Construction Surveying

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Division 5 and 6

GPS Construction Surveys

- Where are we?
- Where do we want to be?
- How do we get there?

Where were we in 2008?

- Some RE offices use GPS daily.
- Some RE office use GPS occasionally.
- Some RE offices have never used GPS.

Where do we want to be?

- Every RE office with GPS survey capability.
- Every RE office with proper field and office software.
- Every RE office with proper training on GPS equipment.
- Every RE office with a support system (Location and Surveys) or a User Group.

Where are we in 2010?

- Some RE offices use GPS daily.
- Some RE office use GPS occasionally.
- Some RE offices rarely use GPS.

How did we get here?

- New 2008 GPS survey equipment purchase. Done
- Training from Location and Surveys and the Construction Unit. Done
- Patience from RE to allow employees to learn and utilize new technology. ???

GPS
In Construction

Construction Stakeout and Establishing Photo Controls

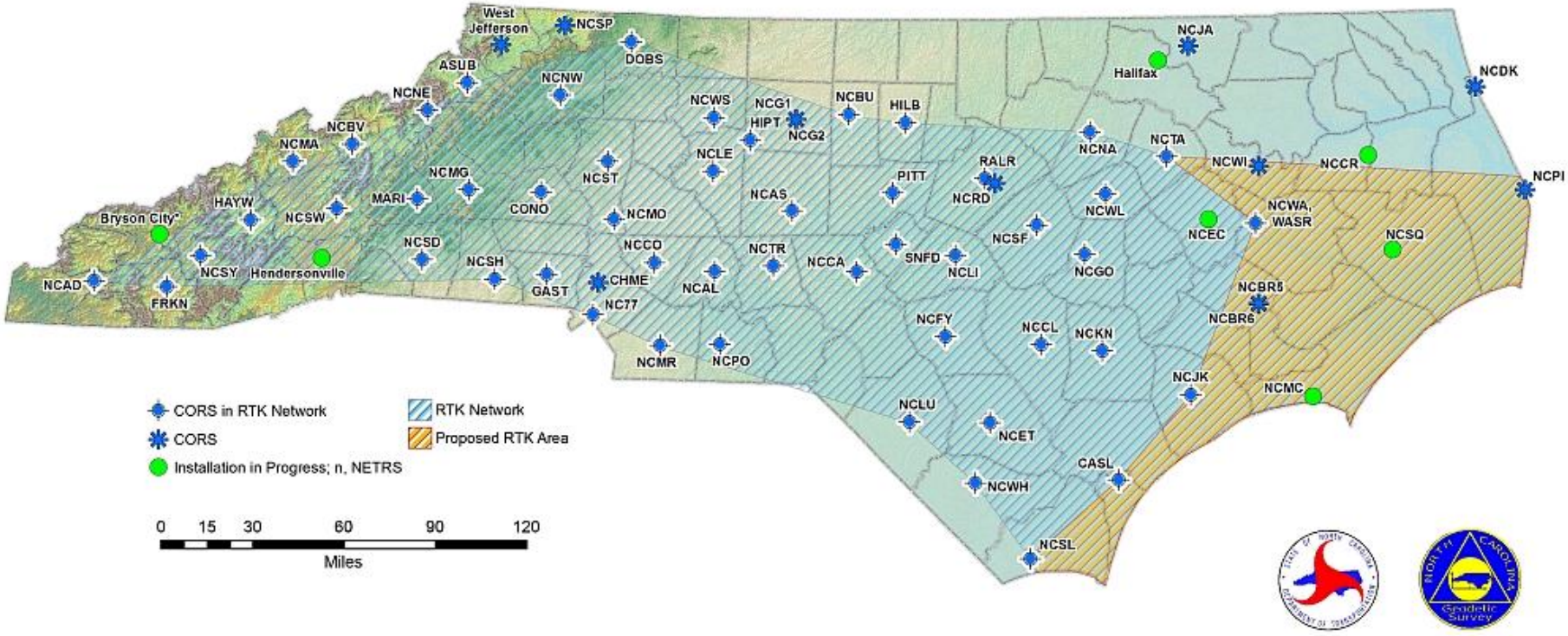
GPS
In Construction

Horiz Accuracy ~ 0.03’

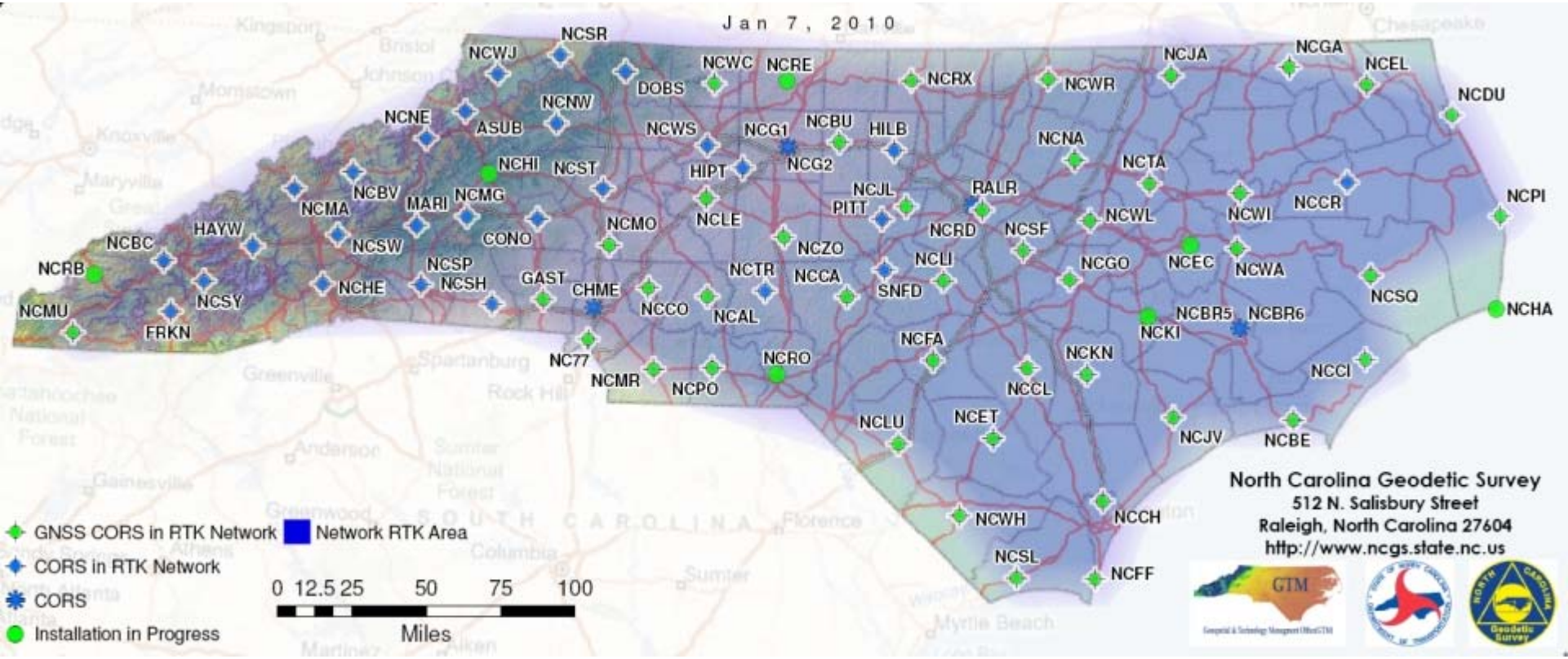
Vertical Accuracy ~ 0.07’

Note:
Due to Reduced Vertical Accuracy of GPS - Use Total Stations or Levels for Critical Elevations

NC VRS NETWORK in 2008

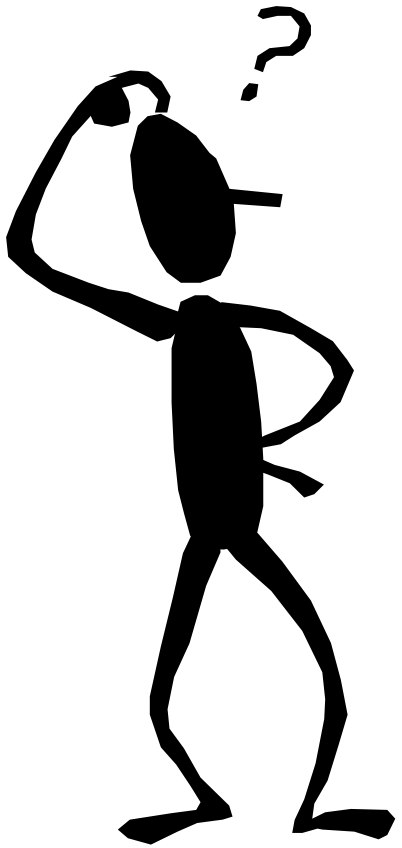


NC VRS Network 2010



GPS

Any Questions?



Earthwork

- How does a Resident Engineer’s office handle earthwork when Photogrammetry is not involved?

Several Options

1. Average End Volume using Computation Sheets
2. **Trimble Geomatics Office**
3. Geopak

Average End Volume using Computation Sheets

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DEPARTMENT OF TRANSPORTATION
RALEIGH, NORTH CAROLINA

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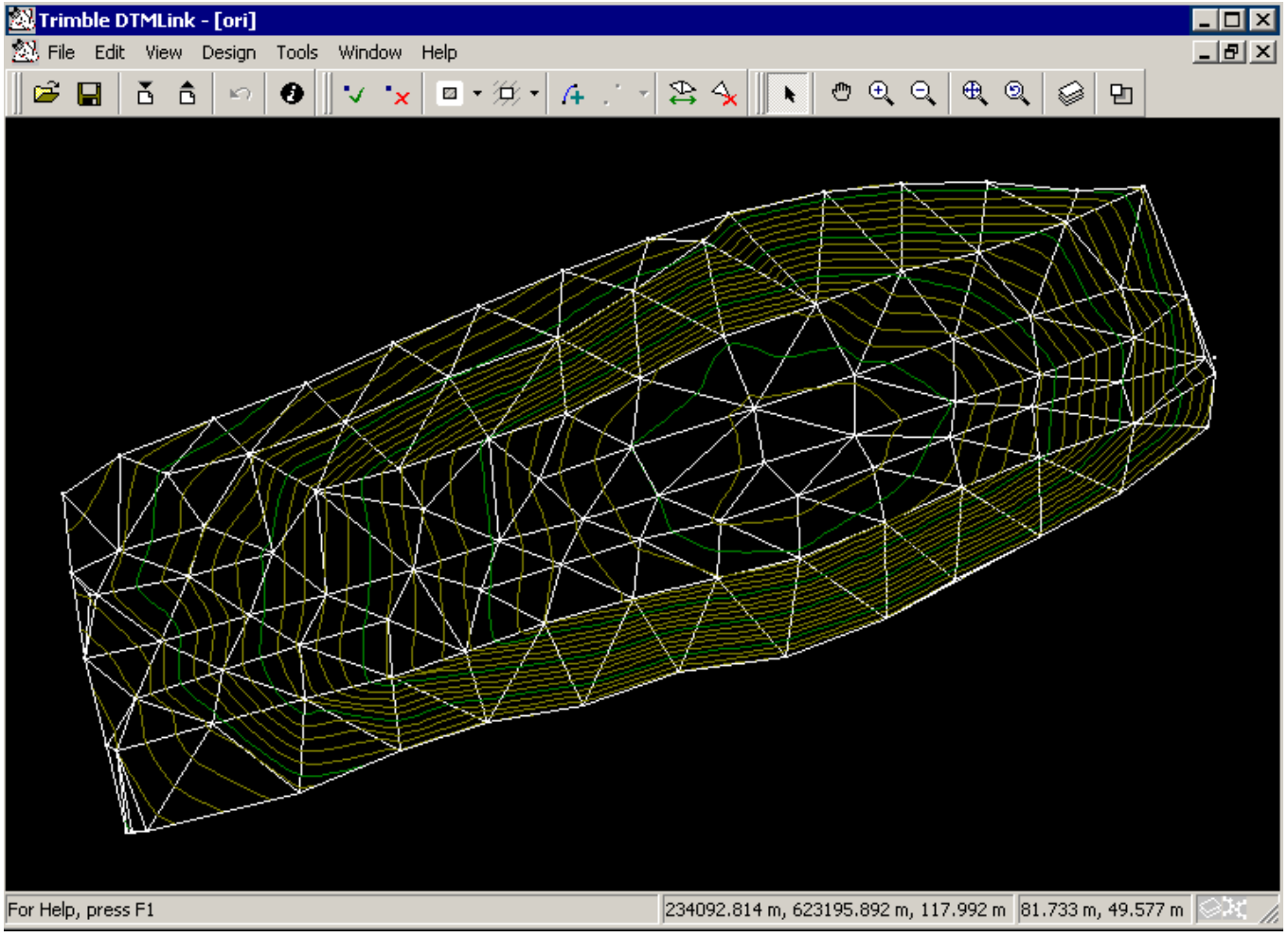
EARTHWORK COMPUTATIONS FOR FINAL ESTIMATE

TATION	EARTH EXCAVATION				ROCK EXCAVATION				EMBANKMENT			
	DIST.	AREA	AVE. AREA	CU. YDS.	DIST.	AREA	AVE. AREA	CU. YDS.	DIST.	AREA	AVE. AREA	CU. Y

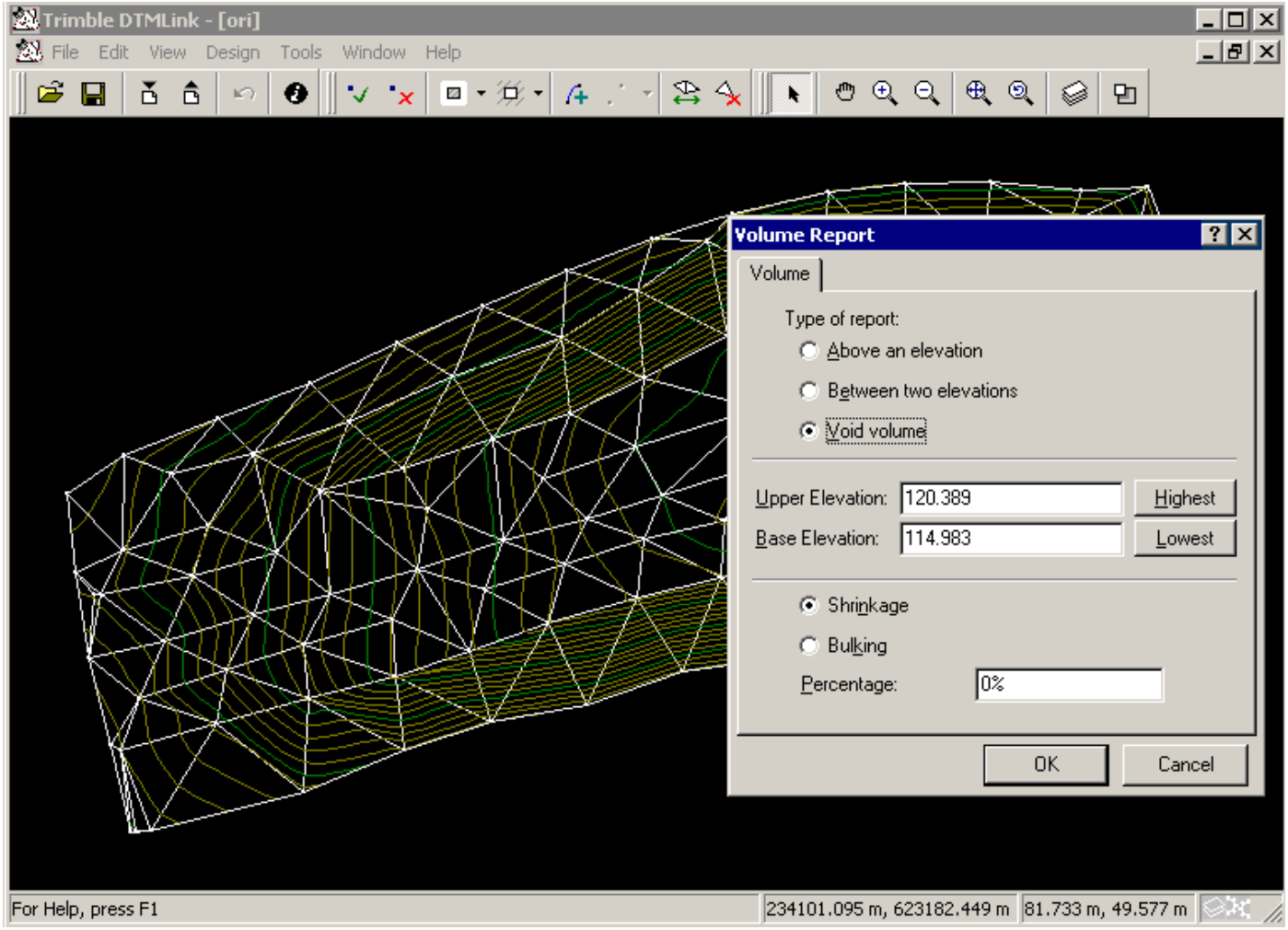
Trimble Geomatics Office

- Graphic view of surface.
- Calculate volumes for borrow or unclassified excavation.
- Generate volume report for file.

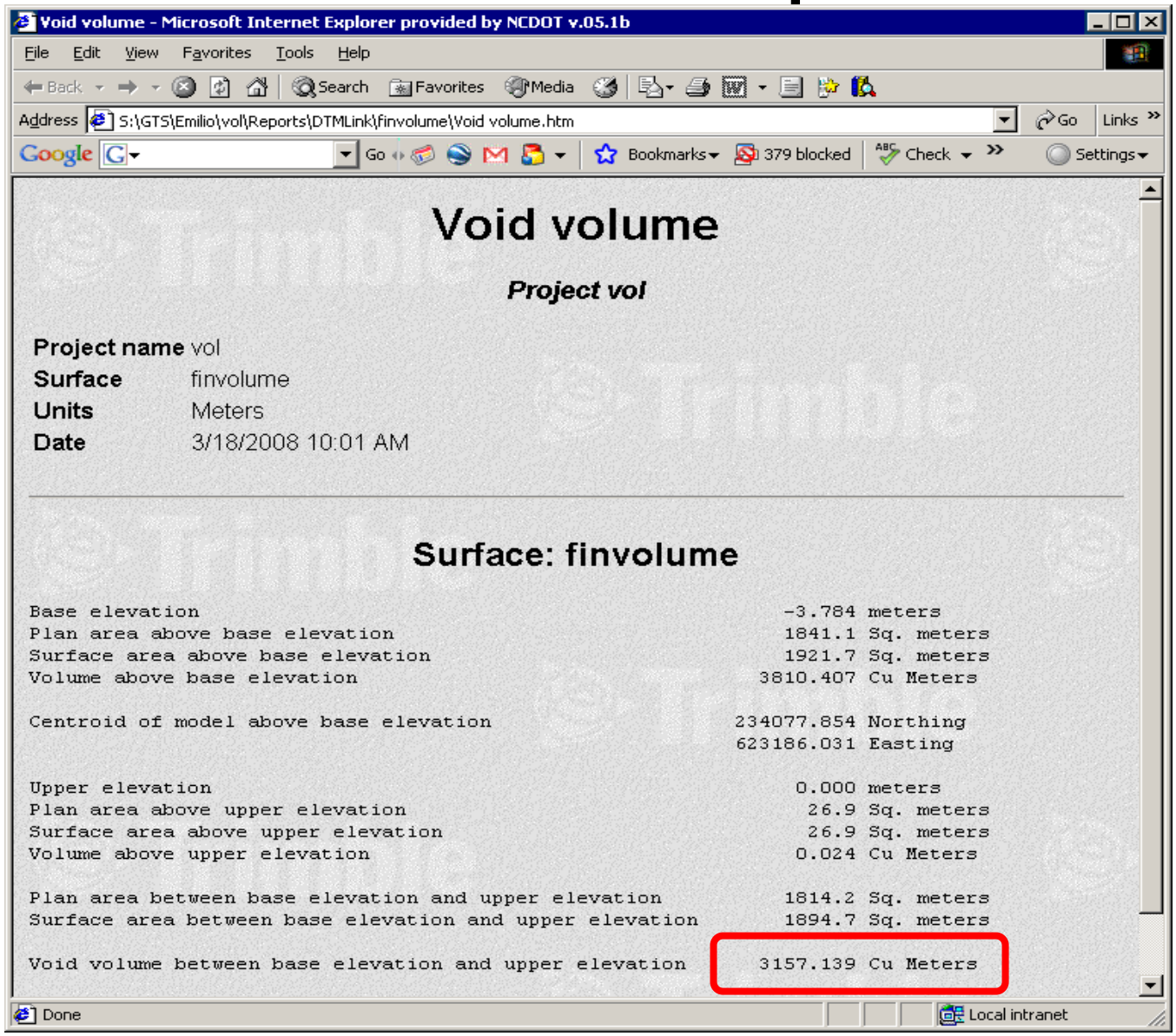
Graphic view of surface.



Calculate volumes for borrow or unclassified excavation



Generate volume report for file



Div 6 W-4404

- January 23, 2009
  Used Cub Cadet with Trimble R8 mounted on the Cadet.
  Topo of 14 acres = 3500 points collected.
  Actual GPS time= 2 hrs.
  Office time with TGOffice = 1 hr.

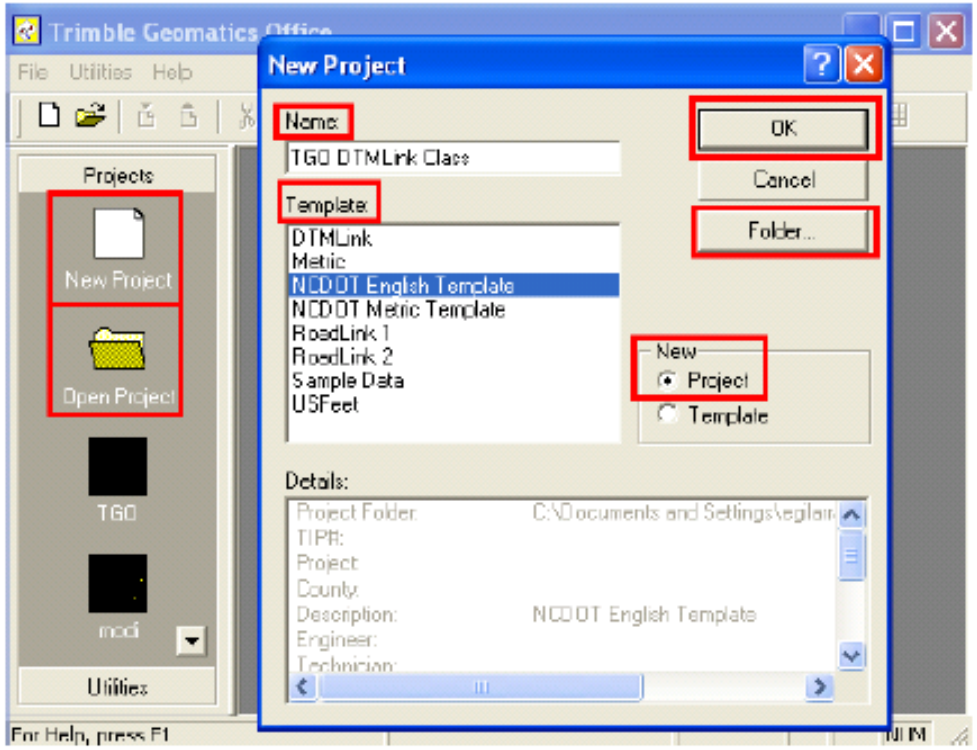
- June 16, 2009
  Walking pit slopes and bottom for volume check on truck count.
  Topo of 9 acres = 1120 points collected.
  Actual GPS time = 7 hrs.
  Office time with TGOffice = 1.5 hrs.

- November 24, 2009
  Location & Survey assisted with GPS and sonar setup to Topo bottom of pit.
  Used motor boat with their people and equipment.
  Actual GPS time = 2 hrs.
  Reminder: Location and Survey is available to assist in collecting survey data underwater utilizing sonar technology

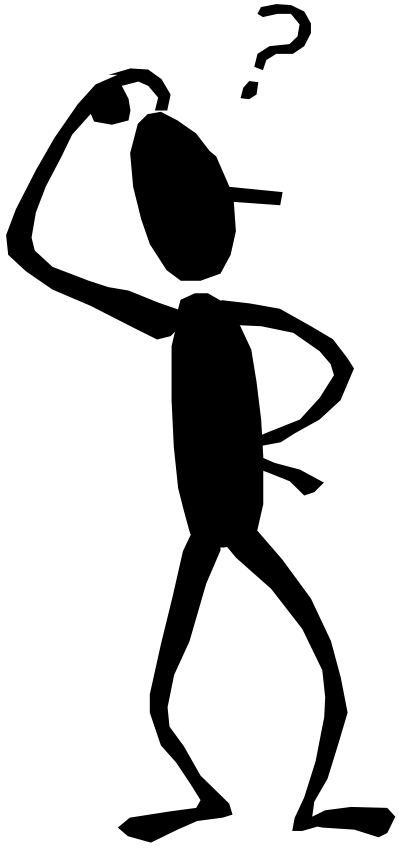
TGO/DTMLink (stock pile)

The purpose of this document is to transfer DTM data from Data collector to TGO and calculate volumes.

1. **Create a New Project or Open Project**
   When TGO is opened you will have the option to create a *New Project* or *Open Project,*
   To create a new click in *New Project* and the *New Project* window will open, use the *Folder* key to select the location where the project is going to be stored, select the appropriate *Template*, be sure to *Project* under the *New* options and type a *Name* and click *OK*.



Earthwork Questions?



Automated Machine Guidance

Automated Machine Guidance

- Provision Currently being used on a Design Build Project in Div. 8
- Developed Draft Special Provision for Bid-Build Projects
  - Model Provided by NCDOT
    - (Corridor Modeling)
  - Guidance for Stakeout
  - Survey Equipment provided by Contractor
  - Training provided by Contractor

AMG Committee Members

• Ron Hancock	NCDOT Construction Unit
• Phillip Johnson	NCDOT Construction Unit
• Ted Walls	NCDOT Roadway Design Unit
• Jim McMellon	NCDOT Roadway Design Unit
• Charlie Brown	NCDOT Location and Surveys
• Emory Kincaid	NCDOT Location and Surveys Unit
• Emilio Gilarranz	NCDOT Location and Surveys Unit
• Keith Johnston	NCDOT Photogrammetry Unit
• Carl Storch	NCDOT Photogrammetry Unit
• David Weir	Barnhill Contracting Company
• Mark Eakes	Barnhill Contracting Company
• Gerhard Pilcher	H. B. Rowe & Co., Inc
• Brett Calcutt	R. E Goodson Construction Co., Inc
• Jonathan Bivens	S. T. Wooten Corporation
• Jeff Morris	S. T. Wooten Corporation

DRAFT

AUTOMATED MACHINE GUIDANCE

9-30-09

CONSTRUCTION REQUIREMENTS AND SUBMITTALS

Electronic Information. Electronic information, consisting of survey and design information including but not limited to cross-section models, alignment data, and plan view geometry, does not constitute part of the bid or contract documents. This information, used for project design and quantity estimation purposes, is provided for the bidder's use in automation of bid estimating, grading and contractor staking if provided in the contract. Furnishing this information does not relieve a bidder or contractor from the responsibility of making an investigation of conditions to be encountered. The bidder or contractor shall assume the risk of error if the information is used for any purposes for which the information was not intended. Any assumption the bidder or contractor may make from this electronic information is at the bidder or contractor's risk. The bidder or contractor assumes the sole risk of liability or loss if the bidder or contractor does rely on this electronic information to its detriment, delay or loss.

If the Contractor elects to use Global Positioning System (GPS) machine control grading and shall be used in conjunction with Section 801 of the Standard Specifications for Roads and Structures. The use of this technology is referenced as Automated Machine Guidance (AMG)

All equipment using AMG shall be able to generate end results that meet the Standard Specification. Perform test sections for each type of work to be completed with AMG to demonstrate that the system has the capability to achieve acceptable results. If acceptable results cannot be achieved, conform to the requirements for conventional stake out.

The Department will provide a Digital Terrain Model of the design surface. If the Contractor revises the Original DTM, submit the revised DTM to the Department for review and approval 10 days prior to beginning grading operations. The submittal should include a narrative detailing changes to the original DTM.

30 days prior to beginning grading operations, the Contractor shall submit to the Engineer an AMG work plan to include, but not limited to, GPS site calibration, calibration methods for construction equipment and local GPS base station used for broadcasting differential correction data to rover units.

INSPECTION

The Engineer will perform quality assurance checks of all work associated with AMG. If it is determined that work is not being performed in a manner that will assure accurate results, the Engineer may require corrective action at no cost to the Department.

The Contractor shall provide the Engineer with a GPS rover unit for use during the duration of the contract. The rover will be loaded with the same model that is used with the AMG and have the same capability as rover units used by the Contractor. The rover will be kept in the possession of the Engineer and will be returned to the Contractor upon completion of the contract. Any routine maintenance required for the rover will be the responsibility of the Contractor. Formal training of at least 16 hours shall be provided to the Engineer by the Contractor on the use of the proposed AMG system.

SUBGRADE AND BASE CONTROLS

If the Contractor elects to use AMG for fine grading and placement of aggregate base or other roadway materials, the GPS shall be supplemented with a hand or robotic total station. Include details of the proposed system in the AMG work plan. In addition, the following requirements apply for the use of AMG for subgrade and base construction.

1. Provide control points at intervals along the project not to exceed 1000 feet. The horizontal position of these points shall be determined by static GPS sessions or by traverse connection from the original base line control points. The elevation of these control points shall be established using differential leveling from project benchmarks, forming closed loops where practical. A copy of all new control point information shall be provided to the Engineer prior to construction activities.

2. Provide control points and conventional survey grade stakes at critical points such as, but not limited to, PCs, PTs, superelevation transition points, and other critical points as requested by the Engineer.

3. Provide hubs at the top of the finished subgrade on the cross section at 500 foot intervals. These hubs shall be established using conventional survey methods for use by the Engineer to check the accuracy of construction.

MEASUREMENT AND PAYMENT

No direct payment will be made for work required to utilize this provision. All work will be considered incidental to various grading operations.

Automatic Machine Guidance

Questions?

Construction Stakeout Manual Revisions In Progress

- GPS
- Permit Stakeout – Safety Fence
- Automated Machine Guidance
- Additional Topics???

Distribution May 2010

SAFETY FENCE

- Stakeout of safety fence is covered in Section 801.
- Required to stakeout limits of the permitted area according to the permit drawings.
- Some Divisions prefer to perform this important task with its own survey forces.

SAFETY FENCE

- The Roadside Environmental Unit revised the safety fence drawings
  - assist in the stakeout of safety fence.
  - delineate permitted areas.
- The accurate stakeout of the safety fence is critical in our efforts to ensure environmental stewardship.
- The revised drawings are located on the Construction Unit Website.

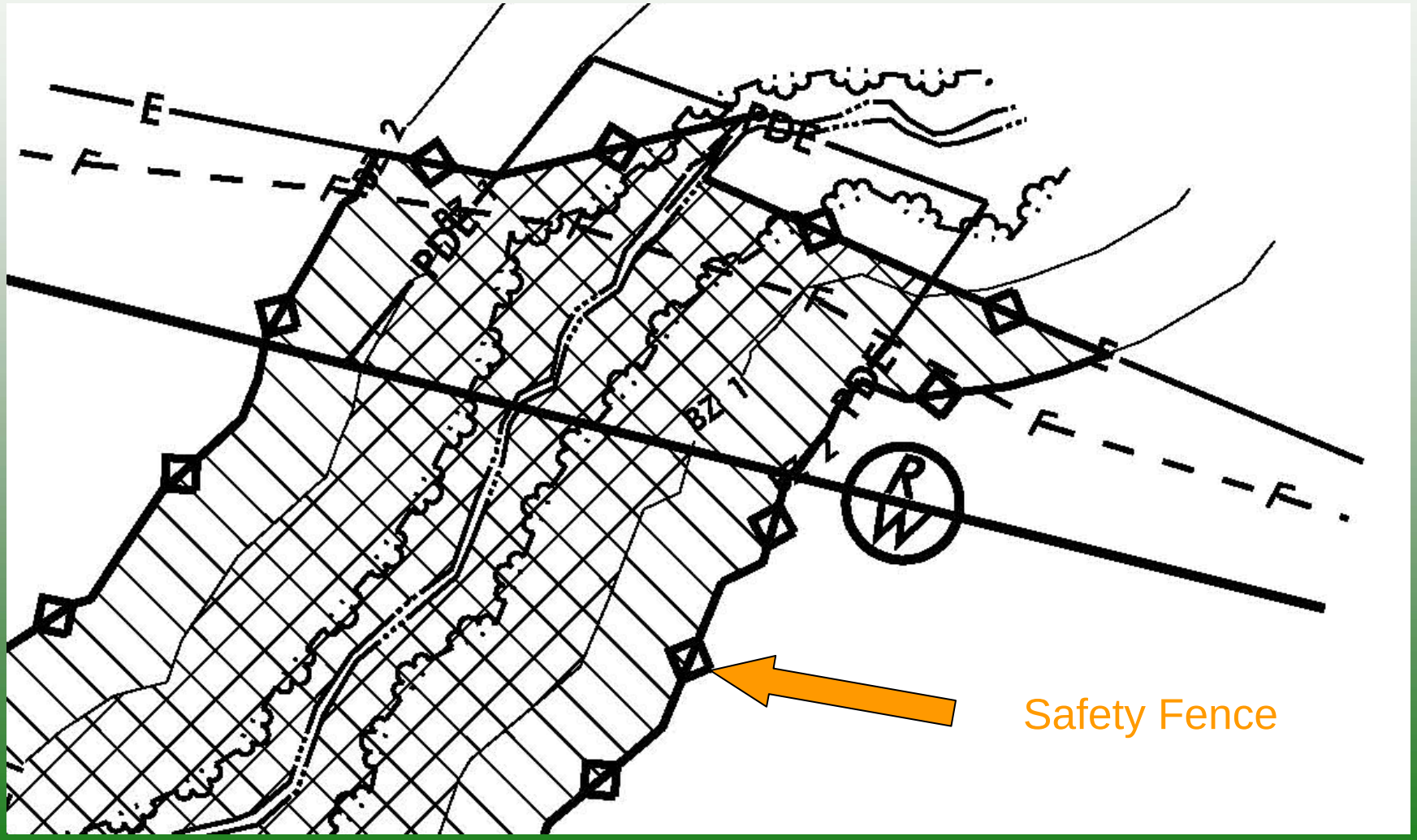
www.ncdot.org/doh/operations/dp_chief_eng/constructionunit/formsmanuals

The revised drawings provide guidance for stakeout of the orange safety fence in the following permit situations:

- Jurisdictional Stream – Riparian Buffer Zone
- Jurisdictional Stream- High Quality Water (HQW)
- Jurisdictional Stream- No High Quality Water / No Buffer
- Wetland – Mechanized Clearing
- Wetland – Hand Clearing

The drawings should be used with the environmental permit drawings located in the contract and also with the ESA locations shown in the erosion control plans. Electronic permit drawings are available from the Hydraulics Unit; these Microstation drawings will provide coordinates for the permit limits and will greatly increase the accuracy of the safety fence layout.

Permit Drawing



Additional Survey Training?

- Earthwork?
- Recommend Survey User Groups!
- Provide training requests to the Construction Unit.