EXPERIENCE WITH HIGH ACCURACY COUNTY DTM MAPPING USING SURVEYING, PHOTOGRAMMETRIC, AND LIDAR TECHNOLOGIES - GOVERNMENT AND CONTRACTOR PERSPECTIVES

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ABSTRACT

Hillsborough County, like many other Florida counties, has had an increasing demand for high accuracy (ASPRS Class 1) digital terrain model (DTM) representations of the terrain to support a variety of applications, ranging from road design to wetland and flood plain delineation. Survey & Mapping Services of the County Survey Division is responsible for the DTM acquisition and has been progressively obtaining this data through the past five years for designated areas of the County with the support of the Southwest Florida Water Management District (SWFWMD). The DTMs have been photogrammetrically produced by a team of selected aerial mapping contractors and are subject to quality control review and validation by the County. The County, its contractors, and SWFWMD have worked together to develop optimal specifications and procedures for the DTM creation, delivery, and review. Elements of the process include selection and prioritizing of areas; ground control and checkpoint surveying; source data production; DTM components and data structure; ties between contractor datasets; accuracy testing and reporting; scheduling and delivery; and conformance with the Florida Minimum Technical Standards (MTS). The County, in cooperation with SWFWMD, has recently initiated a program to map the remaining County area using LiDAR technology.

This presentation will review the elements of Hillsborough County's DTM mapping program from both the County's and a contractor's perspective, and present a model for future DTM acquisition in Hillsborough County and other areas of Florida.

INTRODUCTION

Hillsborough County and SWFWMD have recognized a pressing need for accurate topographic data that would extend integrally throughout designated Hillsborough County lands. This need for accurate topographic data led to a five-year cooperative effort between Hillsborough County and SWFWMD in a Digital Elevation Mapping Project (Cooperative Project). The primary intent of the Cooperative Project was to create an elevation surface dataset for Hillsborough County in digital format that would be compatible with the County's and SWFWMD's Geographic Information Systems (GIS).

Utilization of the Topographic Data

The Cooperative Project serves as part of the Stormwater Management Program that was designed to help determine the effects of development upon natural drainage.

The use and benefits of this project include warning the public of flood threats, assisting SWFWMD in floodplain identification, providing updated terrain elevation information on 1988 datum where only 1929 datum was available previously, and updating the GIS Base Map. Additional benefits include assisting Emergency Operations Centers in emergency planning, assistance in a process to locate most suitable places for shelter locations, and identification of water run-off patterns for minimizing water pollution. Utilization of the Cooperative Project lies also in the protection provided to natural functions of wetland and upland conservation areas that preserve a good level of natural flood protection within Hillsborough County. A program like this provides a good source of information for more protection from flooding hazards to both residents and business owners, and assisting in removing population from areas of greatest risk.

Mapping Priorities

Flood management, water quality, density and location of the population, coastal geography and funding were some of the determining factors that set the mapping priorities for Hillsborough County. The mapping priorities were mutually agreed upon by the cooperative partners. The result is that the mapping started from the coast of Tampa Bay and proceeded east to areas less prone to flooding and water quality issues.

Hillsborough County and SWFWMD were the major sponsors of the Cooperative Project. Funds contributed from the City of Tampa were provided for mapping cells within the city boundaries that are considered critical for flood protection.

During this five year project that started in 2001 and finished in 2005, six independent photogrammetric firms used aerial photography to map the topography of approximately 595 square miles of land in three major basin areas of Hillsborough County, as shown in Figure 1. Digital topographic data were produced by conventional photogrammetric mapping methods.

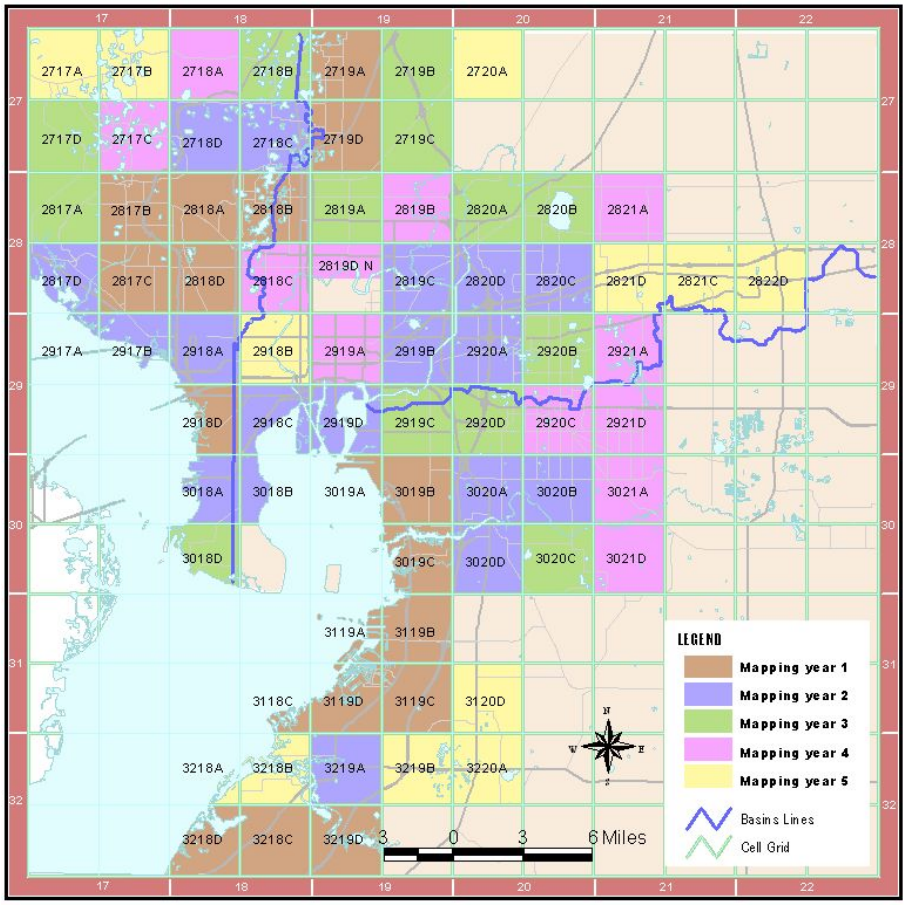

Figure 1. Hillsborough County map showing the progress of the Cooperative Project.

AREA OF INTEREST – MAPPING CELLS

For the new topographic mapping purposes, the land of Hillsborough County was divided into uniform mapping areas called "cells". The cells represent the optimal size of the areas to be mapped as separate projects, and have a digital topographic data file size comfortable to handle in ESRI (Environmental Systems Research Institute) and CAD (Computer–Aided Design) environments. Figure 2 shows cell line layout and the basic naming convention for the cells.

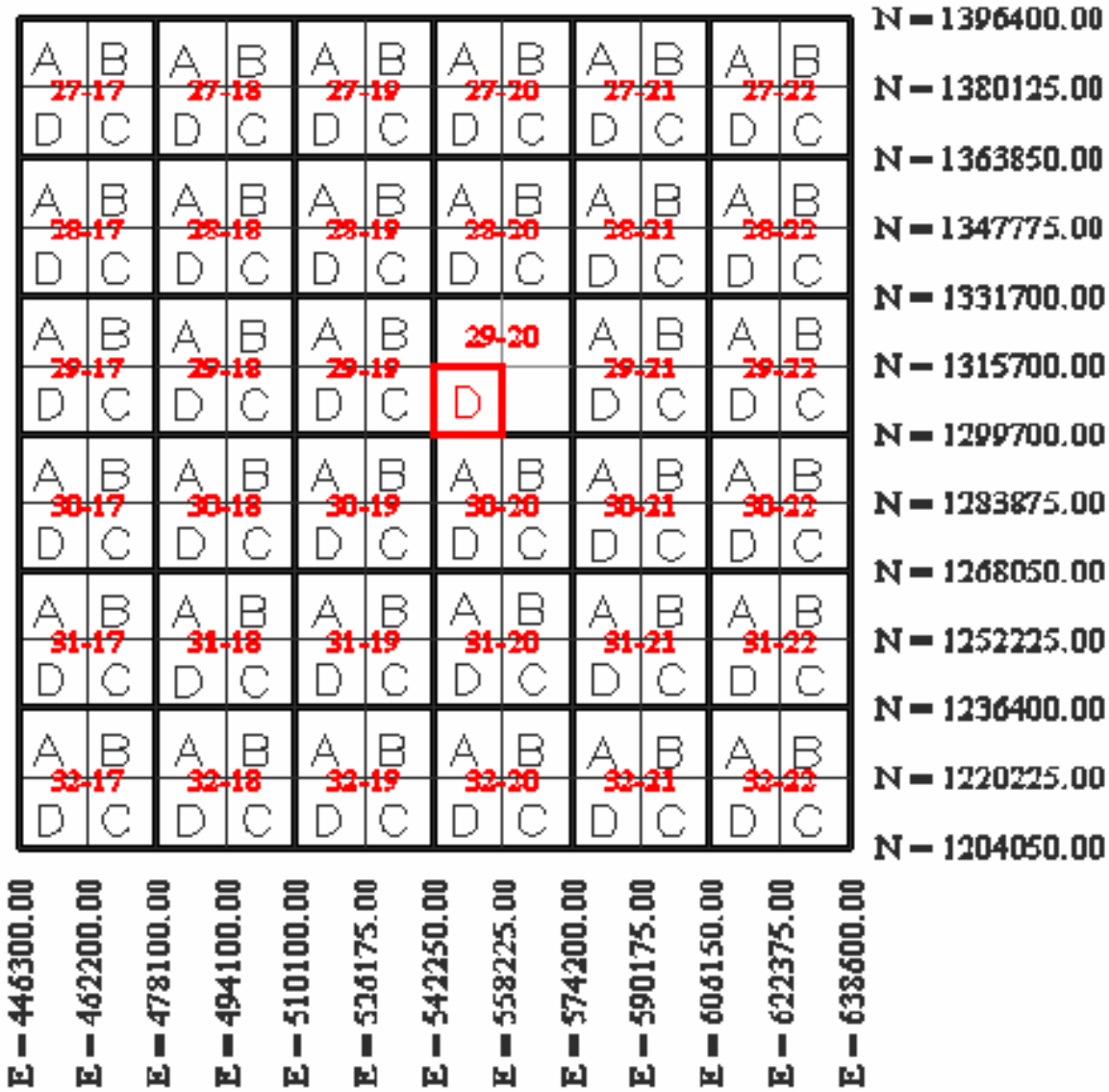

Figure 2. Digital Elevation Mapping Project cell grid naming convention and corner coordinates for the cells.

Each township is divided into four mapping cells, A, B, C, and D, each covering approximately 9 square miles. The name of a particular cell consists of the number of the township, the number of the range, and the cell letter. An example is illustrated in the highlighted cell shown in Figure 2 where the name of the cell would be 2920D.

Individual cells were contracted as separate project areas and the project boundaries were defined by the cell lines. Photogrammetrically compiled topographic data of every mapped cell were terminated on the cell boundaries. To ensure continuity of the data between the adjacent cells, it was critical that the compiled topographic data finished precisely on the cell line.

PROJECT SPECIFICATIONS

It was desired that the data obtained from the Cooperative Project would supplement and replace existing elevation data. The National Geodetic Vertical Datum of 1929 (NGVD29) previously used for elevation maps would be replaced with North American Vertical Datum of 1988 (NAVD88). Existing five-foot SWFWMD contour maps would be replaced with denser contour maps produced from the new data. Densification and updating of the benchmark network to NAVD88 would also be one of the main contributions of the Cooperative Project.

It was essential to specify defining project elements and to develop good working project specifications that would satisfy the Cooperative Project objectives. Utilization of practical knowledge gained from the mapping process of pilot project areas helped to accomplish this task, as did significant input, experience, and knowledge contributed by professionals from contracted photogrammetric firms. The final project specifications, discussed in more detail herein, were the product of a mutual effort between the Cooperative Project partners and the contracted professionals.

TOPOGRAPHIC MAPPING

Project Planning

To begin, the contracted photogrammetric firm designed a flight plan that was submitted to Hillsborough County for each of the projects prior to acquisition of photography. The flight plan furnished the layout of project boundaries and flight lines required to obtain the desired coverage. The flight plan also included the layout of the desired ground control network for the project area. One flight plan was created and submitted for each cell, or for as many adjacent cells as were contracted at the same time to the same photogrammetric firm.

Ground Survey

The County Survey Field Office was responsible for establishing the horizontal and vertical coordinates of ground control points in the locations according to the flight plan prepared by the photogrammetrist. Both targeted and photo identifiable points were used in these projects. Survey field work was certified and submitted prior to proceeding with aerial triangulation.

In conjunction with the control surveying, the County Survey Field Office established an adequate number (20-35) of independent quality control (QC) checkpoints for each mapping cell. These QC checkpoints were equally distributed throughout the cell, and field surveyed with the view of ensuring quality of the compiled data and testing the accuracy of the final digital terrain model (DTM), as subsequently described herein.

Coordinate Systems and Units

State Plane Coordinate system, Florida West Zone 0902, North American Datum of 1983 (NAD83) with adjustment of 1990 for horizontal coordinates, and North American Vertical Datum of 1988 (NAVD88) for vertical coordinates were used throughout all stages of the project. All survey data were measured and reported in U. S. Survey Feet.

Mapping – Data Collection

Digital topographic data were produced by conventional photogrammetric mapping methods. After analytical aerial triangulation was performed in order to set the stereo models in the photogrammetric instruments, the digital topographic maps were stereo-compiled at mapping scale 1 inch = 200 feet, utilizing aerial photography flown at an altitude of not more than 2,400 feet above ground.

Bare-earth terrain is represented by mass points and 3D breaklines collected not more then 50 feet apart. The photogrammetric collection was voided in areas where the ground was obscured in the stereo models unless openings within obscured areas existed and mass points or partial breaklines with bare-earth elevation could be collected. Obscured areas were delineated by 2D closed polygons in the order to clearly mark the areas where the data does not fully comply with the project specifications.

The project specification called for DTM collection where elevation of topographic features on the land would be incorporated and mass points and breaklines would be irregularly spaced to better characterize the true shape of the bare earth terrain. The result is that the distinctive terrain features are more clearly defined and the generated contours more closely approximate the real shape of the terrain. Such DTMs were more expensive and time

consuming to produce than uniformly spaced digital elevation models (DEMs), but the DTMs are technically superior to standard DEMs for the Cooperative Project applications.

DELIVERED DATA

The specifications developed for the project required that all DTM data files were delivered to Hillsborough County on CD-ROMs in ArcInfo Generate format separated into two directories named "Data" and "SuppData".

The Data directory contained all the DTM data files in ArcInfo Generate format and ArcInfo macro file. The DTM data were separated into files that depict different surface features and were delivered for each cell separately.

The Supplemental Data directory contained all files created during the data collection process that were not required in Data directory. This also included AutoCAD drawings, black and white ortho-image, etc.

The following portrays an example for DTM data files naming convention as delivered:

Data
2918d.aml (ARCInfo macro file)
2918db.lin (building envelope breaklines – closed polygons)
2918dis.lin (island breaklines within water bodies, if any exist – closed polygons)
2918disp.pnt (mass points on islands within water bodies, if any exist)
2918dr.lin (hard surface feature breaklines: roads, road centerlines, and large paved areas)
2918dsp.pnt (mass points)
2918dt.lin (soft terrain breaklines)
2918dvsp.pnt (mass points in vegetation obscured areas)
2918dwr.lin (river water body breaklines)
2918dwc.lin (coastal water body breaklines – closed polygons)
2918dwl.lin (lake water body breaklines – closed polygons)

SuppData
2918dbr.lin (bridge envelope breaklines)
2918ddsp.pnt (mass points for display on the final contour maps)
2918dv.lin (obscured areas 2D outlines – closed polygons)

The main part of the file name (2918d) is the cell name. The cell name convention was described earlier in this paper.

ARCInfo Generate Files

Three different surface feature codes were used in this project for various files. The surface feature code "1" was used for mass points; mass points for display, mass points in vegetation obscured areas, and mass points on islands within water bodies. The code "2" was used for soft breaklines (terrain, top of banks, ridges, etc.), and code "3" was used for hard breaklines (roads, commercial paved areas, building envelopes, water, obscured area outlines, islands, bridges, etc.).

QUALITY CONTROL PROCESS

The ESRI ArcGIS, ArcInfo, and ArcView programs were used to analyze the submitted data. Once the DTM data files in ArcInfo Generate format have been delivered to Hillsborough County and checked to see that all the files are in right directory and named accordingly to specifications, additional directories were added.

Directory "InfoCov_Tins" was added as a working directory for ArcInfo where the Triangulated Irregular Network (TIN) surface was generated by running the AML file (ARCInfo macro file). Shapefiles of all the generate files created in ArcView program were placed into the "Shapefiles" directory that also served as working directory.

Checking the TIN

The TIN model, created by using ArcInfo workstation, was loaded into ArcView program with 3D Analyst extension and shaded accordingly. Also the ortho-image for the area was added. Then all the aspects were checked by zooming and panning throughout the cell area.

Figure 3. Shaded TIN model of an area where the photogrammetrically compiled topographic data (points and breaklines) correctly represent the terrain.

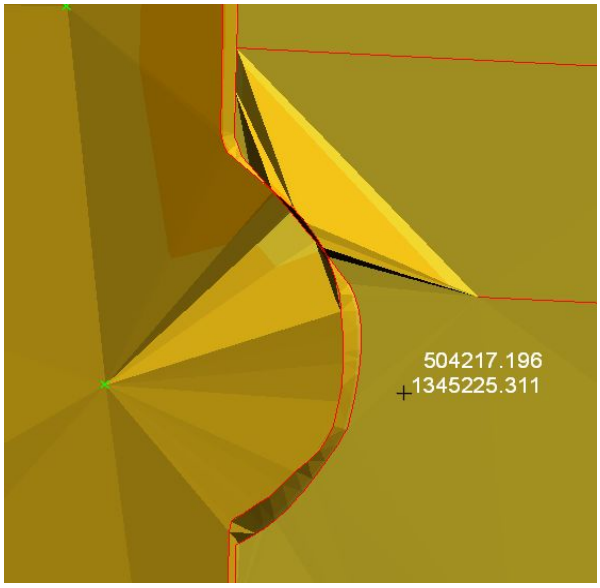

Figure 4a. Shaded TIN model where the continuity of the terrain breaklines are in error.
Figure 4b. Shaded TIN model where the terrain breaklines are crossing.

By utilizing the corresponding ortho-image of the area the compiled data integrity was checked. The TIN model generated from the DTM was checked for elevation irregularities ("spikes") in the terrain representation that occurred for various reasons; for example, as a result of compilation or data translation errors. Terrain irregularities also appeared as an interpretation result of the TIN model creation program if two breaklines were crossing.

The project technicians were to make sure all the DTM data are within the cell boundary and no elevation point or any breakline is extended beyond the boundary. An adequate amount of elevation information (mass points or last

vertex of the breaklines) was required to be compiled precisely on the cell boundary line in the order to ensure continuity of the data between adjacent cells.

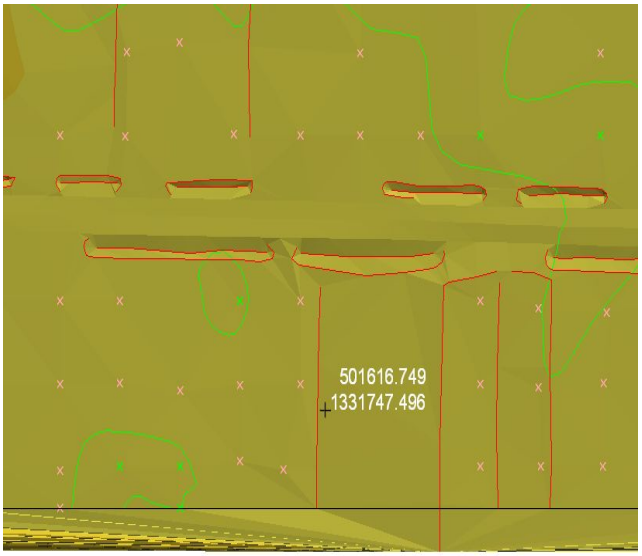

Figure 5a. Shaded TIN model of the area where the elevation of the vertexes on the road center line are in error.
Figure 5b. Shaded TIN model of the area where the terrain breakline is extended beyond the cell boundary.

When areas of missing data or with incorrect information were found, the areas were labeled with X and Y state plane coordinates for instant identification and exported as a jpeg file (detail). These detail files were then sent to the contracted photogrammetric company for evaluation and corrections were made accordingly. Examples of the detail files are shown in Figure 4a., 4b., and in Figure 5a., 5b.

ACCURACY STANDARDS

For decades, when photogrammetrical topographic or planimetric maps were produced in hardcopy form, users became accustomed to specifying map requirements in terms of the published map scale and contour interval. With conventional photogrammetric mapping, the flying height and mapping camera characteristics more or less dictate the vertical accuracy of topographic maps.

The three existing standards considered for the project and their characteristics are as follows:

National Map Accuracy Standards

In 1947, prior to the advent of DEMs, the U.S. Bureau of the Budget published the National Map Accuracy Standards (NMAS) that defined the horizontal and vertical map accuracy standard for printed maps at all published scales and contour intervals.

The major points in understanding the NMAS are that the NMAS pertains to graphic topographic maps with a published scale and contour interval; they predated the introduction of DEMs; apparent vertical errors can be offset by permissible horizontal errors; and test points must be well defined. Therefore, it is advisable not to use the NMAS for evaluating and reporting the accuracy of digital mapping. The NMAS becomes obsolete for digital mapping products (Maune, 2001).

American Society for Photogrammetry and Remote Sensing Accuracy Standards

In 1990, the Specifications and Standards Committee of American Society for Photogrammetry and Remote Sensing (ASPRS) published the ASPRS Accuracy Standards for Large-Scale Maps, with anticipation that these

standards may form the basis for revision of the NMAS. A major feature of the ASPRS standards is that they indicate limiting root-mean-square errors (RMSE) at ground scale as a function of the contour interval (Maune, 2001).

The RMSE is the cumulative result of all errors including those introduced by the processes of ground control surveys, map compilation, and final extraction of ground dimensions from the map (USCOE, 2002).

The limiting RMSEs were established for three classes of maps. Class 1 maps are the most accurate; Class 2 maps have twice the RMSE of a Class 1 map; and Class 3 maps can have errors triple those of a Class 1 map.

ASPRS Vertical Accuracy

Vertical map accuracy is defined as the RMSE in evaluation in terms, of the project's evaluation datum for well-defined points only. Contours are not considered as well-defined feature. For Class 1 maps the limiting RMSE in evaluation is set by the standard at one-third of the contour interval (CI) for well-defined points only. Spot heights shall be shown on the map within a limiting RMSE of one-sixth of the CI. Map accuracies can also be defined at lower spatial accuracy standards. Maps compiled within limiting RMSEs of twice or three times those allowed for Class 1 map shall be designated Class 2 or Class 3 maps respectively (USCOE, 2002). Table 1 summarizes the limiting vertical RMSEs pertaining to Cooperative Project.

The ASPRS standards define the vertical accuracy by comparing the elevations of selected well-defined points as determined from the map to corresponding elevations determined by independent field survey of higher accuracy.

Table 1. ASPRS Topographic Elevation Accuracy Requirement for Well-Defined Points

ASPRS Limiting RMSE in Feet						
	Well-Defined Topo-Feature Points			Spot or DTM Elevation Points		
Target CI	Class 1	Class 2	Class 3	Class 1	Class 2	Class 3
1	0.33	0.66	1.00	0.17	0.33	0.50
2	0.67	1.33	2.00	0.33	0.67	1.00

National Standard for Spatial Data Accuracy

In 1998, the Federal Geographic Data Committee (FGDC) endorsed and published Geospatial Positioning Accuracy Standards that included the National Standard for Spatial Data Accuracy (NSSDA) (Maune, 2001). The NSSDA implemented a statistical and testing methodology for estimating the positional and vertical accuracy of points on maps and in digital geospatial data, with respect to georeferenced ground positions of higher accuracy.

Accuracy is reported in ground distances at the 95% confidence level. Accuracy reported at the 95% confidence level means that 95% of the positions in the dataset will have an error with respect to true ground position that is equal to or smaller then the reported accuracy value. The reported accuracy value reflects all uncertainties, including those introduced by geodetic control coordinates, compilation, and final computation of ground coordinate values in the product (FGDC, 1998).

Major Points in Understanding the NSSDA Standards

NSSDA standards postdate the introduction of DEMs and they replace the NMAS for digital geospatial data, including DEMs.

The NSSDA does not define threshold accuracy values. Ultimately, users identify acceptable accuracies for their applications. Data and map producers must determine what accuracy exists or is achievable for their data and report it according to NSSDA.

DEMs are evaluated by computing vertical RMSE (RMSEz) and vertical accuracy (Accuracy z) values. Both RMSEz and Accuracy z are computed in terms of ground distances (feet or meters) as opposed to map distances (fractions of an inch) used by the NMAS.

Accuracy is reported in ground distances at the 95% confidence level. Apparent vertical errors in DEMs are not offset by permissible horizontal errors as allowed by the NMAS and ASPRS 90 standards.

When comparing the vertical relationship between NSSDA and NMAS, the equivalent contour interval per NMAS = 3.2898 * RMSEz when the vertical error has a normal distribution (Maune, 2001).

NSSDA Vertical accuracy

It is assumed that systematic errors have been eliminated as best as possible. If vertical error is normally distributed, the factor 1.9600 is applied to compute linear error at the 95% confidence level. Therefore, Accuracy z, reported according to the NSSDA shall be computed by the following formula: Accuracy z = 1.9600 * RMSEz (FGDC, 1998).

For the Cooperative Project, NSSDA was applied in part for the field verification procedure using field surveyed checkpoints as subsequently described.

ACCURACY TESTING

According to the NSSDA, vertical accuracy is tested by comparing the elevations in the topographic dataset with elevations of the same points as determined from an independent source of higher accuracy – for example field surveyed QC checkpoints. Because the digital topographic dataset (DTM) points are not well-defined in terms of being recoverable on the ground, it is unrealistic to expect QC checkpoints to be field surveyed at exactly the same horizontal coordinates as in the topographic dataset. For these reasons, FGDC specifies that vertical accuracy is computed by a comparison of "linearly interpolated elevations in the dataset with corresponding known elevations." For the digital topographic dataset, this linear interpolation is best performed on a TIN surface, prior to the generation of digital contours, because the original data is best depicted by the TIN surface.

Quality Control (QC) Checkpoints

The Accuracy testing of the Digital Elevation Mapping Project topographic dataset was performed by Hillsborough County (in-house) by utilizing field surveyed QC checkpoints collected independently for every cell by County Survey Field Office.

The NSSDA states, "A minimum of 20 check points shall be tested, distributed to reflect the geographic area of interest and the distribution of error in the dataset. When 20 points are tested, the 95 percent confidence level allows one point to fail the threshold given in product specifications."

For the Cooperative Project, depending on the mapped area size, 20 to 35 QC checkpoints were field surveyed on flat, open, and vertically stable, well-defined terrain, preferably on hard surface areas. QC checkpoints were equally distributed throughout the cell and field surveyed with the intent of ensuring quality of the compiled data and testing the accuracy of the final DTM. The deliveries included field sketches and Excel spreadsheets or DBF files with point name, northing, easting, elevation, and description for the QC checkpoints.

Interpolation from TIN Surface

A TIN model created using ArcInfo workstation was loaded into ArcView program with 3D Analyst extension and the shapefile for the QC checkpoints was created. This program was then used to automatically interpolate TIN surface z-values at each of the horizontal checkpoint coordinates listed in the checkpoint file for the particular mapping cell. The software would interpolate the appropriate TIN triangle, using the elevations at the three surrounding corners of the triangle.

RMSE Calculations

TIN model interpolated z-values and the field surveyed elevations of the QC checkpoints were used to determine elevation differences (ΔZ) for each of the checkpoints using MS Excel spreadsheet as shown in Figure 6.

Positive (+) differences ΔZ, obtained by subtracting TIN model interpolated z-values from their field surveyed elevations, indicate places where the compiled topographic data are too low, and negative (-) differences ΔZ indicate areas where the topographic data were compiled too high.

All the elevation differences ΔZ greater than 0.33 feet were marked in the spreadsheet. Positions of the corresponding QC checkpoints where ΔZ were greater then 0.50 feet were analyzed, utilizing the ortho-image of the area and possibly deleted from the QC checkpoints set if, for example, the point appears to be located in obscured area.

The MS Excel command used to compute RMSE for 25 elevation differences ΔZ in column G, rows 10 through 34 of the spreadsheet at Figure 5 is =SQRT(SUMSQ(G10:G34)/COUNT(G10:G34)). Consequently, based on the NSSDA vertical accuracy standards as previously described, the NSSDA Accuracy z for the same elevation differences ΔZ would be computed as =G36*1.96 were the G36 is RMSE result of the spreadsheet at Figure 6. The identical procedure for RMSE z and NSSDA Accuracy z computation was used for every mapping cell.

DIGITAL ELEVATION MAPPING ACCURACY TESTING

area: 3020D_TIN
contractor:
date: 6/18/03

QC Points	North83_ft	FIELD East83_ft	Elev88_ft	TIN Elevation_ft	ΔZ_ft
CP26	1282671.45	556610.10	55.36	55.06	0.29
CP27	1281862.40	554420.42	51.62	51.77	-0.14
CP28	1282293.57	550645.63	29.02	28.92	0.10
CP29	1282346.31	547048.87	9.91	9.51	0.40
CP30	1282607.29	542889.78	22.43	22.31	0.11
CP31	1278622.97	543578.68	38.63	38.56	0.07
CP32	1278421.41	546131.66	29.25	29.16	0.09
CP33	1278264.07	551158.76	57.09	56.68	0.40
CP34	1278802.76	553337.04	52.65	52.24	0.41
CP35	1279218.45	555704.51	64.32	64.32	0.00
CP36	1275852.55	555774.64	62.59	63.12	-0.53
CP37	1276031.94	553588.33	42.87	42.84	0.02
CP38	1275415.46	550712.90	60.25	59.46	0.79
CP39	1275404.66	545225.62	35.26	35.09	0.18
CP40	1275763.84	543352.65	24.40	24.39	0.02
CP41	1272201.07	543296.97	30.35	30.65	-0.30
CP42	1272491.53	546389.10	48.02	47.92	0.10
CP43	1272892.88	550299.02	60.95	60.98	-0.03
CP44	1272621.85	553548.36	69.78	70.19	-0.41
CP45	1272732.92	556841.02	64.18	64.66	-0.48
CP46	1270284.16	556225.61	71.65	72.17	-0.52
CP47	1269691.67	553103.98	69.52	69.65	-0.13
CP48	1269522.78	550722.53	62.32	62.24	0.08
CP49	1269833.77	546641.23	48.74	48.71	0.02
CP50	1269134.83	542734.98	32.62	32.32	0.30

RMSE z (ft) = 0.31
NSSDA - Accuracy z (ft) = 0.61

Figure 6. Illustration of the Excel spreadsheet showing the table of RMSE z and NSSDA Accuracy z calculations for 25 QC checkpoints selected for one of the mapping cell area (3020D).

Result

Approximately 75 mapping cells of Hillsborough County varying in overall mapping area size and in the number of used QC checkpoints in the individual cells were field verified. The result of the vertical RMSEs calculations varied from cell to cell. As graphically shown in Figure 7, approximately 37% of the mapped cells have vertical RMSE smaller than 0.33 feet, 57% have vertical RMSE between 0.34 and 0.66 feet, and 5% have vertical RMSE greater then 0.66 feet. In no mapping cell did the vertical RMSE exceeded 0.88 feet.

PROJECT CONCLUSION AND NEW PROJECTS

During this five year project, six independent photogrammetric firms mapped topography of approximately 595 square miles of land in Hillsborough County as shown in Figure 1. Digital topographic data were produced by conventional phogrammetric mapping methods with the overall goal to ensure that a high quality, well-documented GIS database is built and maintained. The Cooperative Project provides very complex, detailed, and accurate topographic information that fully satisfy all the Cooperative Project objectives.

Digital Contour Maps

The County recognizes that many of the clients prefer topographic data in contour map form. This year, to meet this need, Survey Division of Hillsborough County is preparing a project that will furnish generation of digital contour maps utilizing the Cooperative Project topographic data.

In order to generate consistent digital contour maps, one of the challenges is that the accuracy of the topographic data varies from cell to cell as shown in Figure 6. In order to maintain integrity, the contour maps in all the areas will need to be generated considering the weakest topographic data from all the datasets. This will ensure that stated accuracy of the final digital contour maps will be consistent throughout all mapped areas of the project. Another issue is continuity of the data from cell to cell. The source of this and other challenges lies in the fact that data was compiled separately by various photogrammetric companies throughout the five year period.

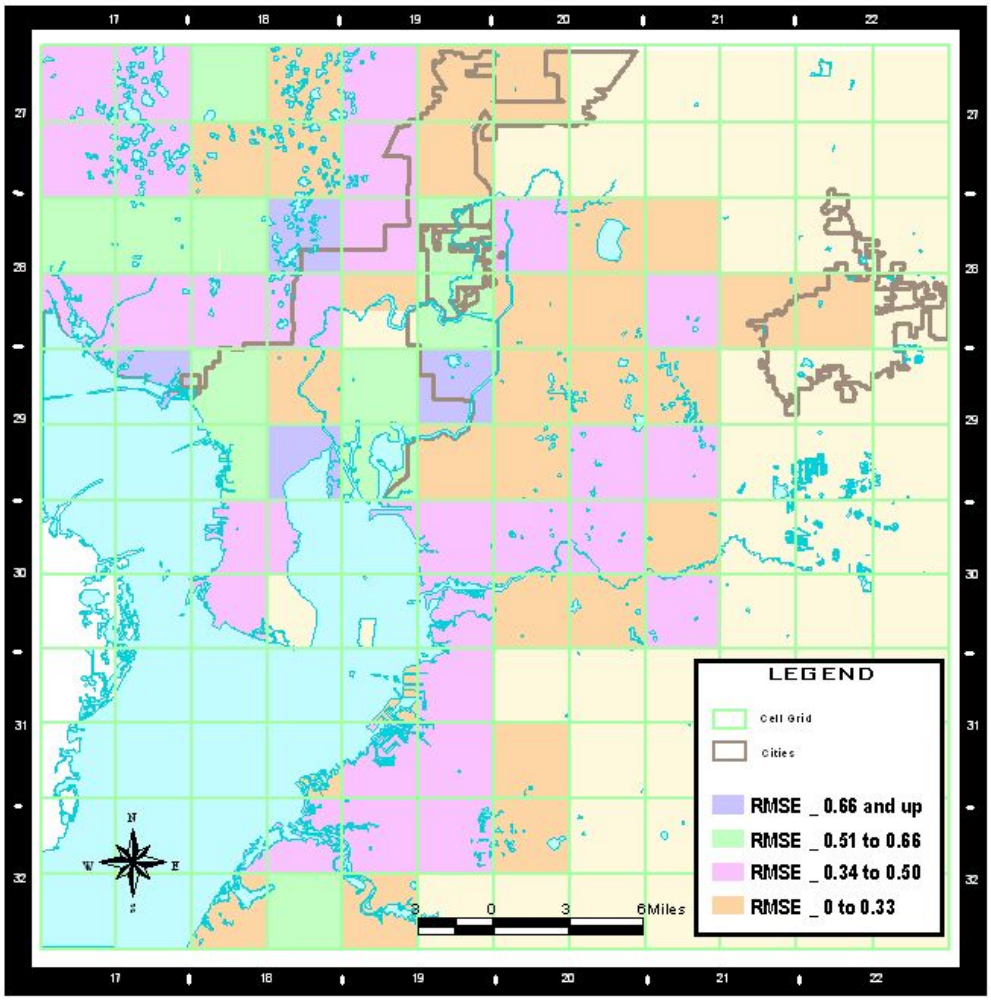

Figure 7. Graphical representation of vertical RMSE throughout Hillsborough County mapped cells.

Light Detection and Ranging (LiDAR) Mapping

Topography of approximately 57% of Hillsborough County land was mapped by conventional phogrammetric mapping methods during the five-year cooperative effort between Hillsborough County and SWFWMD (Figure 1). This year the cooperative effort between Hillsborough County and SWFWMD has been renewed in a Hillsborough County 2007 LiDAR Photogrammetric Mapping Project that will serve as part of Watershed Management Plan Topographic Information Mapping Project. All elevation project data will support creation of Federal Emergency Management Agency Flood Insurance Rate Maps (FEMA FIRM).

This project will furnish topographic mapping data for approximately 450 square miles of the remaining, unmapped land in Hillsborough County utilizing progressive LiDAR technology. The certified end product created and delivered by one contracted photogrammetric firm, continuous 2 foot contours generated throughout the mapped area, are expected to be seamless as much as possible with the Digital Elevation Mapping Project data.

The LiDAR project will provide Hillsborough County not only with more dense cloud of bare-earth elevation mass points in open areas, that will be fully supported with breaklines in order to achieve smoother and more accurate digital terrain model, but also with firsthand experience with this relatively new technology. County Survey Division will have great opportunity to compare these two technologies and analyze them from different aspects that are essential to Hillsborough County and their clients.

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