Introducing the
United States National Grid

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In 2005, the Department of Homeland Security (DHS) recommended that any DHS grant submission reference the use of a nationally defined coordinate system for all spatial referencing, mapping, and reporting. DHS recognizes that many different coordinate systems can be used to reference incident events in time and space. The expanding use of portable GPS-enabled devices, public safety access points (PSAP)-enhanced cell phones, and automated vehicle location (AVL) technology has increased the need for accurate and consistent identification, communication, and mapping of ground coordinates.

The objective of this U.S. National Grid standard is to create a more interoperable environment for developing location-based services within the United States and to increase the interoperability of location services appliances with printed map products by establishing a nationally consistent grid reference system as the preferred grid for NSDI applications. The U.S. National Grid is based on universally-defined coordinate and grid systems and can, therefore, be easily extended for use world-wide as a universal grid reference system.
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A consistent system is important because people cannot easily convert between multiple reference systems without the aid of location services appliances, calculators, or conversion tables. DHS has proposed that the United States National Grid (USNG) be used to increase the interoperability of location services appliances with printed map products by providing a nationally consistent grid reference system.

USNG relies on the familiar Universal Transverse Mercator (UTM) coordinate system and is applied not only in the United States but also worldwide. USNG is a nonproprietary alphanumeric referencing system derived from the Military Grid Reference System (MGRS). Many GPS receivers, from recreational to survey-grade instruments, support and report positional information in an MGRS/USNG format. ArcGIS 9.1 includes grid and graticule support for map layouts. The ESRI Military Analyst extension supports MGRS with a dynamic coordinate conversion and provides batch conversion of data from decimal degrees to MGRS coordinates in addition to degrees, minutes, seconds (DMS) and UTM. This article introduces USNG to both casual and experienced GIS users by taking the reader on a virtual tour of the available resources for learning about USNG. It is organized as a series of stops or waypoints that are numbered from 1 through 7.

Waypoint 1—The Federal Geographic Data Committee (FGDC) develops policies, standards, and procedures that enable organizations to cooperatively produce and share geographic data. This interagency committee is composed of representatives from many federal agencies. FGDC, in cooperation with state, local and tribal government organizations, the academic community, and the private sector, is developing the National Spatial Data Infrastructure (NSDI). Positional reporting and spatial accuracy are necessary when using and sharing spatial information. FGDC is a key player in the development and deployment of positional standards in government, academia, and industry. USNG provides a standard method for plotting and reporting positions across the United States.

Visit the FGDC home page (www.fgdc.gov) and look at the bottom of the page. The line immediately below the FGDC street address reads USNG: 18STJ94731361. The alphanumeric sequence, 18STJ94731361, is the FGDC's USNG address. Clicking on this link displays the location of FGDC's headquarters in the National Map Viewer. This ArcIMS-powered Web site provides a framework for geographic knowledge and gives the public access to high-quality geospatial data and information from multiple partners. Return to the FGDC home page.

Click on the USNG link at the bottom of the page to go to FGDC's USNG site and bookmark it. It contains links to the FGDC USNG standard, information on reading a geoaddress, articles, a link to *The National Map* portal, and other resource sites.

Waypoint 2—Type www.xyproject.org to go to The Public XY Mapping Project Web site. Formed by a group of concerned citizens in 1997, The Public XY Mapping Project is a nonprofit science and education corporation dedicated to the development and implementation of spatial addressing in the United States. Spatial addresses complement conventional one-dimensional street addresses. Two-dimensional addresses can provide location information during a disaster when signs or streets are destroyed or for sites that are removed from a road network.

One of The Public XY Mapping Project's goals is to increase public awareness of the need for consistent addressing and develop and recommend FGDC/NSDI standards for a national system. USNG standards were proposed in 2000 and adopted in 2002. Since then, the project has focused on training and implementation activities.

Click on the link United States National Grid for Spatial Addressing to view a document written by N.G. "Tom" Terry Jr., The Public XY Project executive director. "A Proposal for a National Spatial Data Infrastructure Standards Project" introduces USNG and explains how it is related to the familiar Universal Transverse Mercator (UTM) coordinate system. UTM zones are six degrees wide. With USNG, these UTM zones are further subdivided into eight-degree latitude slices called Grid Zone Designations (GZDs). This article discusses the concept of address precision. Print or save this document for future reference.

Waypoint 3—Return to the FGDC USNG page and click on the USNG Coordinate link to read an article written by Terry that appeared in *Professional Surveyor* magazine in October 2004. "The United States National Grid" provides more information on GZDs, 100,000-meter-square identification, and grid coordinates at various scales. Terry discusses numeric precision, the power of truncation, and string concatenation/presentation. This article also introduces the practice of "read right, then up" when locating a USNG address on a map. Save or print this comprehensive article.

Waypoint 4—Return to the FGDC USNG page and click on "Geoaddress—Where is It?" This article, also by Terry, appeared in *Professional Surveyor* magazine in November 2004. It tells how USNG addressing is used to report, map, and respond to public safety emergencies in the Washington, D.C., area. It discusses the importance of integrating digital positional devices, emergency communications, digital framework data, and paper maps. This article provides a realistic look into the future of coordinate-based emergency response.

Waypoint 5—Go to the FGDC USNG page (www.fgdc.gov/usng) and click on the first link to view the USNG standard (FGDC-STD-011-2001). This long document (43 pages) presents the objective, scope, applicability, and structure of USNG and detailed instructions for its use. Because this is a standards document, it mandates implementation rules. These rules are summarized below. Although dry, these rules are important, particularly Rule 4—Spatial Reference. An understanding of datums is necessary to properly apply USNG.

FGDC USNG Standards—The Rules
(Adapted from the United States National Grid Standards Working Group Federal Geographic Data Committee, December 2001, FGDC-STD-011-2001)

Rule 1—Conformance, MGRS
USNG coordinates shall be identical to the MGRS numbering scheme over all areas of the United States including outlying territories and possessions.

Rule 2—Conformance, UTM
USNG basic coordinate values and numbering are identical to UTM coordi-
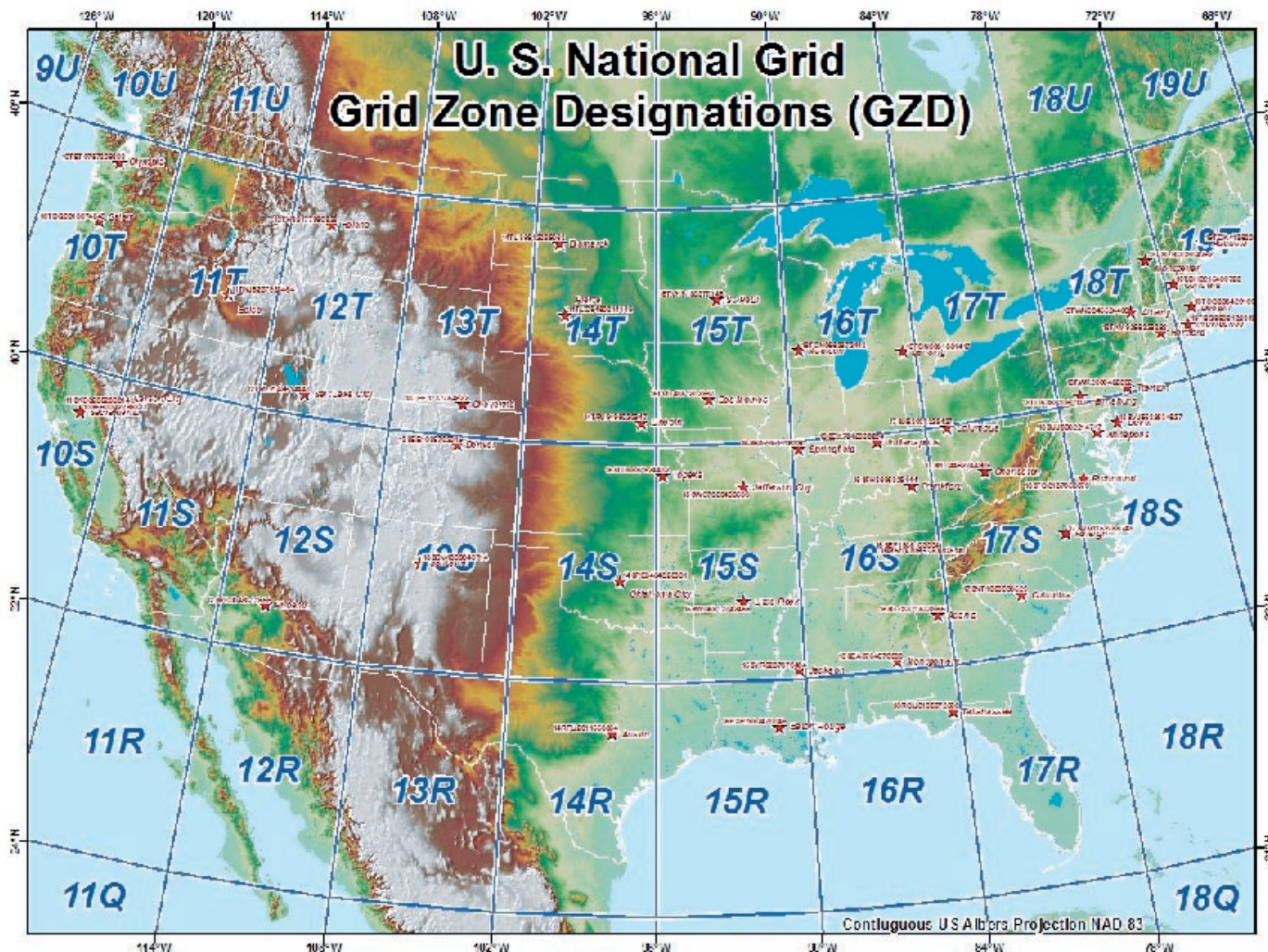
(MGRS) that is being promoted to increase the interoperability of location services appliances with printed map products by providing a nationally consistent grid reference system.

nate values over all areas of the United States including outlying territories and possessions.

Rule 3—Structure
Numbering scheme shall be alphanumeric as follows:

Grid Zone Designation (GZD)—The United States geographic area shall be divided into six-degree longitudinal zones designated by a number and eight-degree latitudinal bands designated by a letter. Thus, each area is given a unique alphanumeric GZD.

100,000-Meter-Square Identification—Each six-by-eight-degree GZD area shall be covered by a specific 100,000-meter square identified by a two-letter pair.

Grid Coordinates—A point position within the 100,000-meter square shall be given by the UTM grid coordinates in terms of its easting and northing. For specific requirements or applications, the number of digits will depend on the precision desired in position referencing. In this convention, reading shall be from left with easting first, then northing. An equal number of digits shall always be used for easting and northing.

Rule 4—Spatial Reference
The standard datum for USNG coordinates shall be the North American Datum 1983 (NAD 83) or its international equivalent, the World Geodetic System 1984 (WGS 84).

Rule 5—Accuracy
Paper maps using the USNG grid shall conform to the National Map Accuracy Standards.

Rule 6—Precision
For general field applications, a precision of 100 (or 10 meters) will be typical. For general applications, precision of up to one meter may be used. For special applications, USNG can provide precision greater than one meter.

Waypoint 6—Visit the National Oceanic and Atmospheric Administration (NOAA) National Geodetic Survey (NGS) Web site at www.ngs.noaa.gov. At this site, click on Download Software and choose USNG from the list of utilities. Download the documentation as well as the utility.

This free DOS utility converts geodetic latitude and longitude or UTM to USNG and vice versa. When the utility is run, it prompts for direction of conversion, input datum, input coordinates, and other information. The program processes single points at the command line, and it converts properly formatted file data to create a second output file. Read the documentation carefully.

Waypoint 7—Visit the National Information and Support Center for Geoaddressing (usgrid.gmu.edu) at George Mason University in Fairfax, Virginia. Bookmark this page and visit it periodically, especially the Resources area, to learn about new applications for USNG and stay in touch with others deploying and using USNG.

Conclusion
Watch for opportunities to use USNG coordinates and visit the sites listed in the article for updates, utilities, and new information. Visit *ArcUser Online* (www.esri.com/arcuser) to download the sample dataset that includes a polygon shapefile of GZDs that can be used with data for the continental United States in an ArcMap document to determine the USNG coordinates for a location.