GNSS and Elevation Certificates

North Carolina Geodetic Survey

North Carolina Floodplain Mapping Program

www.ncfloodmaps.com/

Key elements of the new maps
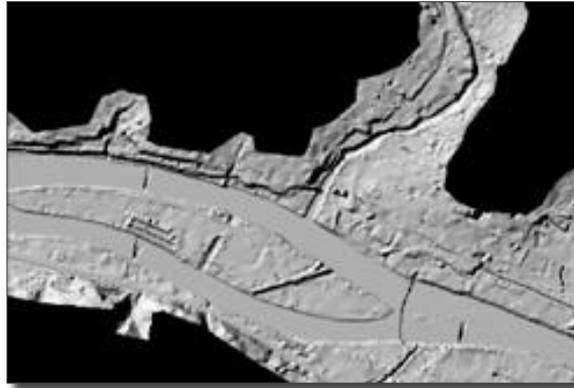
Base + Topography + Flood Data
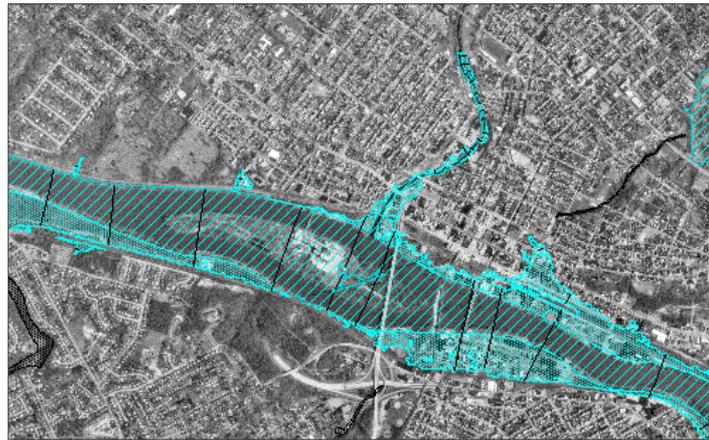
= Digital FIRM

DFIRM map maintenance

North Carolina Floodplain Mapping Program
Map Maintenance Year 2006-2012

www.ncfloodmaps.com/pubdocs/issue_papers/ip70_ncfmp_base_data_review_procedures.pdf
www.ncfloodmaps.com/pubdocs/issue_papers/ip24_final_nc_map_maintenance.pdf

Operational & proposed CORS

The status map shows the location of the different types of existing CORS sites and CORS sites that are being installed:

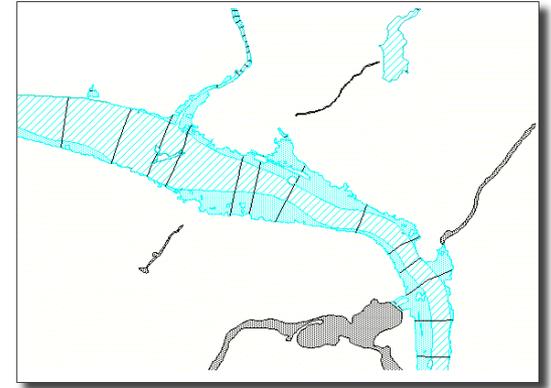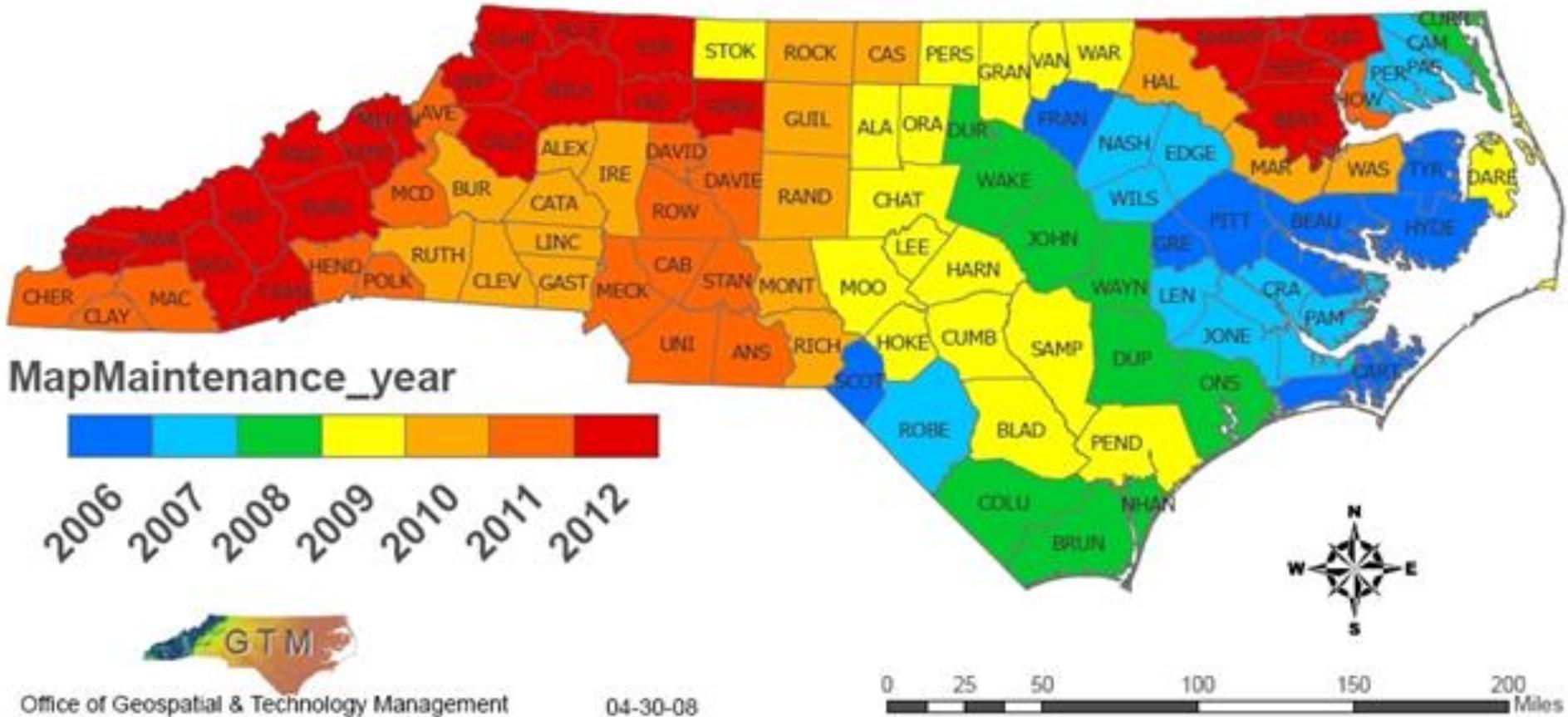- ◆ GNSS CORS site (i.e. can receive signals from both the U.S. and the Russian navigation satellites) in the North Carolina Real-Time Network (RTN) (i.e. can be accessed in real-time via a data cell phone and accessed for post-processing via the Internet)

- ◆ CORS site (i.e. can receive signals from only the U.S. navigation satellites) in the NC RTN

- ✳ CORS site <u>not</u> in the NC RTN (i.e. cannot be accessed in real-time, but can be accessed for post-processing via the Internet)

- ● GNSS CORS site that is being installed and will be incorporated into the NC RTN

- ● SC CORS

- ● TN CORS

The status map also shows the coverage area of the NC RTN (depicted by blue shading), which has achieved statewide coverage.

http://portal.ncdenr.org/web/lr/geodetic/maps/cors
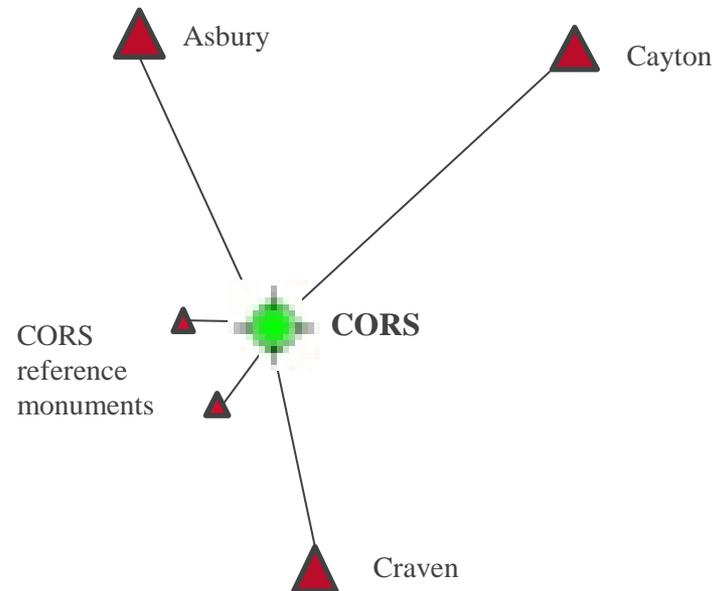
CORS administration

- **Connection to the NSRS**
  - Recommend local static surveys be performed to connect RTN CORS with local NSRS passive stations
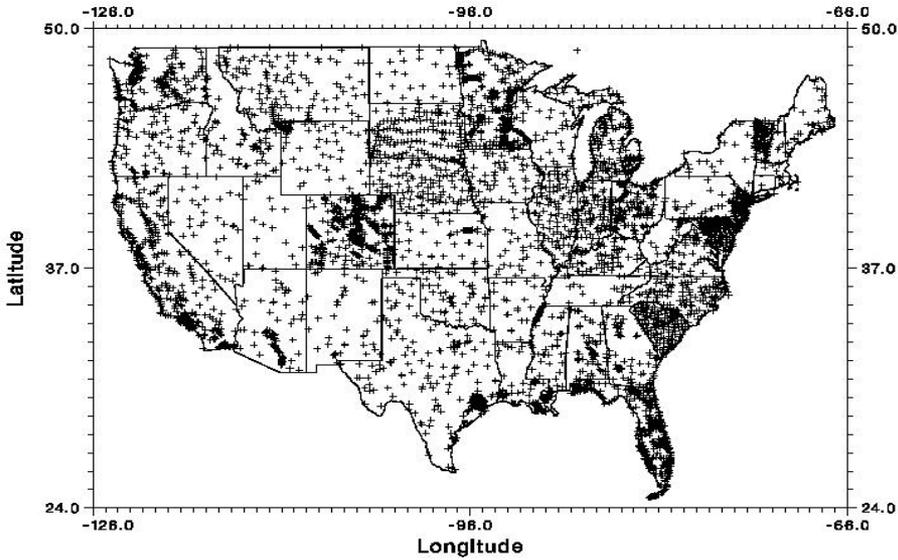 - NCGS uses NGS-58 surveys to connect the CORS to the NSRS
    - CORS
    - ▲ Three (3) HARN monuments
    - ▲ Two (2) local CORS reference monuments
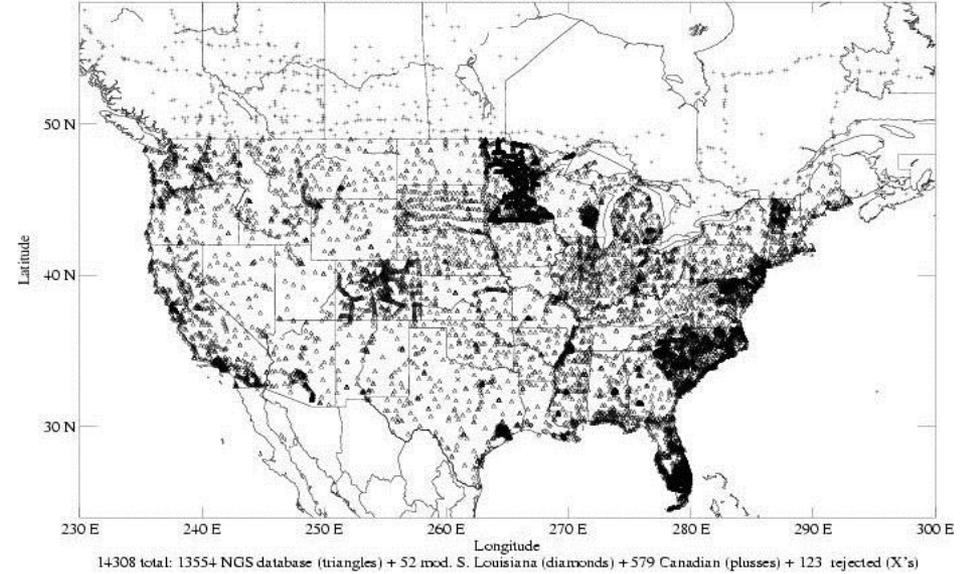
Geoid model history

GPS/BMs for GEOID99 (6169 points)

2003 GPSBM Control Data Used to Create GEOID03

14308 total: 13554 NGS database (triangles) + 52 mod. S. Louisiana (diamonds) + 579 Canadian (plusses) + 123 rejected (X's)

GPS BMs for GEOID09
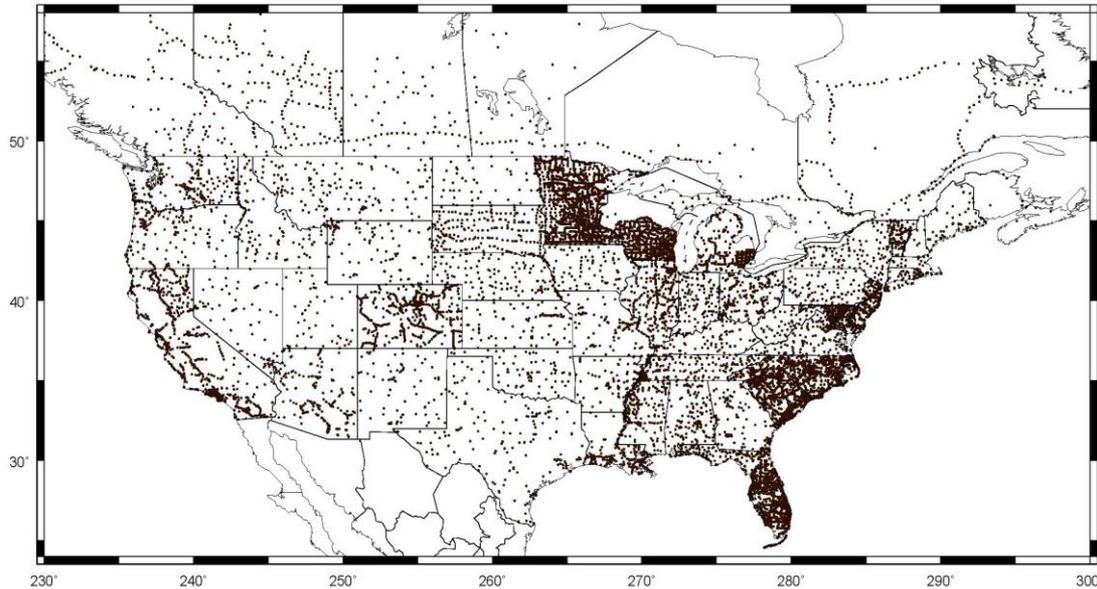
Geoid model history: GEOID09 in NC

Distribution of Control used for the generation of GEOID 09 in North Carolina

Geoid model history: GEOID12 in NC

Distribution of Control used for the generation of GEOID 12 in North Carolina

Elevation determination methods
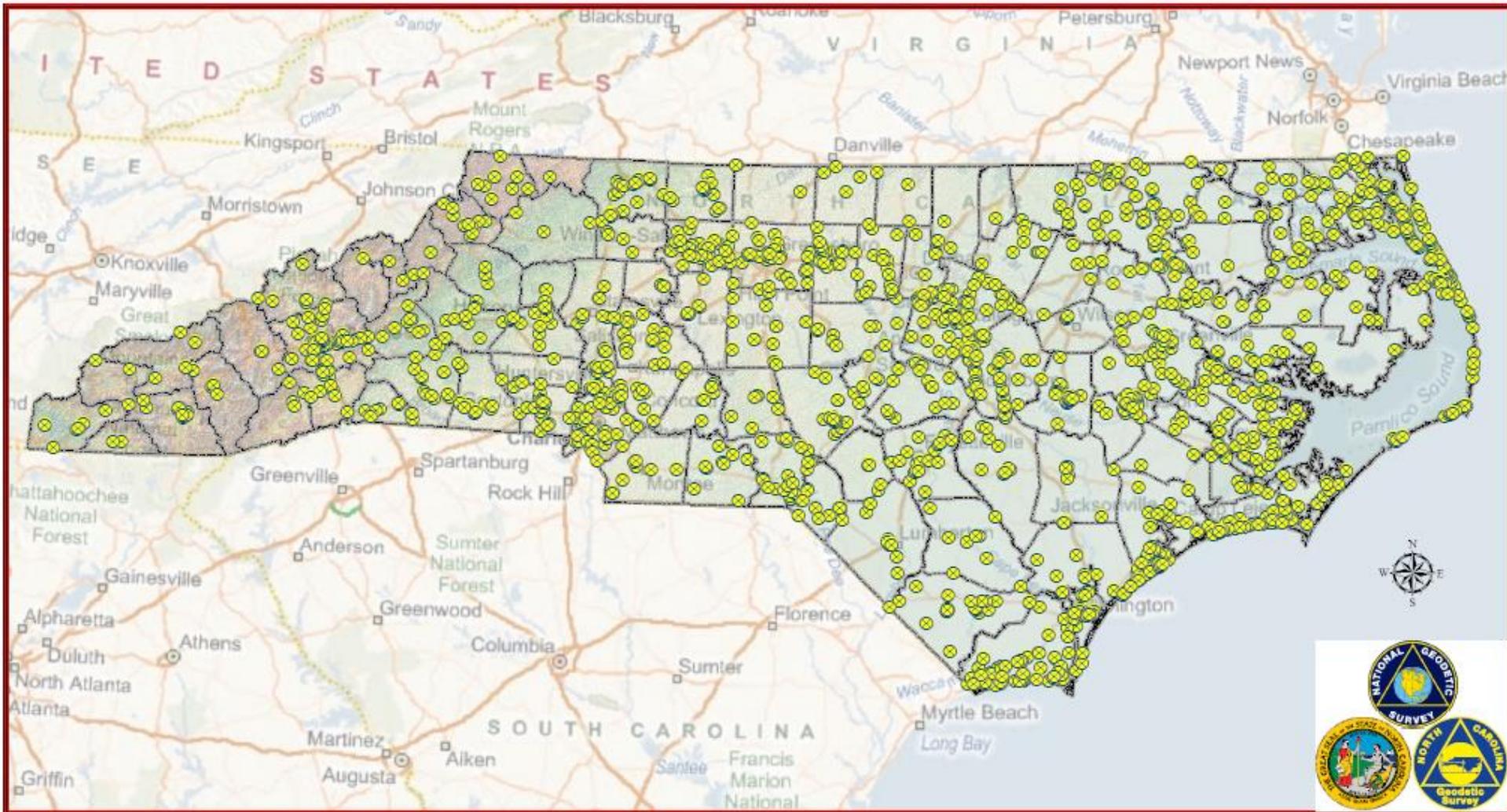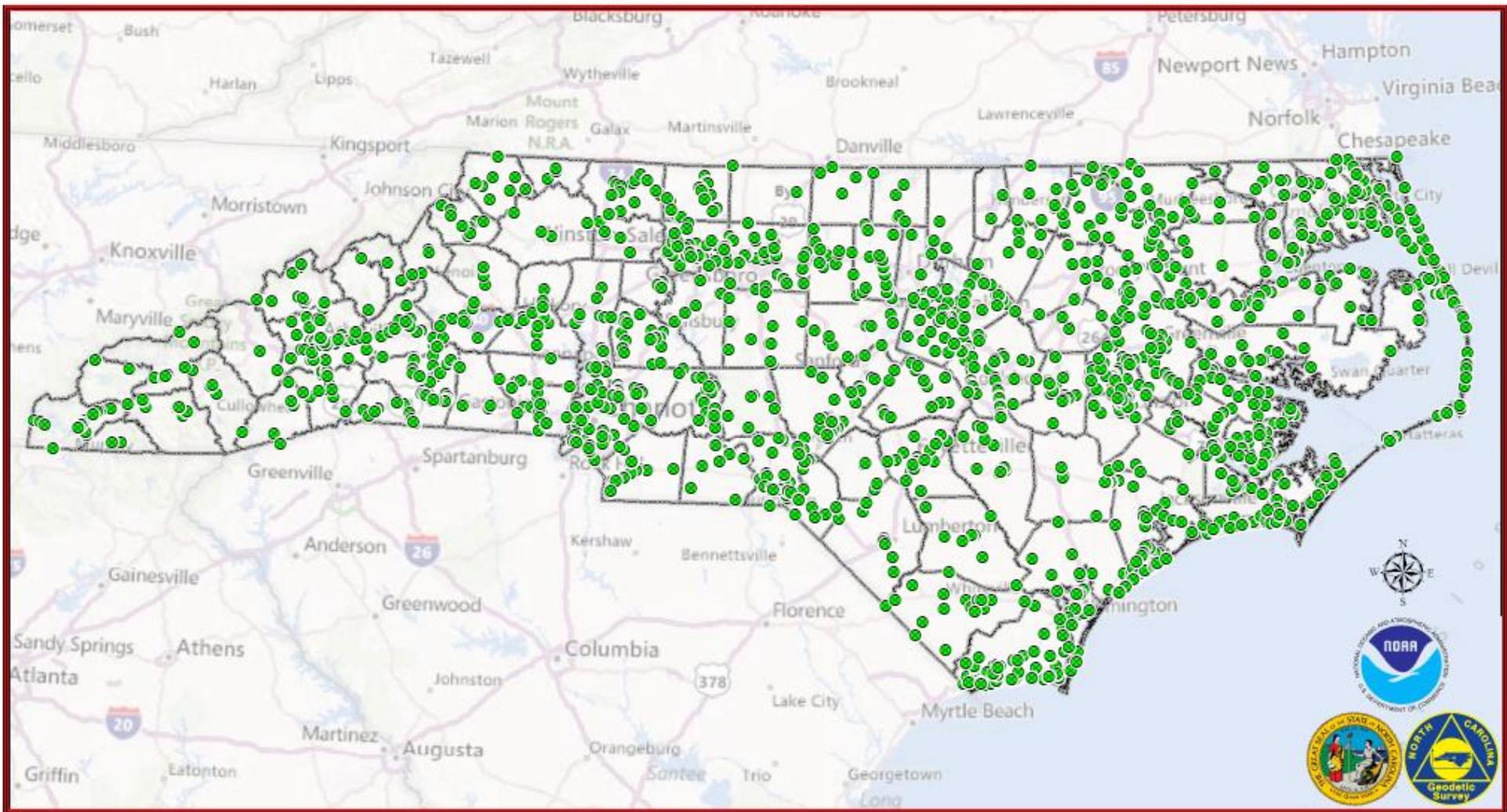
- Leveling

- Global Navigation Satellite System (GNSS)
  - Static (http://www.ngs.noaa.gov/OPUS/)
    - OPUS-S
    - OPUS-RS
  - Real Time Kinematic (RTK)
  - Real Time Network (RTN) (http://rtn2.ncdenr.org/)

GNSS elevation determination methods

- Planning
  - Existing control (horizontal and vertical)
    - ➢ Use 1st order or better control (horizontal)
    - ➢ Don't mix horizontal control (1st, 2nd , and 3rd)
    - ➢ Use marks with Height Modernization or leveled derived NAVD88 heights
  - Mark access
  - Use your planning software
  - Good satellite geometry
  - Collect enough data
  - Space weather
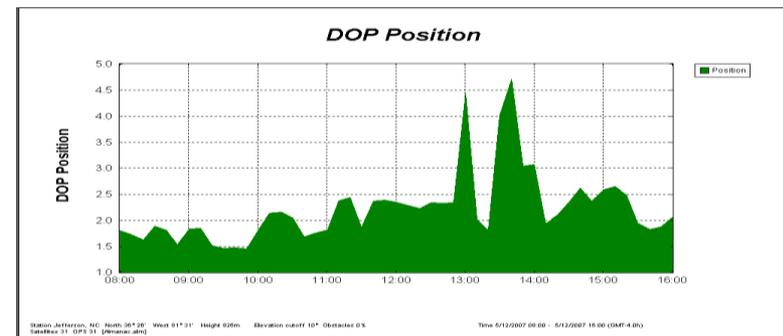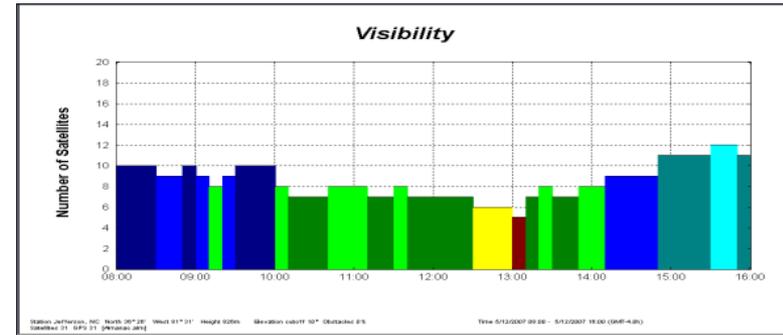
GNSS surveying

- Pick a good open site for control points

- Redundancy

- Good satellite geometry

- Avoid areas that have sources for multipath

- Redundancy

- Avoid antenna height blunders

- Keep equipment adjusted for the highest accuracy

- Check known points before, during and after survey session

- Backup power supply

- The more redundancy the better

- Redundancy

GNSS site selection

Guidelines for establishing GPS-derived heights

NOAA Technical Memorandum NOS NGS 59

Guidelines for Establishing GPS-Derived Orthometric Heights

Guidelines for Establishing GPS-Derived Orthometric Heights

NOS NGS 59

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(301) 713-3191

26 March 2008

NOAA Technical Memorandum NOS NGS-58

GUIDELINES FOR ESTABLISHING GPS-DERIVED ELLIPSOID HEIGHTS
(STANDARDS: 2 CM AND 5 CM)
VERSION 4.3

David B. Zilkoski
Joseph D. D'Onofrio
Stephen J. Frakes

Silver Spring, MD

November 1997

Guidelines for Establishing GPS-Derived Ellipsoid Heights

NOS NGS 58

U.S. DEPARTMENT OF COMMERCE / National Oceanic and Atmospheric Administration / National Ocean Service / National Geodetic Survey

http://www.ngs.noaa.gov/PUBS_LIB/NGS-58.html

http://www.ngs.noaa.gov/PUBS_LIB/NGS592008069FINAL2.pdf

Four basic rules of height determination

- **RULE 1:** Follow NGS' Guidelines for Establishing GPS-Derived Orthometric Heights (Standards: 2cm & 5cm) (http://www.ngs.noaa.gov/PUBS_LIB/NGS592008069FINAL2.pdf)

- **RULE 2:** Use the latest national geoid model, i.e., Geoid12 (http://www.ngs.noaa.gov/GEOID/GEOID12/)

- **RULE 3:** Use the latest national vertical datum, i.e., NAVD 88

- **Rule 4 (NC):** Report positional accuracy and metadata (Board rule .1607) (http://reports.oah.state.nc.us/ncac/title%2021%20-%20occupational%20licensing%20boards%20and%20commissions/chapter%2056%20-%20engineers%20and%20surveyors/21%20ncac%2056%20.1607.html)

NGS bench mark reset procedures

Bench Mark Reset Procedures

Guidelines to preserve elevation data for a *soon-to-be disturbed* or *soon-to-be destroyed* bench mark

Documented by
Curtis L. Smith
National Geodetic Survey
Silver Spring MD 20910
September 2010

http://www.ngs.noaa.gov/PUBS_LIB/Benchmark_4_1_2011.pdf

Highlights of the new Elevation Certificate

- Latest version of the Elevation Certificate (EC) effective March 16, 2009 – March 31, 2012.

- Available for download (in both PDF and MS Word format) from FEMA's website at: http://www.fema.gov/library/viewRecord.do?id=1383

- Elevations certified on or after April 1, 2010, must be submitted on the new form.

- The current form will remain effective until further notice.

Section C (If zone has BFE)

SECTION C - BUILDING ELEVATION INFORMATION (SURVEY REQUIRED)

C1. Building elevations are based on: ☐ Construction Drawings*   ☐ Building Under Construction*   ☐ Finished Construction
*A new Elevation Certificate will be required when construction of the building is complete.

C2. Elevations – Zones A1-A30, AE, AH, A (with BFE), VE, V1-V30, V (with BFE), AR, AR/A, AR/AE, AR/A1-A30, AR/AH, AR/AO. Complete Items C2.a-h below according to the building diagram specified in Item A7. Use the same datum as the BFE.

Benchmark Utilized _____ Vertical Datum_____

Conversion/Comments _____

Check the measurement used.

		feet	meters (Puerto Rico only)
a)	Top of bottom floor (including basement, crawlspace, or enclosure floor) _____._____	☐ feet	☐ meters (Puerto Rico only)
b)	Top of the next higher floor _____._____	☐ feet	☐ meters (Puerto Rico only)
c)	Bottom of the lowest horizontal structural member (V Zones only) _____._____	☐ feet	☐ meters (Puerto Rico only)
d)	Attached garage (top of slab) _____._____	☐ feet	☐ meters (Puerto Rico only)
e)	Lowest elevation of machinery or equipment servicing the building _____._____ (Describe type of equipment and location in Comments)	☐ feet	☐ meters (Puerto Rico only)
f)	Lowest adjacent (finished) grade next to building (LAG) _____._____	☐ feet	☐ meters (Puerto Rico only)
g)	Highest adjacent (finished) grade next to building (HAG) _____._____	☐ feet	☐ meters (Puerto Rico only)
h)	Lowest adjacent grade at lowest elevation of deck or stairs, including structural support _____._____	☐ feet	☐ meters (Puerto Rico only)

Section C2

- A field survey is required for Items C2.a-h.

- Enter the Benchmark Utilized. Provide the PID or other unique identifier assigned by the maintainer of the benchmark. For GNSS survey, indicate the benchmark used for the base station, the Continuously Operating Reference Stations (CORS) sites used for an On-line Positioning User Service (OPUS) solution (attach the OPUS report), or the name of the Real Time Network used.

- Note the Vertical Datum. All elevations for the certificate, including the elevations for Items C2.a-h, must use the same datum on which the BFE is based.

- Conversion/Comments. Show the conversion from the field survey datum used if it differs from the datum used for the BFE entered in Item B9 and indicate the conversion formula or software used. Show the datum conversion, if applicable, in this section or in the Comments area of Section D.

Questions?
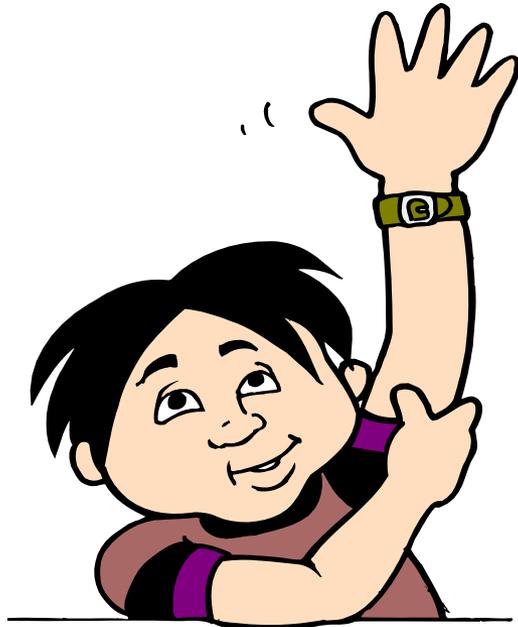
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