CHARLOTTE.

Subject/Title: GIS-05

GIS DATA PROPERTIES

Date Effective	**Revision Date Effective**
January 15th, 2010	

PURPOSE

The purpose for the GIS Data Properties Standard is to establish common, published data properties to facilitate integration, alignment and overlay of GIS data investments. The GIS Data Properties Standard will ensure consistency of GIS data across the City of Charlotte to fortify and advance the City's Enterprise GIS.

SCOPE

The GIS Data Properties Standard is specific to the GIS data properties that affect the display, overlay or rendering of GIS data used by City of Charlotte staff. The specific GIS data properties include:

- Precision
- Datum
- Spheroid
- Projection
- Coordinate System
- Tolerance
- Resolution
- Domain

The Standard shall apply to existing GIS data and all new GIS data investments, including:

1) GIS data created, acquired, maintained and shared by City of Charlotte GIS staff across all KBUs
2) GIS data stored on the City's Spatial Data Warehouse (SDW)
3) GIS data converted, compiled or acquired from vendors or contractors to the City of Charlotte

For purposes of ESRI GIS software terminology, this Standard applies to Feature Datasets and resultant Feature Classes inheriting properties from these Feature Datasets.

BACKGROUND

GIS data that is derived from the three-dimensional round surface of the earth must naturally undergo a transformation before it can be projected onto a flat surface such as a computer screen or paper map. The transformation is mathematically complex and is dependent on a set of variables used to model the properties of the source (the earth) and destination (the computer

screen). The City's experienced GIS users can attest to stories of frustration for time spent trying to decipher differences in data properties so that GIS data sets would align properly on screen.

Most City of Charlotte and Mecklenburg County GIS data possess common data properties. Nonetheless, for the times when there are differences, the time spent researching, determining and resolving differences more than justifies the establishment of the City GIS Data Properties Standard.

With the GIS Data Properties Standard in place, differences that do occur with data properties may be more easily mitigated and even prevented. For example, should the County intentionally or unintentionally change GIS data properties for base map data layers under County stewardship, the GIS Data Properties Standard will help provide a frame of reference for identifying the specific differences. Further, when the City contracts with a 3rd party vendor for GIS data conversion or acquisition, the GIS Data Properties Standard will provide a specification for the data deliverable which will saving time in post-processing.

DEFINITIONS

Datum – A datum provides a frame of reference for measuring locations on the surface of the earth. While a spheroid approximates the shape of the earth, a datum defines the position of the spheroid relative to the center of the earth. The data defines the origin and orientation of latitude and longitude lines.

Domain – The domain extent defines the minimum and maximum coordinate values that can be stored for the X (east-west), Y (north-south), Z (typically used for elevation) and M (linear reference measure used for routing).

ESRI – Environmental Systems Research Institute, the City's vendor for professional desktop and server-based GIS software tools.

Feature Dataset – Within ESRI ArcGIS software, a feature dataset is a collection of related feature classes that share a common coordinate system. Feature datasets are used to spatially or thematically integrate related feature classes. Their primary purpose is for organizing related feature classes into a common dataset for building a topology, a network dataset, a terrain dataset, or a geometric network.

Feature Class - In relational database terminology, a feature class is stored as a table in the database management system (DBMS). Within ESRI ArcGIS software, a feature class is a collection of geographic features with the same geometry type (such as point, line, or polygon), the same attributes, and the same spatial reference. Feature classes allow homogeneous features to be grouped into a single unit for data storage purposes. For example, highways, primary roads, and secondary roads can be grouped into a line feature class named "roads." In a geodatabase, feature classes can also store annotation and dimensions.

Geographic Coordinate System - A geographic coordinate system (GCS) uses a three-dimensional spherical surface to define locations on the earth. A GCS is often incorrectly called a datum, but a datum is only one part of a GCS. A GCS includes an angular unit of measure, a prime meridian, and a datum (based on a spheroid).

GIS – acronym for “Geographic Information System”. A GIS is comprised of hardware, software, people, procedures and data. Procedures include operational processes and standards.

NC FIPS – Stands for North Carolina Federal Information Processing Standards. FIPS are codes used to reference geographical areas. FIPS were developed by the National Institute of Standards and Technology for use by the US Census for referencing US State, counties, populated places, primary county divisions, and other location entities.

Precision – Coordinate (data storage) precision refers to the mathematical exactness of a coordinate and is based on the possible number of significant digits that can be stored for each coordinate. In ESRI software, data are stored in either single (low)- or double (high)-precision coordinates. Single precision stores up to seven significant digits for each coordinate. Double precision stores up to 15 significant digits—typically 13 to 14—and retains a mathematical precision of much less than 1 meter at a global extent. The City of Charlotte and Mecklenburg County both store their GIS data using high precision coordinates.

Projection – A map projection is any method of representing the surface of a sphere or other shape on a plane. Map projections are necessary for creating maps. All map projections distort the surface in some fashion. Depending on the purpose of the map, some distortions are acceptable and others are not; therefore different map projections exist in order to preserve some properties of the sphere-like body at the expense of other properties. Three conformal projections were chosen for use with State Plane Coordinate Systems in the United States: the one used by North Carolina is the Lambert Conformal Conic.

Resolution – All coordinates stored in a feature class are snapped to an underlying coordinate grid. Resolution is the cell size of this grid.

Spheroid - A spheroid is a three-dimensional shape of the earth created from a two-dimensional ellipse. The ellipse is an oval, with a major axis (the longer axis), and a minor axis (the shorter axis). If you rotate the ellipse, the shape of the rotated figure is the spheroid. For North America, the spheroid of choice (and used by the City of Charlotte) is the GRS 1980, on which the North American Datum (NAD 83) is based.

State Plane Coordinate System - State Plane Coordinate System (SPCS) is a coordinate system that divides the 50 states of the United States, Puerto Rico, and the U.S. Virgin Islands into more than 120 numbered sections, referred to as zones. Each zone has an assigned code number that defines the projection parameters for the region. The advantage of using SPCS is that data is usually stored in a common coordinate system with other databases covering the same area.

Tolerance – The tolerance is used to set the minimum distance between coordinates in clustering operations important to GIS such as topology validation, buffer generation, and polygon overlay and for some editing operations.

STANDARD

Data Property	Measurement (Units)
Data Storage Coordinate Precision	**High Precision**
Projected Coordinate System	**NAD_1983_StatePlane_North_Carolina_FIPS_3200_Feet**
Map Projection	**Lambert Conformal Conic**
False Easting	**2000000.002617**
False Northing	**0.0**
Standard Parallel 1	**34.333333**
Standard Parallel 2	**36.166667**
Latitude of Origin	**33.750000**
Linear Unit	**Foot_US (0.304801)**
Geographic Coordinate System	**GCS_North_American_1983**
Angular Unit	**Degree (0.0174532925199433299)**
Prime Meridian	**Greenwich (0.0)**
Datum	**North American Datum 1983 (NAD83)/NSRS 2007**
Vertical Datum (where applicable)	**North American Vertical Datum 1983 (NAVD 88)**
Spheroid	**GRS 1980 (6378137.0, 298.257222101)**
Tolerance	**X,Y = 0.02 (US_Foot) Z=2, M=2**
Resolution	**X,Y = 0.000625 (US_Foot) Z=1, M=1**

The stringent tolerance and resolution settings are assigned to support:

- Spatial reference compatibility across multiple data sets
- Data deliverables that are being provided to the City with coincident lines, points, and polygons included in the deliverable (the small threshold will help to identify overlay discrepancies)
- Topologic dependencies that exist between existing City/County data and other derived data sets (i.e. using parcels or centerlines to create new boundary or polygon layer)
- Data replication services between the City and County

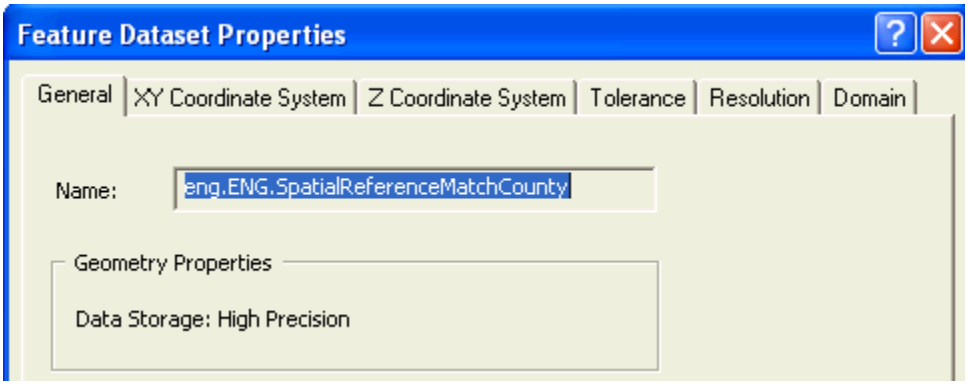
IMPLEMENTATION CONSIDERATIONS

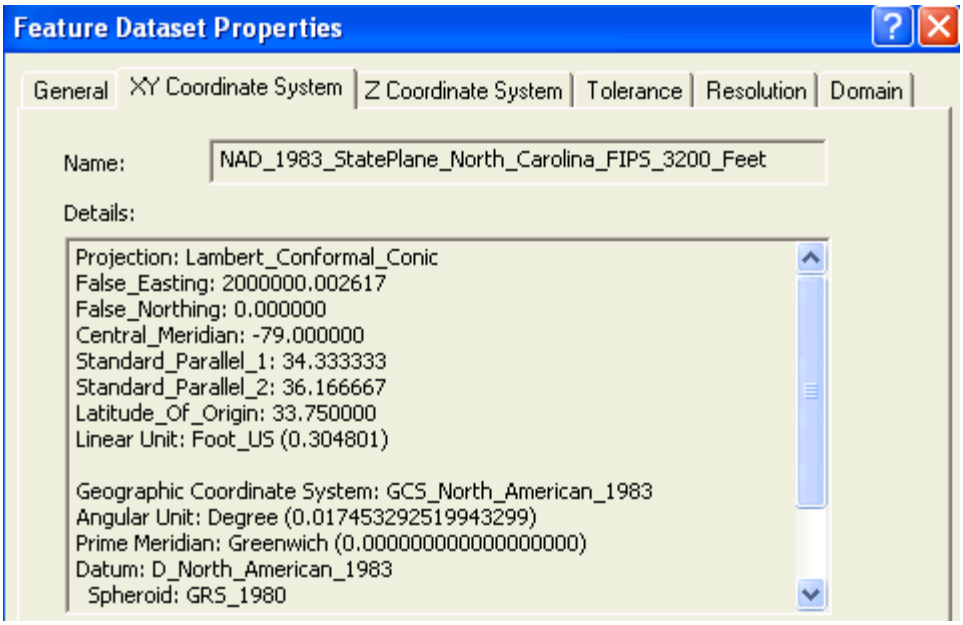
The GIS Data Properties Standard will be implemented for all data stored in the City's Spatial Data Warehouse (SDW). The GIS Enterprise Team will be responsible for coordinating the use of the standard with the KBUs as data is loaded into the SDW.

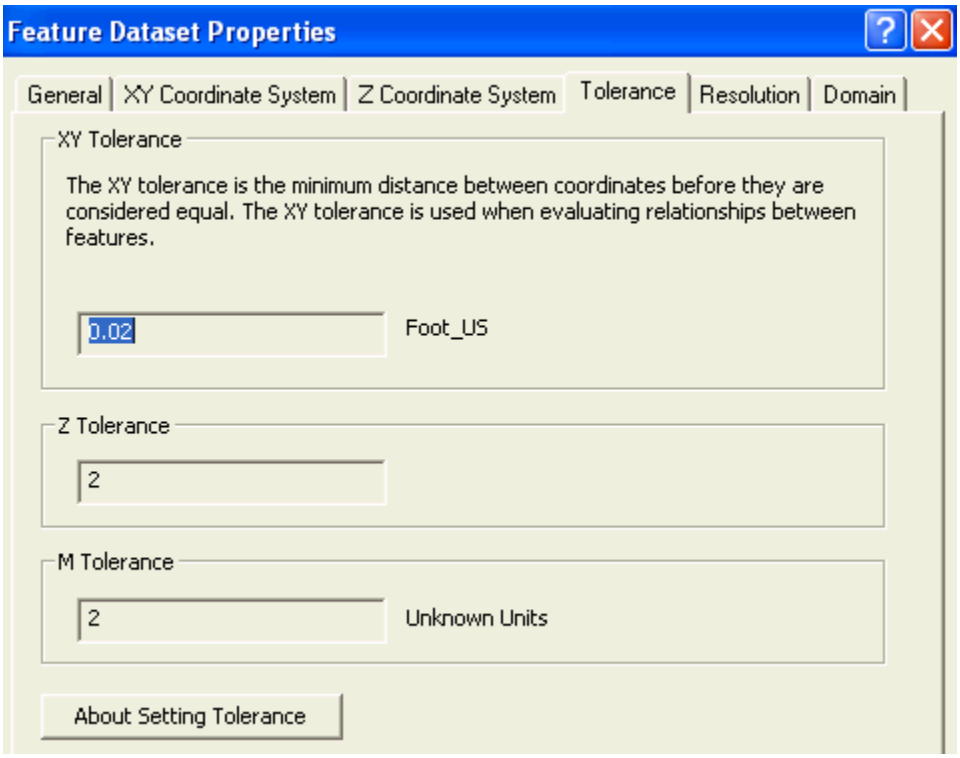
The GIS Data Properties Standard will be implemented with all new investments after the adoption of this standard. The Technology Architecture Review Team (TART) will be responsible for initiating procedures with the GET for the evaluation of new investments that flow through the TPET (Technology Project Evaluation Team) process to ensure compliance.

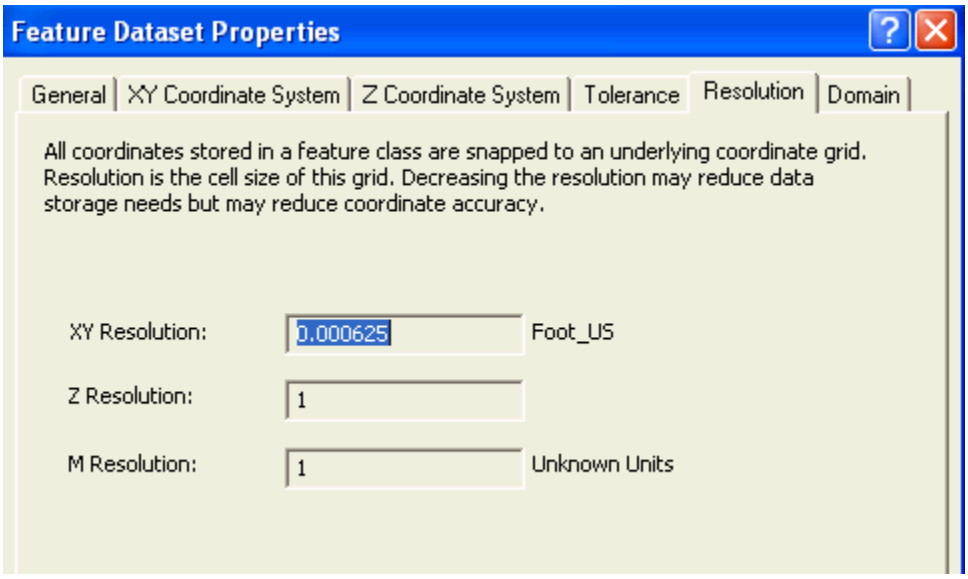
The following graphics depict how the GIS data properties are displayed using the City's current GIS editing environment, ESRI ArcGIS. Various tabs are displayed for a feature data set using these data property standards. They are included to assist City staff with defining GIS data properties.

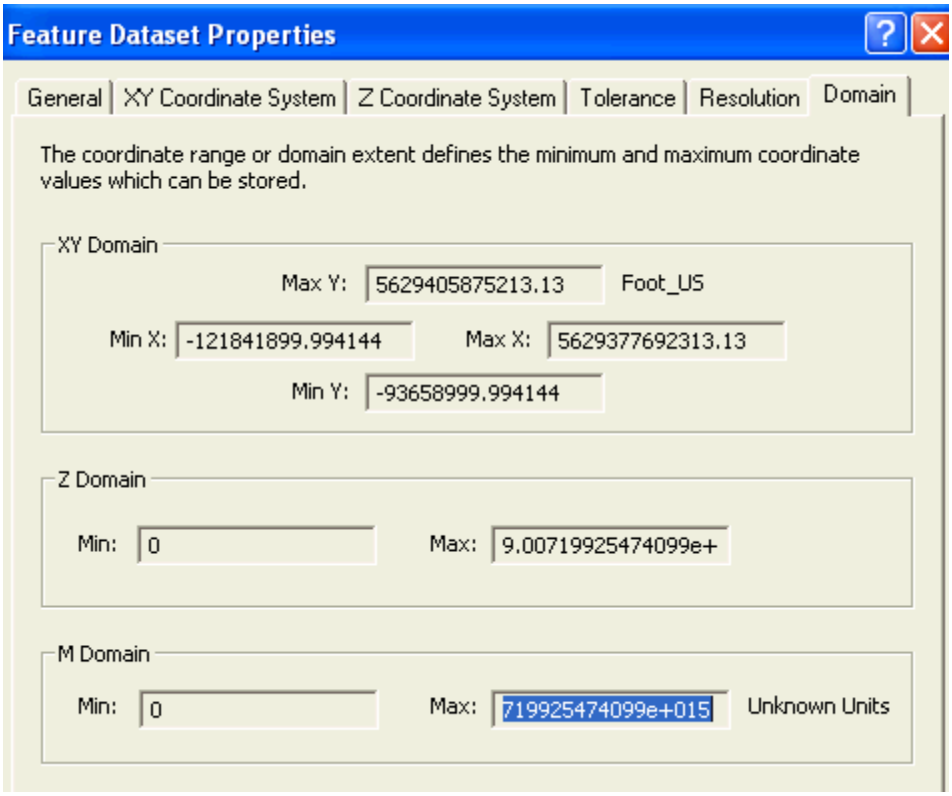
Figure 1 - GIS Data Properties Display in ArcGIS






Feature Dataset Properties
General
XY Coordinate System
Z Coordinate System
Tolerance
Resolution
Domain
XY Tolerance
The XY tolerance is the minimum distance between coordinates before they are considered equal. The XY tolerance is used when evaluating relationships between features.
0.02
Foot_US
Z Tolerance
2
M Tolerance
2
Unknown Units
About Setting Tolerance


Feature Dataset Properties
General
XY Coordinate System
Z Coordinate System
Tolerance
Resolution
Domain
All coordinates stored in a feature class are snapped to an underlying coordinate grid. Resolution is the cell size of this grid. Decreasing the resolution may reduce data storage needs but may reduce coordinate accuracy.
XY Resolution:
0.000625
Foot_US
Z Resolution:
1
M Resolution:
1
Unknown Units



COMPLIANCE

The City's GIS Enterprise Team (GET) shall be responsible for monitoring and measuring compliance. Monitoring will occur as KBU GIS data is loaded into the SDW environment. The GIS Data Properties Standard will be reviewed annually to ensure applicability.

EXCEPTIONS

1. Primary survey data collection accuracy requirements and tolerances shall be defined based on project needs.
2. The tolerance and resolution settings may be treated as recommendations for project environments that do not require this level of resolution and for data conversion project requirements where the data collection accuracy and precision techniques will not attain these specifications. In these cases it is still recommended to require spatial reference compatibility between multiple data sets and feature class deliverables.
3. Specific business applications that only support GIS data in other formats.