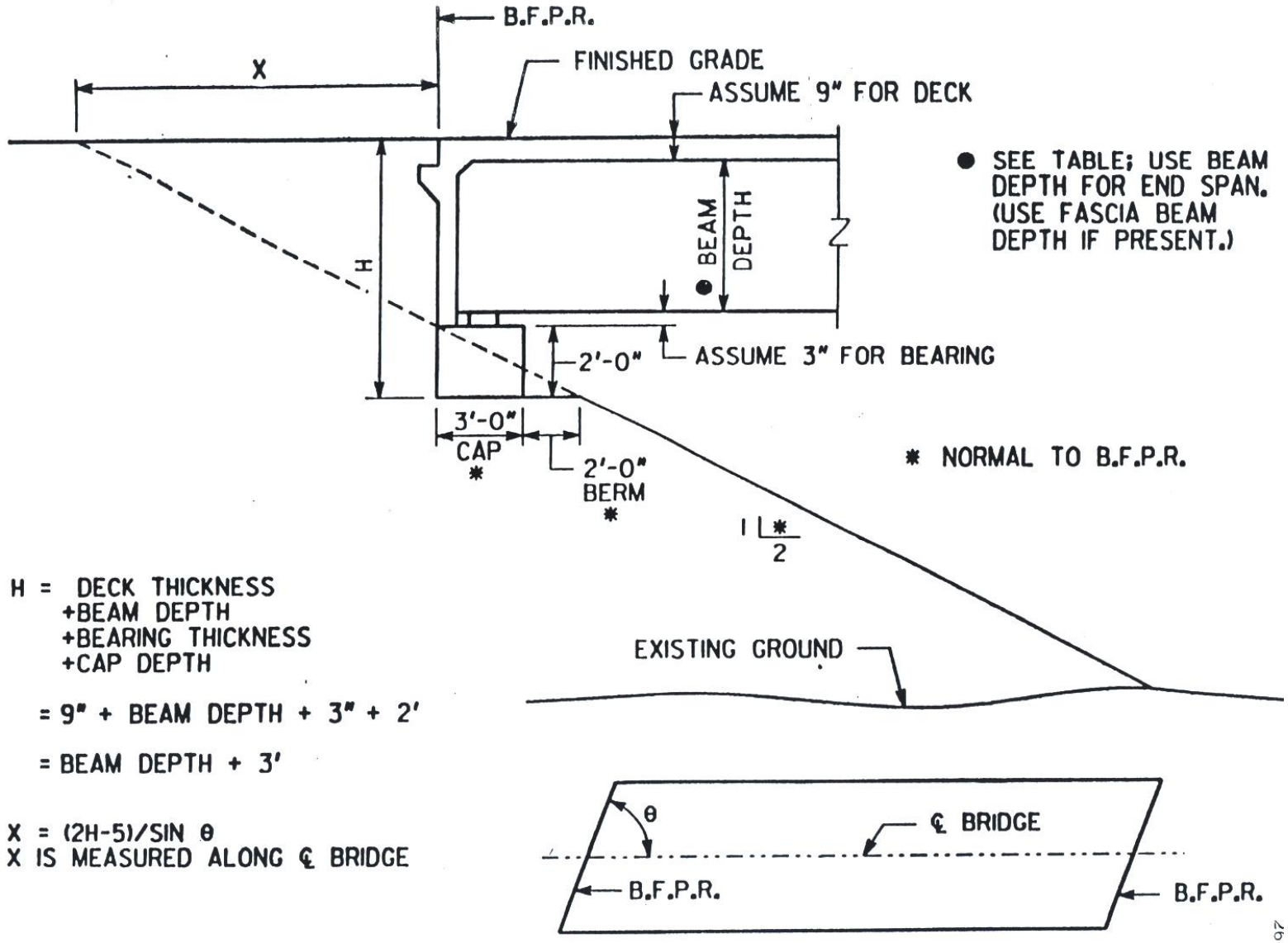
- For stream crossings, the toes of the end rolls and any intermediate bents near or in the stream should be staked. If the stream runs along the embankment or has a sharp bend, stake out the side slopes in that area as well. Clearance from the top of the bank to the toe of the end rolls and to the intermediate bents, as well as the clearance from the side slopes to the creek if applicable 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. 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.

Bridge Staking Procedures

Horizontal Control

- For structure layout, establish a horizontal control network using second order procedures. Place control points in strategic locations so that any point within the bridge site can be set from at least two control points. Provide control points that are substantial enough to remain in place and undisturbed for the duration of the bridge construction. A rebar should be used for these control points. “Always” use the same set of control points to build the bridge from one side to the other.
- The next step is to establish the structure 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.
- Check distances across streams, highways, or other obstructions by use of an approved Electronic distance measuring device (EDM). Never rely on any existing station to establish pier or bridge footing locations without checking it first. Always double check all distances 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. Stake pier locations in accordance with the footing layout included in the plans. After the piers have been staked, stand back and “eyeball” the entire layout, if possible, to determine if it looks correct.

Results from the site inspection should be sent to the Office of Bridge Design in the form of a letter from the District Engineer. This letter should report the distances requested above and should also state whether the proposed bridge fits the site.



H = DECK THICKNESS
+BEAM DEPTH
+BEARING THICKNESS
+CAP DEPTH

= 9" + BEAM DEPTH + 3" + 2'

= BEAM DEPTH + 3'

X = (2H-5)/SIN θ
X IS MEASURED ALONG ℄ BRIDGE

TABLE OF BEAM DEPTHS

BEAM TYPE	BEAM DEPTH
TYPE I PSC	2′-4″
TYPE I – MOD PSC	2′-4″
TYPE II PSC	3′-0″
TYPE III PSC	3′-9″
TYPE IV PSC	4′-6″
TYPE V PSC	5′-3″
BULB- T PSC	6′-0″
T-BEAMS (26′ - 32′ SPANS)	2′-3″ *
T-BEAMS (34′ - 40′ SPANS)	2′-9″*
STEEL BEAMS	SEE PRELIMINARY LAYOUT

- **T-BEAM DEPTH INCLUDES SLAB THICKNESS**
(T-BEAM = REINFORCED CONCRETE DECK GIRDER)

E. 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://topps.dot.state.ga.us/topps/pre/bridge/4170-5.htm.

HYDRAULIC ENGINEERING FIELD REPORT

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

A. Project Location

District_____ County_____ Project No._____

P.I. No._____Route_____ Stream Name_____

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?_____
_____

Required Existing Bridge Information at Project Site

Bridge Identification No._____
Date Built_____
Skew angle of bridge bents_____
Substructure Information:_____
Column type (concrete, steel, etc.)_____
Size of column_____
Number of columns per bent_____
Height of curb, parapet or barrier_____
Guide Bank (Spur Dike) length, elevation and location if applicable_____
_____
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 the survey centerline	_____
At the survey centerline	_____
500 feet downstream of the survey centerline	_____
Normal high tide	_____
Normal low tide	_____

E. Historical Flood Data

Extreme highwater elevation at site _____ Date_____
Highest observed tide elevation _____ Date_____
Location where extreme highwater elevation was taken (upstream or downstream face of bridge, distance upstream or downstream, centerline)_____
Source of highwater information_____
_____

Location and floor elevation of any houses/buildings/structures that have been flooded_____

Information about flood (number of times house/building/structure has been flooded, water surface elevation(s) and date(s) of flood_____
_____
Location and floor elevation of any houses/buildings/structures that have floor elevations within 2 feet of the extreme highwater elevation_____
_____

F. Benchmark Information

Benchmark number_____
Location (CAiCE pt. no. or project station/offset)_____
Physical description_____
_____

Benchmark number_____
Location (CAiCE pt. no. or project station/offset)_____
Physical description_____
_____

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 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 normally should be 200 feet left and right of the centerline of the existing road and/or construction/survey centerline. This topo coverage shall extend to a point 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, and a complete physical description are required for each benchmark.

B. Stream Traverse

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 cross sections 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. 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 cross sections shall include shots where there is a significant change in elevation.

1. Floodplain cross sections are required upstream and downstream of the bridge site. These cross sections shall be located 50 to 100 feet from the roadway centerline, along original ground. These floodplain cross sections should be parallel to the existing bridge and roadway. **This data is also required for bridge and roadway sites located along the stream that are no further than 2000feet 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 cross section 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

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.

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 and gutterlines are required. If the bridge is built on a constant cross slope/superelevation, only the gutterline shots are required.
2. For bridge widening projects, in addition to the begin and end 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 and gutterlines. 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.

F. 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.

G. Historical Flood Data

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

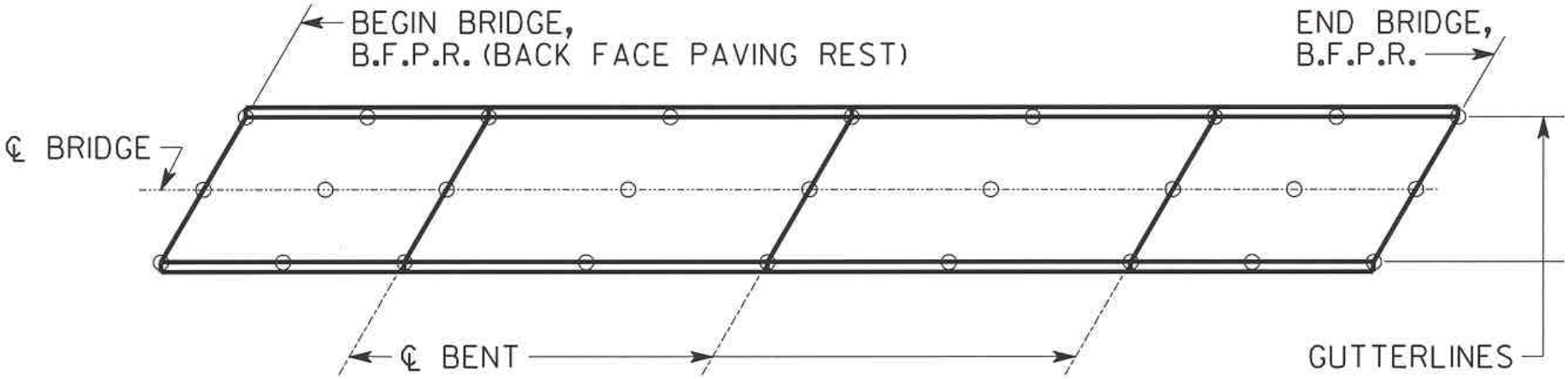
1. The extreme highwater elevation (flood of record) shall be obtained along with the date of occurrence, location (upstream or downstream face of the bridge, distance upstream, downstream, or at the centerline), and the source for this information. If the site is tidal, then the highest observed tide 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.

H. 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. 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 hydraulic engineer will identify any additional information that is required, and provide the surveyor with this information. **The surveyor can contact the Office of Bridge Hydraulics if a question arises during the field survey of the project.**

○ PROVIDE DECK ELEVATIONS AT BFPR, ℄ BENTS AND AT MIDSPAN ALONG THE ℄ BRIDGE AND GUTTERLINES. SEE SECTION II.E OF THE HYDRAULIC ENGINEERING FIELD REPORT.

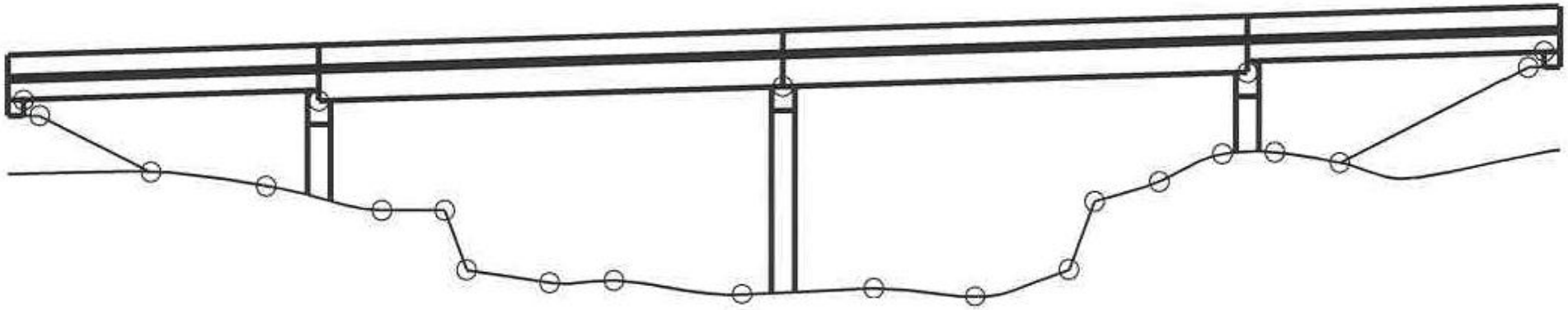


REQUIRED BRIDGE DECK ELEVATIONS

FIGURE I

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

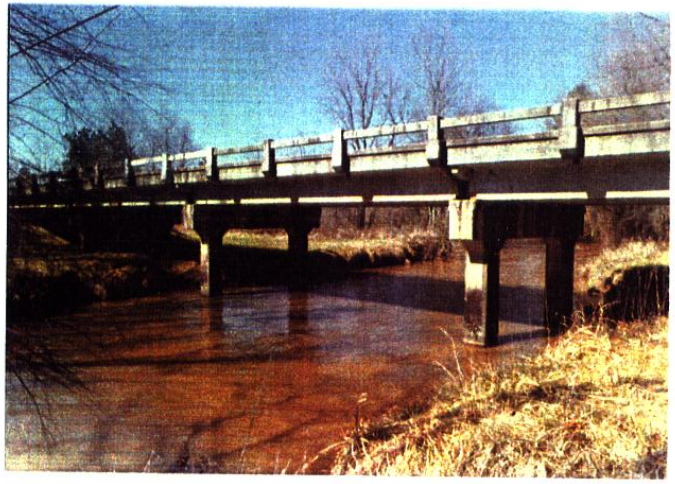
A SUFFICIENT NUMBER OF STREAMBED SHOTS SHALL BE TAKEN TO INSURE AN ACCURATE STREAM CHANNEL CROSS SECTION.



TYPICAL SECTION - PROFILE OF BRIDGE OPENING

FIGURE 2

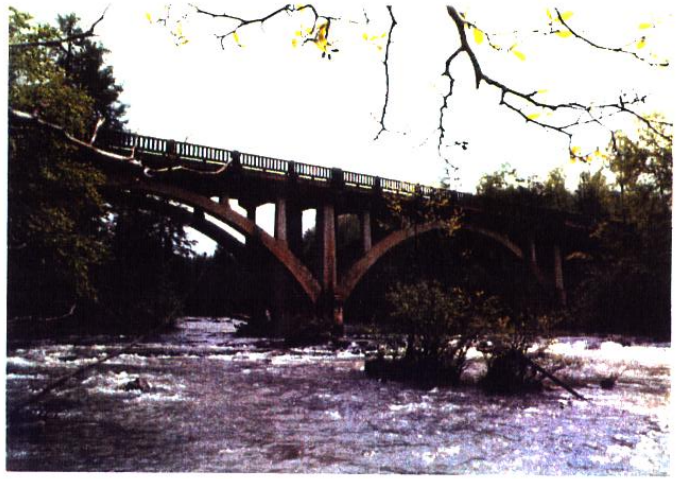
BRIDGE BENT TYPES



CONCRETE BENTS

CONCRETE BENTS W/WEBWALL

VERTICAL ABUTMENT



SPECIAL DESIGN

BRIDGE BENT TYPES

TIMBER PILING

STEEL "H" PILING

METAL SHELL PILING

PRESTRESSED CONCRETE PILE

4120-1

Minimum Survey Data for Bridge Projects

See document history

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.

Authored by the Office of Bridge Design, 404-656-5280

Document History:

- added to Manual of Guidance: 06/26/85
- added to TOPPS: 06/07/96
- reviewed: 03/05/08

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4465-4

Survey Procedures for Highway Bridges Over Railroads

See document history

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 Office of Environment/Location, Bureau of Photogrammetry and Surveys.

Authored by the Office of Environment/Location

Document History:

- added to Manual of Guidance: 01/25/88
- added to TOPPS: 03/13/01
- reviewed: 11/10/06

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http://wwwb.dot.state.ga.us/topps/pre/env/4465-4.htm

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.

4465-7

Guidelines for Lake Surveys

See document history

The Project Manager, during the prepartion 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 #1) 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 #2) 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.

Authored by the Office of Environment/Location, 404-699-4401

- added to Manual of Guidance: 011/16/92
- added to TOPPS: 05/01/96

- reviewed: 11/10/06

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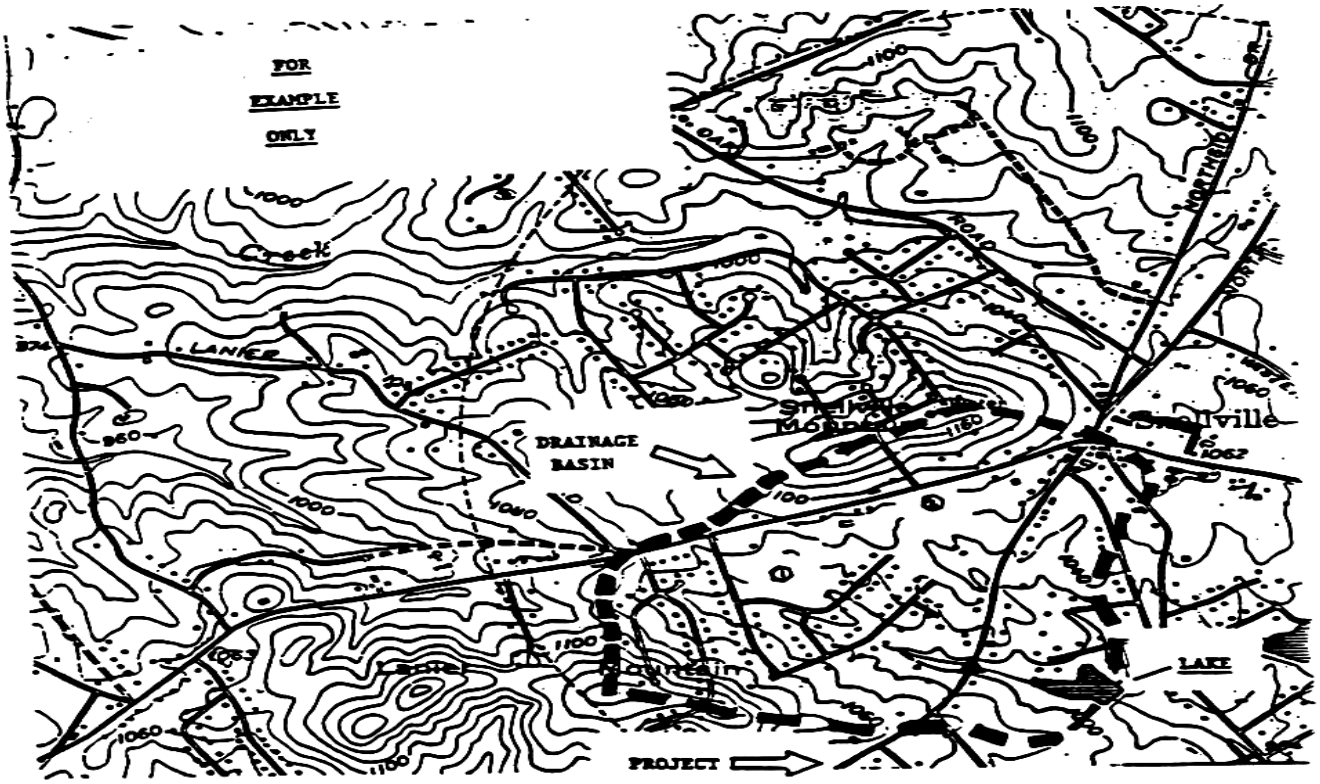
http://wwwb.dot.state.ga.us/topps/pre/env/4465-7.htm



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

Figure 1

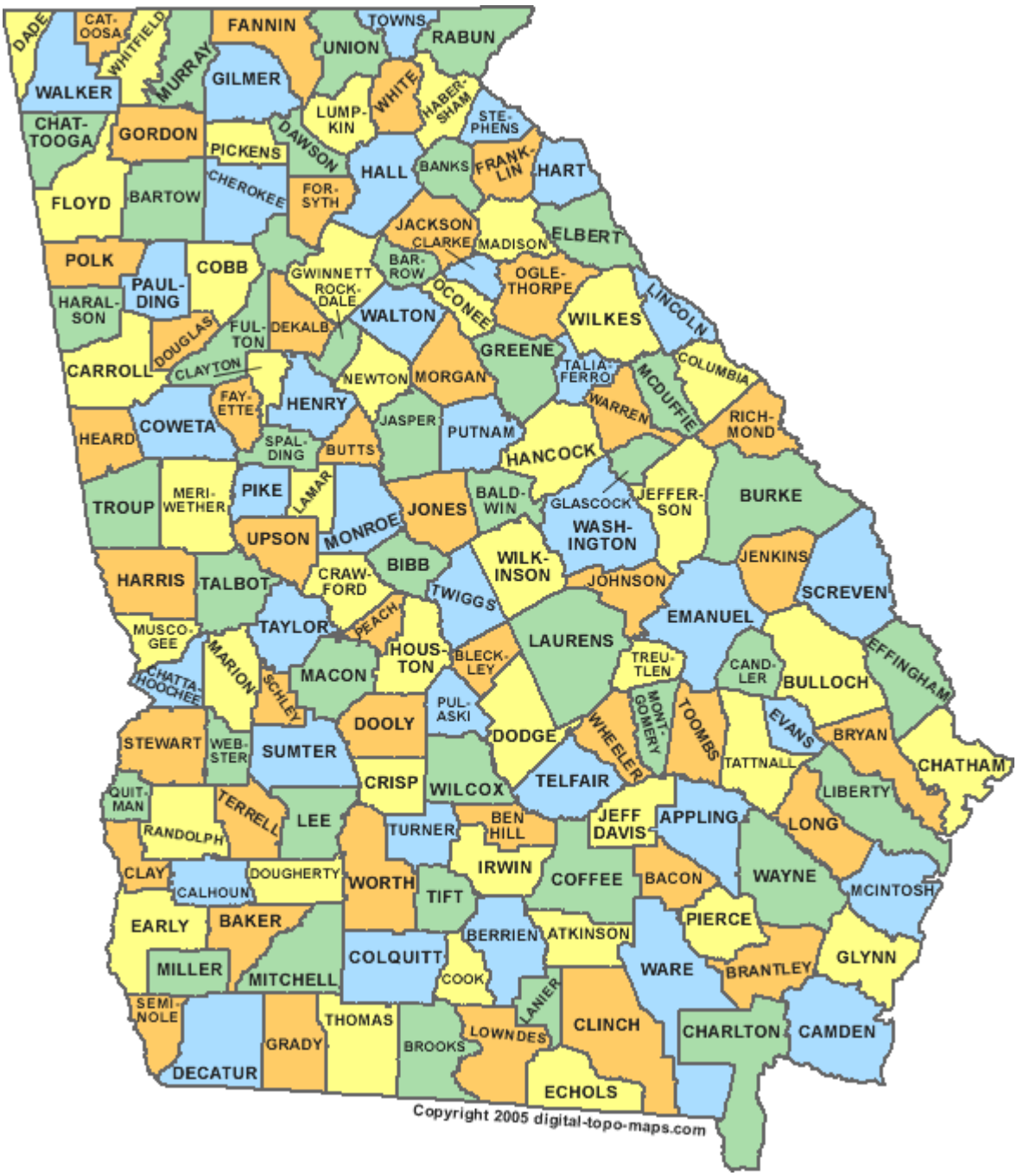
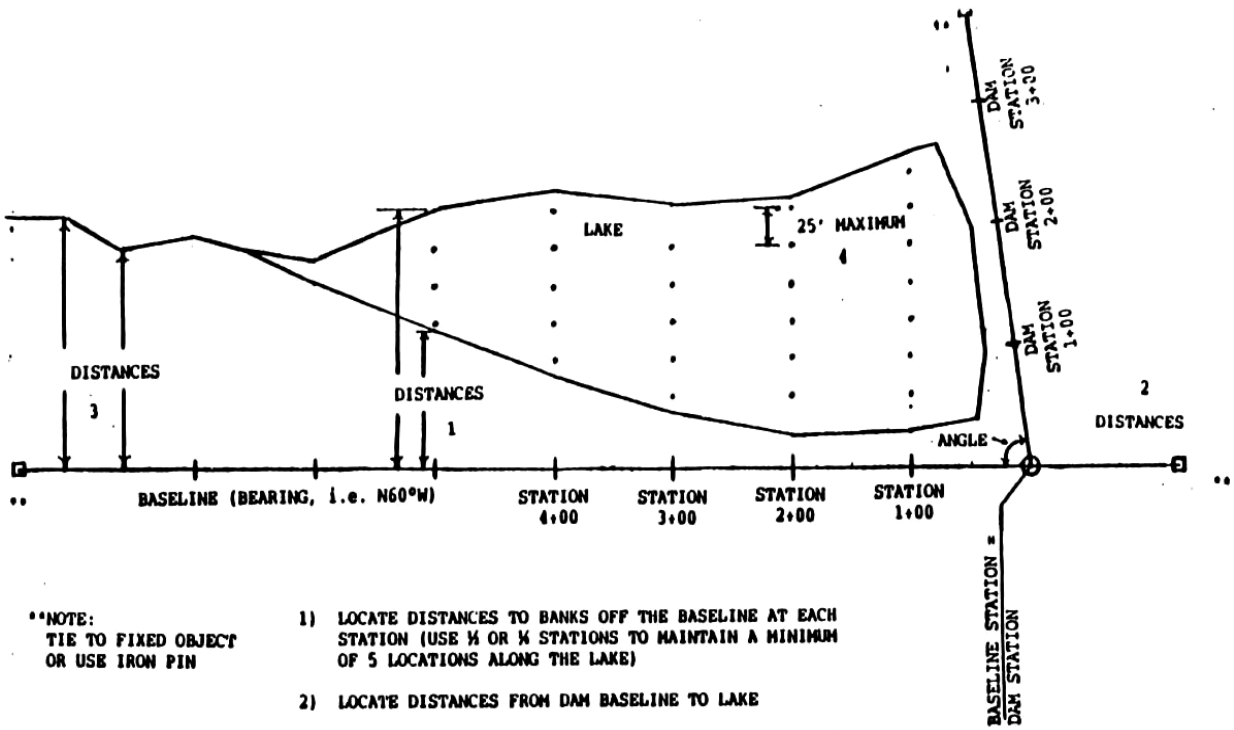

DADE
CAT-OOSA
WHITFIELD
FANNIN
TOWNS
RABUN
UNION
MURRAY
GILMER
WALKER
WHITE
HABER-SHAM
LUMP-KIN
STE-PHENS
CHAT-TOOGA
GORDON
DAWSON
PICKENS
HALL
BANKS
FRANK-LIN
HART
CHEROKEE
FOR-SYTH
FLOYD
BARTOW
JACKSON
CLARKE
MADISON
ELBERT
POLK
COBB
BAR-ROW
GWINNETT
ROCK-DALE
OGLE-THORPE
PAUL-DING
OCONEE
LINCOLN
HARAL-SON
WALTON
WILKES
DOUGLAS
FUL-TON
DEKALB
GREENE
CARROLL
CLAYTON
NEWTON
MORGAN
TALIA-FERRO
COLUMBIA
MCDUFFIE
FAY-ETTE
HENRY
WARREN
RICH-MOND
HEARD
COWETA
JASPER
PUTNAM
SPAL-DING
BUTTS
HANCOCK
TROUP
MERI-WETHER
PIKE
LAMAR
JONES
BALD-WIN
GLASCOCK
JEFFER-SON
BURKE
UPSON
MONROE
WASH-INGTON
BIBB
WILK-INSON
JENKINS
HARRIS
TALBOT
CRAW-FORD
TWIGGS
JOHNSON
SCREVEN
EMANUEL
MUSCO-GEE
TAYLOR
PEACH
LAURENS
HOUS-TON
BLECK-LEY
TREU-TLEN
CAND-LER
BULLOCH
EFFINGHAM
CHATTA-HOOCHEE
MARION
SCHLEY
MACON
PUL-ASKI
MONT-GOMERY
TOOMBS
EVANS
BRYAN
DOOLY
DODGE
WHEELER
STEWART
WEB-STER
SUMTER
TATTNALL
CHATHAM
CRISP
WILCOX
TELFAIR
LIBERTY
QUIT-MAN
TERRELL
LEE
JEFF DAVIS
APPLING
LONG
RANDOLPH
TURNER
BEN HILL
IRWIN
CLAY
DOUGHERTY
WORTH
COFFEE
BACON
WAYNE
MCINTOSH
CALHOUN
TIFT
EARLY
BAKER
PIERCE
BERRIEN
ATKINSON
COLQUITT
GLYNN
MILLER
MITCHELL
COOK
WARE
BRANTLEY
SEMI-NOLE
LANIER
THOMAS
CLINCH
CHARLTON
CAMDEN
GRADY
BROOKS
LOWNDES
DECATUR
ECHOLS
Copyright 2005 digital-topo-maps.com

Figure 2



**NOTE:
TIE TO FIXED OBJECT
OR USE IRON PIN

1) LOCATE DISTANCES TO BANKS OFF THE BASELINE AT EACH STATION (USE ½ OR ¼ STATIONS TO MAINTAIN A MINIMUM OF 5 LOCATIONS ALONG THE LAKE)

2) LOCATE DISTANCES FROM DAM BASELINE TO LAKE

3) LOCATE STREAM ENTRANCE REFERENCED FROM THE BASELINE

4) MEASURE DEPTHS ALONG THE BASELINE AT A MAXIMUM 25 FOOT SPACING (ADJUST THE SPACING TO MAINTAIN A MINIMUM OF 5 LOCATIONS ACROSS THE LAKE)

5) TAKE RANDOM SAMPLES OF THE LAKE BOTTOM IF SILTATION BY OTHERS IS ANTICIPATED

6) THE WATER ELEVATION SHOULD BE REFERENCED TO THE TOP OF THE RISER PIPE OR THE TOP OF THE SPILLWAY

7) ELEVATIONS SHOULD ALSO BE TAKEN ALONG THE TOP OF THE DAM

FIGURE #3

Figure 3

STATE AID PROJECTS

GENERAL INFORMATION:

Projects on Local Government Priority List are reviewed by the State Aid Coordinator and the Area Engineer. At this time, a determination is made regarding the need for Corps of Engineers permits or hydraulic studies.

The Scheduling Engineer submits request for authorization of field surveys. The Scheduling Engineer and State Aid Coordinator establish priorities of the surveys. The State Aid Coordinator determines the priority from the Local Government.

1. PRE-SURVEY ACTIVITIES

A. Project Review – Before any field survey activities are begun, the Location Engineer shall initiate a field review of the project.

1. This review shall include the Area Engineer and the local government official who is most knowledgeable of the project, and the State Aid Coordinator on complicated projects.

2. The Location Engineer should keep notes (written or tape-recorded) of how the local government wishes the project to be built. These instructions are to include all commitments which the local government has made to local residents (i.e., proposed alignment, structures which are to be missed, boundaries which are to be followed, etc.).

3. The Area Engineer and District Preconstruction Engineer will provide input to insure that all proposals conform with good engineering practices (i.e., vertical and horizontal alignments, drainage, etc.).

4. All points of conflict will be resolved between the government officials, the Area Engineer, and the Survey Engineer.

5. Cross sections will **NOT** be measured on the project unless they are deemed necessary by the Area and Preconstruction Engineers.

B. SURVEY INSTRUCTIONS – The Location Engineer shall transcribe the notes from the Project Review Meeting into written instructions for the survey party.

The Location Engineer will insure that tax maps of the project are provided to the surveyors. No property deeds are required. The Location Engineer shall obtain the names and addresses of all property owners affected by the project. The Location Engineer and the Survey Party Chief shall conduct a field review of the project to discuss the project instructions, contact property owners, and flag property corners and side property lines.

1. On most projects, the front property lines will be the center of the existing road.

2. A point on the property lines should be flagged outside the limits of the proposed right-of-way **(80′ R/W** on projects to be constructed with State funds, otherwise **60′** or as instructed by the local government).

3. Local residents should be asked to identify all topographic features, which might impact the project (graves, wells, irrigation systems, etc.).

C. Location Survey

CONTROL – In the absence of State Plane Coordinates, a horizontal control traverse shall be staked through the project and looped back to the beginning traverse points. No vertical control is set unless cross sections are required.

1. The traverse closure should be a minimum of 1: 10,000.

2. If there are no State Plane Coordinates on or adjacent to the project, assumed coordinates are to be used.

D. Topo – ONLY topo what is **WITHIN** the proposed right-of-way and affects the alignment, or otherwise has an impact on the project and should be located:

1. Existing road.
2. Crossroads.
3. Existing structures.
4. Existing drainage structures (size, type).
5. Miscellaneous (wells, graves, etc.).

E. Alignment – Locate points which will determine the project alignment.

1. Points which will control the alignment at critical points. The critical locations should have been identified by the local government official (i.e., centerline of road to be **60′** from steps to house, etc.).

2. No points are required when the new roadway follows the existing road.

3. Starting and ending points for the alignment will be provided.

4. A starting bearing 9magnetic) must be provided.

F. Property

1. Locate all known property corners**.**
2. Locate intersecs of side property lines and center of existing road.
3. Locate a point on each side property line (previously flagged) outside the proposed right-of-way.

G. Data Transmission – Data is uploaded into the computer and rough sketches and other field notes are sent to the Survey Data Engineer.

2. DATA PROCESSING (SURVEY DATA ENGINEER)

When the survey has been completed the surveyor puts the file in their personal share on the District server. He/she also gives the SDE a packet with sketches and information about the project. Each file is named according to the county and road number, using the first three letters of the county followed by the road number. All subsequent files would also begin with the first three letters of the county name, followed by the county road number. The file is copied by the SDE to his/her directory and logged into a book where the process and priority is kept. The SDE processes the file according to the **Survey Processing Guidelines** released in early 1999. It is important that point codes and field sketches are used when preparing this database. Make sure the **MICROSTATION (.DGN)** file is moved and rotated correctly to match the original coordinates.

Survey Data Engineer Responsibilities also include

A. Create the Project and prepare the CAiCE database.
B. Chain property.
C. Set proposed alignment (based on critical points and notes from Location Engineer's field review).
D. Set and chain proposed right-of-way

3. DESIGN

A. The finished survey data is delivered to the Design Office.
B. The file is given to a drafter who finishes the drawing and adds the property owner's names.
C. The entire right-of-way is plotted on a continuous roll for the Survey Engineer and Local Government Coordinator. They use this in making a field inspection for errors or necessary alignment changes that need to be
corrected. This is very helpful to the drafters in cutting down on revisions before the actual right-of-way plans are plotted.

D. If a review of the roll plot reveals that changes need to be made, the SDE or designer makes the needed changes. The designer then divides the job into sheets. The sheets are grouped together and plotted. The finished sketches are then checked by the SDE, Location Engineer, Local Government Coordinator and the State Aid Coordinator.

E. All files involved with the project are then copied to compact disk by the SDE.

This operational step is helpful in eliminating corrections on the individual right-of-way plan sheets. This speeds up the process of drawing the **PR** right-of-way plans.

The District Design Office inspects projects with suspected wetland impact and prepares sketches and other information for use by the Environmental Section in obtaining permits for let projects.

4. STAKE OUT

A. **Alignment stakeout** – After the Location Engineer approves the alignment and the local government indicates that it is ready to start right-of- way acquisition:

NOTE: If alignment is on new location, it should be staked as soon as possible so the local office can approve it.

1. The beginning and ending points of the project, PC's and PT's need to be established.

B. **Right-Of-Way** – The right-of-way shall be staked in conjunction with the alignment. Right-of-Way points should be set with a cloth tape.

C. **Cross Sections** – Earthwork and drainage cross sections will **NOT** be measured unless **APPROVED** by the Preconstruction Engineer.

D. **Referencing Points** – PC's, PT's, POT's or control deltas should be referenced a minimum of at least 1-foot beyond the required right-of-way so that the centerline can be re-established as necessary.

CONSULTANT CHECK DELIVERABLES

PROJECT NO: _____ P.I. NO: _____

FIELD ENHANCEMENTS BY: _____ DATE: _____

MAPPING FILES PRODUCED BY: _____ GDOT PROJECTMANAGER_____

ITEMS NEEDED FOR MAPPING 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 proceeded that far into the design phase and checks have not been required.

☐ A Caice Archive file of the Project.

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

☐ The primary traverse shall be established by either the conventional survey method or by Global Positioning System (GPS) technology. All subsequent survey data shall be collected from the adjusted primary traverse values and reduced to State Plane. If GPS was used to establish vertical control, the written agreement from the Department to use GPS to gather vertical data must be submitted.

☐ 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

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 survey control, alignment, computed and found property corners.
- 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.
- Load a grid factor from the survey control pack into the Allegro 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.
- 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. file and raw data file should be sent to Bob Cagle at the office of Environment/Location. A letter, such as the example on the next page, should also be transmitted.

Revised: May 06

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 Office of Environment/Location 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). **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.

When carrying trig-levels on district traverses, distances between the district set control deltas should not exceed **800 feet** and **never what environment 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 automatically computes the correction for refraction and curvature of the earth's surface. If not using the SMI 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).**

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

GDOT SPECIFIC

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.

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.

This procedure is used on each set-up when gathering field data in the sideshot 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.

GDOT SPECIFIC

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

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 half way 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 step4 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 owners 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. *****

<u>Example of a Spirit Level Calibration Check</u> (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:** Environment and Location

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: Environment and Location

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: _____

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 ect.

GDOT STANDARD SURVEY FEATURE CODES

SMI Code	Description	CAiCEZone Code	Point	Chain Type	Type
	Ground Elevations				
1	TERRAIN POINT ON BREAK LINE	TPBL	51		G
2	RANDOM TERRAIN POINT	TRP	51	G	
	Property and Right-of-Way				
3	RIGHT-OF-WAY MARKER FOUND	RWM	50	F	
4	RIGHT-OF-WAY POINT COMPUTED	RWC	50	F	
5	RIGHT-OF-WAY UTILITY COMPANY	RWU	50		F
6	RIGHT-OF-WAY PRESCRIPTION PT	RWE	50		F
7	POINT ON EASEMENT LINE	POEL	50		F
8	PROPERTY CORNER FOUND	PCF	50	F	
9	PROPERTY POINT ON LINE	PPOL	50	F	
10	PROPERTY POINT COMPUTED	PPC	50	F	
	Alignment				
15	POINT ON TANGENT, EXISTING	APOT	50	F	
16	POINT OF CURVATURE, EXISTING	APOC	50	F	
17	POINT ON CURVE, EXISTING	APC	50	F	
18	POINT OF TANGENCY, EXISTING	APT	50	F	
19	POINT OF INTERSECTION	API	50	F	
20	ALIGNMENT CENTERLINE	ACL	52		F
	Roadways				
24	EDGE OF DIRT ROAD	TEDR	51		G
25	EDGE OF ASPHALT DRIVE	TEAD	51		G
26	EDGE OF CONCRETE DRIVE	TECD	51		G
27	EDGE OF ASPHALT PAVEMENT	TEAP	51		G
28	EDGE OF ASPHALT SHOULDER	TEAS	51		G
29	EDGE OF CONCRETE PAVEMENT	TECP	51		G
30	EDGE SURFACE TREATMENT ROAD	TEST	51		G
31	CURB, ASPHALT	TCA	51		G
32	CURB, HEADER	THC	51		G
33	CURB & GUTTER, TOP	TCGT	51		G
34	CURB & GUTTER, F/L	TCGF	51		G
35	V-GUTTER	TVG	51		G
36	BRIDGE APPROACH SLAB, EDGE	TBAS	51		G
37	BRIDGE END, CENTER	TBRDG	52		F
38	BRIDGE END, CORNER	TBRDG	52		F
39	BRIDGE COLUMN, CENTER	TCOLC	52	F	
40	BRIDGE COLUMN, EDGE	TCOLE	52	F	
41	BRIDGE GUTTER LINE	TBGL	52		F
42	BRIDGE CENTERLINE	TBCL	52		F
43	ENDROLL	TENDROLL	51		G
44	BRIDGE CAP	TBCAP	52	F	
	Drainage				
45	SINGLE CATCH BASIN, Gutr F/L	DCB	52	F	
47	DOUBLE CATCH BASIN, Gutr F/L	DDCB	52	F	
49	DROP INLET, TOP	DDI	52	F	

SMI Code	Description	CAiCEZone Code	Point	Chain Type	Type
	Drainage				
50	SPUR DIKE	DSPURDK	51		G
51	TOP OF WATER ELEVATION	DWE	52	F	
52	STREAM CENTER, F/L	DSC	51		G
53	STREAM EDGE	DSE	51		G
54	STREAM BANK TOP	DSB	51		G
55	DAM, TOP	DDT	51		G
56	DAM, TOE	DADB	51		G
57	OBSCURED AREA	OBSC	51		G
58	CULVERT END, F/L	DCEF	52		F
59	HEAD WALL, END	DHWE	52		F
60	CULVERT, WINGWALL END	DCWE	52		F
61	EDGE OF WATER	DEW	52		F
62	SWAMP EDGE	DSWE	52		F
63	WETLAND BOUNDARY	DWB	52		F
	Utilities				
68	STRAIN POLE	USTRPOL	52	F	
69	ELECTRICAL BOX	UELBOX	52		F
70	OVERHEAD ELECTRICAL LINE	UOEL	52		F
71	OVERHEAD TELEPHONE LINE	UOTL	52		F
72	POWER POLE, CENTER	UPP	52	F	
73	LIGHT POLE, CENTER	ULP	52	F	
74	TELEPHONE POLE, CENTER	UTP	52	F	
75	TELEPHONE PEDESTAL, CENTER	UTPD	52	F	
76	GUY POLE, CENTER	UGP	52	F	
77	POLE ANCHOR	UPGA	52	F	
78	YARD LIGHT, ELECTRICAL	UYLE	52	F	
79	YARD LIGHT, GAS	UYLG	52	F	
80	WATER METER, CENTER	UWM	52	F	
81	WATER VALVE	UWV	52	F	
82	FIRE HYDRANT, CENTER	UFH	52	F	
83	MANHOLE STORM SEWER, TOP	UMHST	52	F	
84	MANHOLE STORM SEWER, F/L	UMHSTF	52	F	
85	MANHOLE, TELEPHONE, TOP	UMHT	52	F	
86	MANHOLE, ELECTRICAL, TOP	UMHE	52	F	
87	MANHOLE, SANITARY SEWER, TOP	UMHSS	52	F	
88	MANHOLE, SANITARY SEWER, F/L	UMHSSF	52	F	
89	SANITARY SEWER LINE, CENTER	USSL	52	F	
90	GAS METER, CENTER	UGM	52	F	
91	GAS VALVE, CENTER	UNGV	52	F	
92	GAS VENT PIPE	UNGVP	52	F	
93	GAS LINE MARKER	UNGLM	52	F	
	General Topo				
95	WALL FACE	TWF	52		F
96	WALL FACE, TOP	TWFT	51		G
97	WALL FACE, BOTTOM	TWFB	51		G

SMI Code	Description	CAiCEZone Code	Point	Chain Type	Type
	General Topo				
98	IRRIGATION PIVOT POINT	TIRRPVTP	52	F	
99	IRRIGATION LIMITS	TIRRLMT	52	F	
100	SIGN, CENTER	TS	52	F	
101	GASOLINE MONITORING WELL	TGMW	52	F	
102	GASOLINE FILLER VALVE	TGFV	52	F	
103	GASOLINE VENT PIPE	TGVP	52	F	
104	GASOLINE PUMP	TGP	52	F	
105	GASOLINE STORAGE TANK, END	TGST	52		F
106	GASOLINE PUMP ISLAND	TGPI	52		F
107	CANPOY	TCAN	52		F
108	BUILDING CORNER	TBLD	52		F
109	BUILDING ROOF LINE CORNER	TBLDRL	52		F
110	HOUSE CORNER	THCR	52		F
111	HOUSE ROOF LINE CORNER	THRL	52		F
112	MOBILE HOME CORNER	TMHCR	52		F
113	MOBILE HOME ROOF LINE CORNER	TMHRL	52		F
115	WOODS LINE	TWL	52		F
116	CULTIVATION LINE	TCUL	52		F
117	FENCE, FIELD WIRE	TFFW	52		F
118	FENCE, BARB WIRE	TFBW	52		F
119	FENCE, WOOD	TFW	52		F
120	RAILROAD, TOP OF RAIL	TRCR	52		F
121	RAILROAD, CENTERLINE	TRCL	52		F
122	CEMETERY LINE	TCEM	52		F
123	GRAVE	TGRV	52		F
124	GUARD RAIL	TGR	52		F
125	SIGN, END	TS	52		F
126	SATELLITE DISH	TSATDSH	52	F	
127	LIMIT LINE	TLIML	51		G
128	CONSTRUCTION BOUNDARY, ACTV	TCBA	51		G
129	CONSTRUCTION BOUNDARY, FIND	TCBF	51		G
	Boundaries				
130	COUNTY LINE	BCOL	52		F
131	CITY LIMIT LINE	BCTL	52		F
132	LAND DISTRICT LINE	BLDL	52		F
133	LAND LOT LINE	BLLL	52		F
134	STATE LINE	BSL	52		F
150	Surveyor Defined Value	X	51	G	
151	Surveyor Defined Value	X	51	G	
152	Surveyor Defined Value	X	51	G	
153	Surveyor Defined Value	X	51	G	
154	Surveyor Defined Value	X	51	G	
155	Surveyor Defined Value	X	51	G	
156	Surveyor Defined Value	X	52	F	
157	Surveyor Defined Value	X	52	F	

SMI Code	Description	CAiCEZone Code	Point	Chain Type	Type
158	Surveyor Defined Value	X	52	F	
159	Surveyor Defined Value	X	52	F	
160	MAP CHECK GROUND	MAPCKGRD	52	F	
161	MAP CHECK PAVEMENT	MAPCKPAV	52	F	
162	Surveyor Defined Value	X	52	F	
163	Surveyor Defined Value	X	52	F	
164	Surveyor Defined Value	X	52	F	
165	Surveyor Defined Value	X	52	F	
166	Surveyor Defined Value	X	52	F	
167	Surveyor Defined Value	X	52	F	
168	Surveyor Defined Value	X	52	F	
169	Surveyor Defined Value	X	52	F	
170	Surveyor Defined Value	X	52	F	
171	Surveyor Defined Value	X	51		G
172	Surveyor Defined Value	X	51		G
173	Surveyor Defined Value	X	51		G
174	Surveyor Defined Value	X	51		G
175	Surveyor Defined Value	X	51		G
176	Surveyor Defined Value	X	52		F
177	Surveyor Defined Value	X	52		F
178	Surveyor Defined Value	X	52		F
179	Surveyor Defined Value	X	52		F
180	Surveyor Defined Value	X	52		F
181	Surveyor Defined Value	X	52		F
182	Surveyor Defined Value	X	52		F
183	Surveyor Defined Value	X	52		F
184	Surveyor Defined Value	X	52		F
185	Surveyor Defined Value	X	52		F
186	Surveyor Defined Value	X	52		F
187	Surveyor Defined Value	X	52		F
188	Surveyor Defined Value	X	52		F
189	Surveyor Defined Value	X	52		F
190	Surveyor Defined Value	X	52		F
191	Surveyor Defined Value	X	52		F
192	Surveyor Defined Value	X	52		F
193	Surveyor Defined Value	X	52		F
194	Surveyor Defined Value	X	52		F
195	Surveyor Defined Value	X	52		F
196	Surveyor Defined Value	X	52		F
197	Surveyor Defined Value	X	52		F
198	Surveyor Defined Value	X	52		F
199	Surveyor Defined Value	X	52		F
	Dimension Codes: (Drainage)				
200	DRAINAGE PIPE, F/L, C	DP	52	F	F
201	DRAINAGE PIPE, F/L, M	DP	52	F	F
202	DRAINAGE PIPE, F/L, P	DP	52	F	F

SMI Code	Description	CAiCEZone Code	Point	Chain Type	Type
	Dimension Codes (General Topo)				
210	SIDEWALK, CENTER	TSW	52		F
211	FENCE, CHAIN LINK	TFCL	52		F
212	TREE, CENTER	TTRE	52	F	
213	WELL	TWELL	52	F	
	Dimension Codes (Roadway)				
225	DIRT ROAD, C/L	TDR	51		G
227	DIRT DRIVE, C/L	TDD	51		G
235	MILE POST, RAILROAD	TMPR	52	F	
236	KM POST, HIGHWAY	TKMP	52	F	
237	MILE POST, HIGHWAY	TMPH	52	F	
	Survey control				
240	NGS CONTROL MONUMENT	SNGSCM	52	F	
241	LOCATION CONTROL MONUMENT	SLCM	52	F	
242	LOCATION CONTROL DELTA	SLCD	52	F	
243	DISTRICT CONTROL DELTA	SDCD	52	F	
244	CONTROL RE-SHOT FOR CHECK	SCCHK	52	F	
245	BENCHMARK	SBNCHMK	52	F	
250	MISCELLANEOUS	MISC	52	F	

NOTE: (The types of points and chains are denoted as follows)

G = 3D Point or Chain

F = 2D Point or Chain

PAR = Property parcel chains generated by the Survey Data Engineer

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 Engineer at the Office of Environment/Location. This contact number is 404-699-4470. The SCE 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.

SAFETY VEST

A beginning in staying safe along a publically travelled roadway is to be as highly visible as possible. The Department has guidelines in place which will help us do so with TOPPS policy number 7180-7. This policy has been placed on the next page 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.

7180-7

Personal Protective Equipment Policy - Safety Vests/Garments

See document history

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 an approved 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 the 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 the Class III ANSI jacket available for employee purchase from the Engineers Association is acceptable.
  NOTE: This jacket 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.

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 the MAP Manual of Administrative Procedures. Issuance and replacement procedures may also be read in the MAP Manual of Administrative Procedures.

Authored by the Office of General Support, 404-656-5322

Document History:

- added to TOPPS: 01/24/01
- revised: 12/08/03
- reviewed: 05/04/05
- reviewed: 09/29/06

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 and made of orange mesh 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.

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 Office of Environment/Location for clarification. The contact number for the SCE is 404-699-4470.

7180-8
Personal Protective Equipment Policy - Head Gear

See document history

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 or GDOT approved soft ball type cap shall be worn at all times for the following conditions:

1. Working within State or County owned Rights of way.
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 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 the MAP Manual of Administrative Procedures. Issuance and replacement procedures may also be read in the MAP Manual of Administrative Procedures.

Authored by the Office of General Support, 404-656-5322

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- added to TOPPS: 06/02/03
- revised: 09/26/03
- reviewed: 09/29/06

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. TOPPS 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.

7130-6
Standards for Strobe Light Installations

See document history

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.

The chart listed below sets the Department's policy for the minimum number, color and position of strobe lights for each equipment type. District Engineers or Department Heads may, on a case by case basis, authorize the use of additional lights if they feel a situation warrants their use. When additional lights are authorized for equipment, the State Equipment Management Administrator must be notified of the number and color of the additional strobe lights either by letter or email.

Matrix for Minimum Strobe Light Installation

NOTE:

1. Unless specified, one light will always be amber.
2. One amber light should always be visible for 360 degrees as mandated by state law.

PREFIX	VEHICLE NAME	NUMBER & POSITION OF STROBE LIGHTS
124 125 126	COMPACT SEDAN, ASSIGNED MID-SIZE SEDAN, ASSIGNED FULL SIZE SEDAN, ASSIGNED	TWO - REAR DECK MOUNTED (AMBER/CLEAR) AND ONE MAGNETIC ROOF MOUNTED FOR USE WHILE STOPPED.
127 128	COMPACT WAGON,ASSIGNED MID-SIZE WAGON,ASSIGNED	SAME AS 124, 125, 126 ASSIGNED.
400 401	SMALL PICKUP FULLSIZE PICKUP	ONE CENTER MOUNTED.
402	SUBURBAN	ONE CENTER MOUNTED
403	CARGO VAN	ONE CENTER MOUNTED
404	PASSENGER VAN	ONE CENTER MOUNTED

450	CREW CAB	ONE LIGHT.
452	SUBURBAN-SPORT UTILITY-PICKUPS	ONE CENTER MOUNTED.

For further information, contact the Office of Equipment Management at 770-484-3201.

Authored by the Office of Equipment Management, 770-484-3201

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- added to TOPPS: 12/3/02
- reviewed: 06/01/04
- reviewed: 08/15/05
- reviewed: 10/10/06
- reviewed: 01/23/08

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.

7130-8
Conspicuity Tape Policy

See document history

The Department is committed to following Federal Regulation (49CFR571.108) 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 require 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 Suburban's shall be color coordinated, i.e. yellow on yellow, or white on white.

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.

Authored by the Office of Equipment Management, 770-484-3201

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Reviewed: 01/23/08

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 travel way. 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 if you have the necessary equipment on hand to collect the requested data without having to put personnel in the centerline of the roadway. If the answer to this question is no then you will need to explore the next course of action. This would be to contact the Office of Environment/Location (OEL) Engineering Management Group (EMG) and ask for assistance. The OEL EMG has equipment which will prevent survey personnel from having to stand in the centerline of any roadway. Contact the OEL Engineering Management Operations Manager (EMOM) or OEL Statewide Cadastral Engineer (SCE) for scheduling of OEL survey personnel to collect the necessary data. If you need the data before the OEL office work scheduled permits then the lane closure and traffic flow management will be required.

SAFETY IS EVERYONES RESPONSIBILITY, PASS IT ON!

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.

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 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.

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.

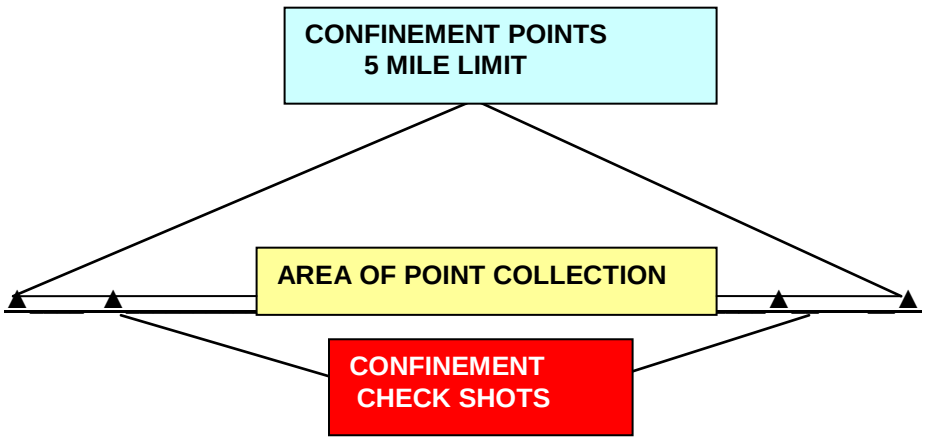
C. A copy of the confinement report(s) as well as a copy of all check shots performed on the project will be supplied to the Department upon request. If these reports are not available at the time requested the data would be considered suspect and the Department and/or Consultant Surveyors would be required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

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 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



Laser Scanner Surveys

USAGE OF HIGH DEFINITION SCANNER (HDS) ON GEORGIA DEPARTMENT OF TRANSPORTATION PROJECTS

When using HDS equipment to perform Department surveys all deliverables to the Department will be exactly the same as they are currently, *.asc files and Design databases.

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.

Contact your equipment vendor for the most up to date procedures on how to be the most accurate and productive with the HDS equipment. Consequently the entity performing the Survey and/or Design activities will be held responsible for the accuracy of the information submitted.

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

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

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 Office of Environment/Location (OEL) 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

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

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: ***(The Types of points and chains are denoted as follows):***

G = 2D & 3D Point or Chain

F = 2D & 3D Point or Chain

PAR = Property Parcel Chains generated by the Survey Data Engineer

***SMI # = For Photogrammetric (Mapping) use only!**

****SMI # = For InRoads Use Only! Do NOT use in CAiCE.**

GDOT STANDARD SURVEY FEATURE CODES

SMI Code	Description	InRoads Code	Zone	Point Type	Chain Type	Group Code
	Ground Elevations					
1	TERRAIN POINT ON BREAK LINE	TPBL	51		G	4
2	RANDOM TERRAIN POINT	TRP	51	G		2
	Property and Right-of-Way					
3	RIGHT-OF-WAY MARKER FOUND	RWM	50	F		1
4	RIGHT-OF-WAY POINT COMPUTED	RWC	50	F		1
5	RIGHT-OF-WAY UTILITY COMPANY	RWU	50	F		1
6	RIGHT-OF-WAY PRESCRIPTION PT	RWE	50		F	3
7	POINT ON EASEMENT LINE	POEL	50	F		1
8	PROPERTY CORNER FOUND	PCF	50	F		1
9	PROPERTY POINT ON LINE	PPOL	50	F		1
10	PROPERTY POINT COMPUTED	PPC	50	F		1
	Alignment					
15	POINT ON TANGENT, EXISTING	APOT	50	F		1
16	POINT OF CURVATURE, EXISTING	APC	50	F		1
17	POINT ON CURVE, EXISTING	APOC	50	F		1
18	POINT OF TANGENCY, EXISTING	APT	50	F		1
19	POINT OF INTERSECTION	API	50	F		1
20	ALIGNMENT CENTERLINE	ACL	52		F	3
	Roadways					
24	EDGE OF DIRT ROAD	TEDR	51		G	4
25	EDGE OF ASPHALT DRIVE	TEAD	51		G	4
26	EDGE OF CONCRETE DRIVE	TECD	51		G	4
27	EDGE OF ASPHALT PAVEMENT	TEAP	51		G	4
28	EDGE OF ASPHALT SHOULDER	TEAS	51		G	4
29	EDGE OF CONCRETE PAVEMENT	TECP	51		G	4

30	EDGE SURFACE TREATMENT ROAD	TEST	51		G	4
31	CURB, ASPHALT	TAC	51		G	4

	Roadways					
32	CURB, HEADER	THC	51		G	4
33	CURB & GUTTER, TOP	TCGT	51		G	4
34	CURB & GUTTER, F/L	TCGF	51		G	4
35	V-GUTTER	TVG	51		G	4
36	BRIDGE APPROACH SLAB, EDGE	TBAS	51		G	4
37	BRIDGE END, CENTER	TBRDGCEN	52		F	4
38	BRIDGE END, CORNER	TBRDGCOR	52		F	4
39	BRIDGE COLUMN, CENTER	TCOLC	52	F		1
40	BRIDGE COLUMN, EDGE	TCOLE	52	F		1
41	BRIDGE GUTTER LINE	TBGL	52		F	4
42	BRIDGE CENTERLINE	TBCL	52		F	4
43	ENDROLL	TENDROLL	51		G	4
44	BRIDGE CAP	TBCAP	52	F		2
	Drainage					
45	SINGLE CATCH BASIN, Gutr F/L	DCB	52	F		2
47	DOUBLE CATCH BASIN, Gutr F/L	DDCB	52	F		2
49	DROP INLET, TOP	DDI	52	F		2
50	SPUR DIKE	DSPURDK	51		G	4
51	TOP OF WATER ELEVATION	DWE	52	F		2
52	STREAM CENTER, F/L	DSC	51		G	4
53	STREAM EDGE	DSE	51		G	4
54	STREAM BANK TOP	DSB	51		G	4
55	DAM, TOP	DDT	51		G	4
56	DAM, TOE	DADB	51		G	4
57	OBSCURED AREA	DOBSC	51		G	4
58	**CODE REMOVED (Replaced by Code 203)**	""	""	""	""	
59	HEAD WALL, END	DHWE	52		F	3
60	CULVERT, WINGWALL END	DCWE	52		F	3
61	EDGE OF WATER	DEW	52		F	3
62	SWAMP EDGE	DSWE	52		F	3
63	WETLAND BOUNDARY	DWB	52		F	3

	Utilities					
68	STRAIN POLE	USTRPOL	52	F		1
69	ELECTRICAL BOX	UELBOX	52		F	3
70	OVERHEAD ELECTRICAL LINE	UOEL	52		F	3

71	OVERHEAD TELEPHONE LINE	UOTL	52		F	3
72	POWER POLE, CENTER	UPP	52	F		1
73	LIGHT POLE, CENTER	ULP	52	F		1
74	TELEPHONE POLE, CENTER	UTP	52	F		1
	Utilities					
75	TELEPHONE PEDESTAL, CENTER	UTPD	52	F		1
76	GUY POLE, CENTER	UGP	52	F		1
77	POLE ANCHOR	UPGA	52	F		1
78	YARD LIGHT, ELECTRICAL	UYLE	52	F		1
79	YARD LIGHT, GAS	UYLG	52	F		1
80	WATER METER, CENTER	UWM	52	F		1
81	WATER VALVE	UWV	52	F		1
82	FIRE HYDRANT, CENTER	UFH	52	F		1
83	MANHOLE STORM SEWER, TOP	UMHST	52	F		2
84	MANHOLE STORM SEWER, F/L	UMHSTF	52	F		2
85	MANHOLE, TELEPHONE, TOP	UMHT	52	F		2
86	MANHOLE, ELECTRICAL, TOP	UMHE	52	F		2
87	MANHOLE, SANITARY SEWER, TOP	UMHSS	52	F		2
88	MANHOLE, SANITARY SEWER, F/L	UMHSSF	52	F		2
89	SANITARY SEWER LINE, CENTER	USSL	52	F		1
90	GAS METER, CENTER	UGM	52	F		1
91	GAS VALVE, CENTER	UNGV	52	F		1
92	GAS VENT PIPE	UNGVP	52	F		1
93	GAS LINE MARKER	UNGLM	52	F		1
	General Topo					
95	WALL FACE	TWF	52		F	3
96	WALL FACE, TOP	TWFT	51		G	4
97	WALL FACE, BOTTOM	TWFB	51		G	4
98	IRRIGATION PIVOT POINT	TIRRPVTP	52	F		1
99	IRRIGATION LIMITS	TIRRLMT	52	F		1
100	SIGN, CENTER	TSC	52	F		1
101	GASOLINE MONITORING WELL	TGMW	52	F		1
102	GASOLINE FILLER VALVE	TGFV	52	F		1
103	GASOLINE VENT PIPE	TGVP	52	F		1
104	GASOLINE PUMP	TGP	52	F		1
105	GASOLINE STORAGE TANK, END	TGST	52		F	3
106	GASOLINE PUMP ISLAND	TGPI	52		F	3
107	CANPOY	TCAN	52		F	3
108	BUILDING CORNER	TBLD	52		F	3
109	BUILDING ROOF LINE CORNER	TBLDRL	52		F	3

110	HOUSE CORNER	THCR	52		F	3
111	HOUSE ROOF LINE CORNER	THRL	52		F	3
112	MOBILE HOME CORNER	TMHCR	52		F	3
113	MOBILE HOME ROOF LINE CORNER	TMHRL	52		F	3
115	WOODS LINE	TWL	52		F	3

General Topo

116	CULTIVATION LINE	TCUL	52		F	3
117	FENCE, FIELD WIRE	TFFW	52		F	3
118	FENCE, BARB WIRE	TFBW	52		F	3
119	FENCE, WOOD	TFW	52		F	3
120	RAILROAD, TOP OF RAIL	TRCR	52		F	4
121	RAILROAD, CENTERLINE	TRCL	52		F	3
122	CEMETERY LINE	TCEM	52		F	3
123	GRAVE	TGRV	52		F	3
124	GUARD RAIL	TGR	52		F	3
125	SIGN, END	TSE	52		F	3
126	SATELLITE DISH	TSATDSH	52	F		1
127	LIMIT LINE	TLIML	51		G	4
128	CONSTRUCTION BOUNDARY, ACTV	TCBA	51		G	4
129	CONSTRUCTION BOUNDARY, FIND	TCBF	51		G	4

Boundaries

130	COUNTY LINE	BCOL	52		F	3
131	CITY LIMIT LINE	BCTL	52		F	3
132	LAND DISTRICT LINE	BLDL	52		F	3
133	LAND LOT LINE	BLLL	52		F	3
134	STATE LINE	BSL	52		F	3

New Codes

**152	HIGH WATER MARK	DHWM	52	F		2
**153	FLOOR ELEVATION	TFE	52	F		2
**154	EDGE OF DIRT DRIVE	TEDD	51		G	4

**156	GATE	TG	52		F	3

**158	UNCOVERED DECK	TUD	52		F	3

160	MAP CHECK GROUND	MPCKGRD	52	F		2
161	MAP CHECK PAVEMENT	MPCKPAV	52	F		2
**162	VINYL (PVC) FENCE	TVF	52		F	3

**163	FUEL TANK	TFT	52		F	3
**164	PAVE DITCH	DPD	51		G	4
**165	BRICK COLUMN	TBC	52		F	3
**166	SEPTIC TANK CENTER	DSTC	52	F		1
**167	STEPS	TS	52		F	3
**168	HISTORICAL MONUMENT	THM	52		F	3
**169	FLAG POLE	TFP	52	F		1
**170	DRAIN LINES	DDL	52		F	3

	Surveyor Defined					
171	Surveyor Defined Value	XXA	51		G	4
172	Surveyor Defined Value	XXB	51		G	4
173	Surveyor Defined Value	XXC	51		G	4
174	Surveyor Defined Value	XXD	51		G	4
175	Surveyor Defined Value	XXE	51		G	4
176	Surveyor Defined Value	XXF	52		F	Optional
177	Surveyor Defined Value	XXG	52		F	Optional
178	Surveyor Defined Value	XXH	52		F	Optional
179	Surveyor Defined Value	XXI	52		F	Optional
180	Surveyor Defined Value	XXJ	52		F	Optional
181	Surveyor Defined Value	XXK	52		F	Optional
182	Surveyor Defined Value	XXL	52		F	Optional
183	Surveyor Defined Value	XXM	52		F	Optional
184	Surveyor Defined Value	XXN	52		F	Optional
185	Surveyor Defined Value	XXO	52		F	Optional
186	Surveyor Defined Value	XXP	52		F	Optional
187	Surveyor Defined Value	XXQ	52		F	Optional
188	Surveyor Defined Value	XXR	52		F	Optional
189	Surveyor Defined Value	XXS	52		F	Optional
190	Surveyor Defined Value	XXT	52		F	Optional
191	Surveyor Defined Value	XXU	52		F	Optional
192	Surveyor Defined Value	XXV	52		F	Optional
193	Surveyor Defined Value	XXW	52		F	Optional
194	Surveyor Defined Value	XXX	52		F	Optional
195	Surveyor Defined Value	XXY	52		F	Optional
196	Surveyor Defined Value	XXZ	52		F	Optional
197	Surveyor Defined Value	XXZA	52		F	Optional
198	Surveyor Defined Value	XXZB	52		F	Optional
199	Surveyor Defined Value	XXZC	52		F	Optional

	Dimension Codes: (Drainage)					
200	DRAINAGE PIPE, F/L, C	DPC	52		F	4

201	DRAINAGE PIPE, F/L, M	DPM	52		F	4
202	DRAINAGE PIPE, F/L, P	DPP	52		F	4
**203	CULVERT END, F/L	DCEF	52		F	4
	Dimension Codes (General Topo)					
210	SIDEWALK, CENTER	TSW	52		F	3
211	FENCE, CHAIN LINK	TFCL	52		F	3
212	TREE, CENTER	TTRE	52	F		1
213	WELL	TWELL	52	F		1
	Dimension Codes (Roadway)					
225	DIRT ROAD, C/L	TDR	51		G	3
227	DIRT DRIVE, C/L	TDD	51		G	3
235	MILE POST, RAILROAD	TMPR	52	F		1
236	KM POST, HIGHWAY	TKMP	52	F		1
237	MILE POST, HIGHWAY	TMPH	52	F		1
	Survey control					
240	NGS CONTROL MONUMENT	SNGSCM	52	F		2
241	LOCATION CONTROL MONUMENT	SLCM	52	F		2
242	LOCATION CONTROL DELTA	SLCD	52	F		2
243	DISTRICT CONTROL DELTA	SDCD	52	F		2
244	CONTROL RE-SHOT FOR CHECK	SCCHK	52	F		2
245	BENCHMARK	SBNCHMK	52	F		2
250	MISCELLANEOUS	MISC	52	F		2

Note: ***(The Types of points and chains are denoted as follows):***

G = 2D & 3D Point or Chain

F = 2D & 3D Point or Chain

PAR = Property Parcel Chains generated by the Survey Data Engineer

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****SMI # = For InRoads Use Only! Do NOT use in CAiCE.**

SMI CODES FOR INROADS

User Defined Codes

171-175 Group Code 4
176-199 Group Code 1,2,or3

Group Codes

Code 2-D Point
Code 3-D Point
Code 2-D Chain
Code 3-D Chain