Pre-Work

E/L 0964: ALL-HAZARDS SITUATION UNIT LEADER COURSE

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US National Grid Instructions

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THE U.S. NATIONAL GRID: READ RIGHT, THEN UP

08/04/2014

By Al Studt

Since grade school, we have been trained and have calibrated our eyes to be able to divide a space into tenths and extrapolate between two known divisions or tic marks on a gauge or graph. Similarly, plotting X and Y coordinates is something many will recall. Given a supply pressure hallway between 50 and 60 pounds-per-square-inch (psi)- with 10 psi increments- we all would report 55 psi. if it was slightly off center, we would report 56 psi. if it was close to 60, but not quite, we may report 58 psi. This same process is used to determine the United States National Grid (USNG) coordinates on a map.

The USNG is the national standard coordinate system of the United States that is designed for ground-based operations. This fits into what the fire service does routinely. It can be used daily in dispatch information to identify locations of interest that are unique, combined with or in place of a street address. It also can be used by fire inspectors and preplan teams to mark hazards; utility shutoffs; fire risers; hydrants; and, with an easy-to-use set of characters devoid of degrees, minutes, decimals or seconds. USNG is also mandated for use in multiple states during disasters when the paradigm of street address referencing is blown away, burned over, flooded, and so on. USNG may seem new but is has origins to Military Grid Reference System (MGRS), circa 1949, and is known to U.S. military veterans simply as "grid."

USNG has four components: the Grid Zone Designator (GZD), the 100-Kilometer (km) ID, the Easting, and the Northing. For local operations in your first-due area, in many cases, only the easting and northing is needed. For jurisdictions that contain grid lines boundaries, the 100 km ID and the GZD may be needed. For best use, USNG grid lines must be on your paper or electronic map such as a mobile data terminal and computer-aided dispatch displays. Also, USNG may be observed with free web tools and multiple smart phone applications. You can be a USNG user inside of 90 seconds.

USNG has the following general rule: "Read right, then up." Thus, when reading a map, one always first moves to the easting, and then up to the northing. A typical USNG coordinate from Indianapolis, Indiana would read: "16S EK 7126 0204." This mean, into words, the GZD is "16S," 100 km ID is "EK," within one km grid square (71 02), the location of interest is 26 percent right, and four percent up. The principle digits are always the leading two digits in the easting, and the northing makes up one km grid square. This location of interest is a center field light pole at Victory Field in Indianapolis.

USNG users have the ability to adjust precision. A one km square is four digits, such as “71 02.” A 100-meter square is six digits, i.e., 712 020. Finally, the 10-meter square is eight digits, i.e., 7126 0204. Note that many Web tools, such as global positioning system (GPS) receivers and smart phone apps display 10 digits. Ten digits are not recommended for use because they represent one meter square; GPS receivers, and even maps, are not typically accurate to that level of precision. It is recommended that the highest precision for fire-rescue be eight digits. One advantage of this is that even pairs of digits are easier to remember, transmit, and copy over the radio.

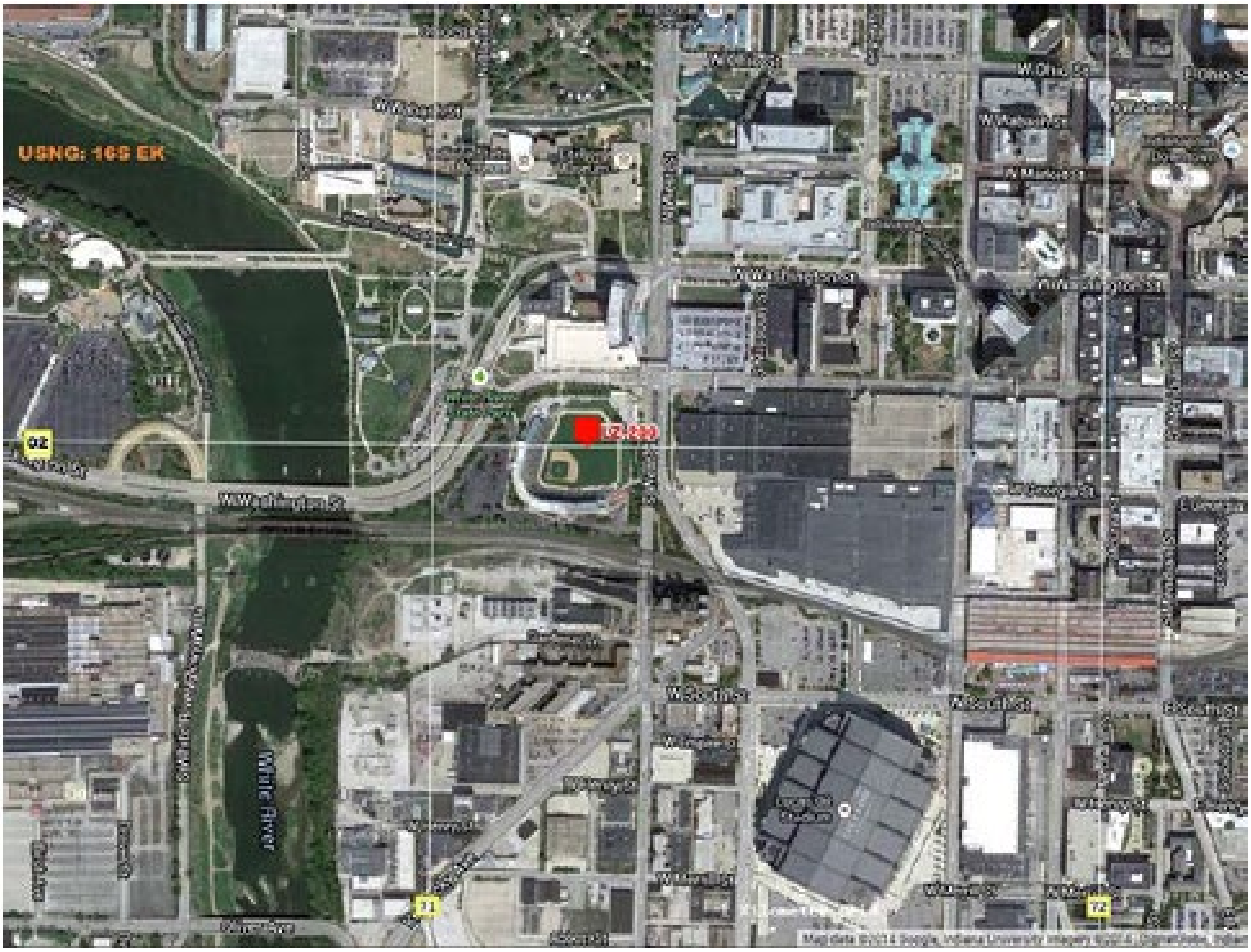
USNG coordinates are never rounded up or down. Rather, they are truncated from the right to left. Rounding results in error because the plotted location will be in an adjacent grid square.

Figure 1 shows a typical internet map view, which is nothing more than a picture. It is what we are all used to seeing; but how usable is it? How does one easily obtain a coordinate for the LZ (helispot) from such display? Add a grid. Having A-Z, 1-9 in the margin is a “bingo” grid. This is not interoperable, nor would it be found in GPS receivers or smart phone applications.

FIGURE 1. Typical Internet Aerial Map Display

Figure 2 shows the interoperable USNG with one km grid lines. Combining the pump panel gauge analogy and the USGN general rule, observe that the LZ icon is 2/10s right from grid line 71 and 0/10s up the grid line 02.

FIGURE 2. Hasty Map with 1 km Grid Lines in 16S CU; Indianapolis, Indiana

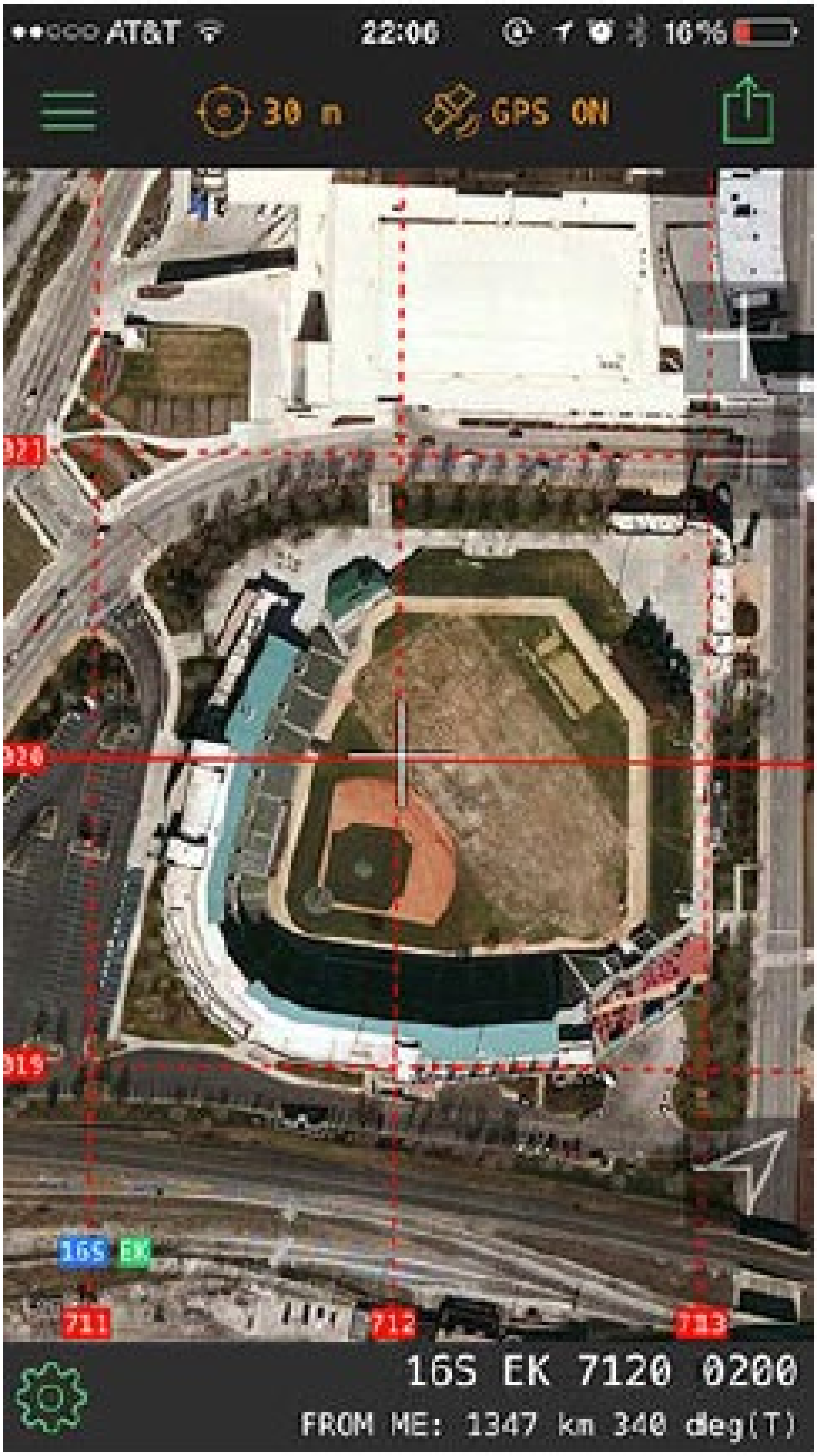


In figure 3, we zoom in to see 100-meter grid lines. The LZ, in left field of the ballpark, is fully within grid square 712 020. Military and medical helicopter pilots interviewed indicate that 100-meter coordinates are the desired precision they need. Consider that for a moment; the word count over the radio could be as few as just six characters when using USNG. If the 100 km ID was needed to make the coordinate more regional, just add two more characters. Worldwide, a helispot can be identified in just 11 characters: 16S EK 712 020.

FIGURE 3. Hasty Map with 100-Meter Grid Lines Showing a Proposed LZ/Helispot

Figure 4 is a view of that grid square from the smart phone app MilGPS.

FIGURE 4. LZ Coordinate 712 020 as Observed on MilGPS App



Given 100-meter grid lines, increasing precision by adding one more digit identifies valves, hydrants, hazards and, utilities in preplans, reports and other documentation or the center field light pole as discussed previously. In each case, from one km to 10 meters, read the tenth between the known divisions, just like the pump panel gauge.

USNG map-making tools exist in standard geographic information systems (GIS) software. Engage your GIS personnel or whoever makes your response maps to add USNG grid lines to the next revision. In the interim, USNG may be made operational rather easily. GPS receiver—hand held and vehicle type—must be set to USNG or Military Grid Reference System (MGRS). If a smart phone is your electronic tool, search the app store for “MGRS” where free and low-cost options exist. On your desk computer, tablet, or your departments dispatch console, add a Web tool such as Mission Manager. Such web tools can convert street addresses to USNG or any coordinate system in seconds or display a USGN coordinate radioed in succinctly from an incident.

If you were to read one document to corroborate the benefits of USNG, read *Implementation Guide to the U.S. National Grid,* issued in September 2013, by the National Alliance for Public Safety GIS.

Per the National Fire Incident Reporting System, 33 percent of requests for service are not a street address. When a street address does not fit, the easiest solution to the fire service has available to them is the national standard USNG.

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One Grid to Rule Them All

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ONE GRID TO RULE THEM ALL

HOW THE U.S NATIONAL GRID SYSTEMS WORKS TO DELIVER PINPOINT ACCURACY FOR LATITUDE AND LONGITUDE COORDINATED

By Brett Ortler

In a country with global positioning satellite (GPS) software on every smartphone, we often take GPS technology for granted, and with it comes a dependence on longitude and latitude. But longitude and latitude has a dark side.

A mapping system is only as useful as it is universal, and when we used in disaster relief or in an emergency response situation. Longitude and latitude coordinates have serious limitations. Much of the problem has to do with notation—there are three different ways to record a position's longitude and latitude, but they aren't easily interchangeable. Converting between notations is time-consuming, especially in a widespread disaster, where several notations are likely being used simultaneously and many different coordinates need to be translated quickly.

This leads to a variety of problems. Converting coordinates wastes resources and manpower and can even lead to outright errors, causing assistance to be sent to the wrong locations entirely. More than anything, relying on longitude and latitude wastes time, and in an emergency situation, delays can cost lives.

This isn't just a problem for officials involved in search-and-rescue or disaster response. This is something that should concern every citizen interested in being prepared for a disaster: whether you're lost in the woods or trying to find your way amid the ruins of a ravaged city, you need a mapping system that is universal, simple, and precise. Thankfully, that system already exists: it's called the U.S. National Grid.

In this example National Grid coordinate, the grid zone is 15T. Zones in the western portion of the country have lower numbers; areas in the east have higher numbers.

PROBLEMS IN THE FIELD

The problems of longitude and latitude aren't obvious until you've seen them crumble in an emergency situation. No one recognizes this more than Steve Swazee, a 31-year veteran of the U.S. Navy and U.S. Marine Corps, and a vocal proponent of the U.S. National Grid. He helped coordinate the Pentagon's response to Hurricane Katrina, and he has seen the perils of relying on latitude and longitude in an emergency situation. "If you have a disaster, you need a grid," says Swazee. He notes that the strongest supporters of the National Grid System are people who have firsthand experience where an emergency response effort was unduly complicated because of the lack of a universal system.

Swazee cites the case of the crash of the Maryland State Police rescue helicopter, known as Trooper 2, as a text book example of the perils involved in depending on longitude and latitude. In that case, a state police helicopter went down in a heavily wooded area while transporting patients.

Emergency responders were soon given a set of longitude and latitude coordinates, but they were not informed that the coordinated were in the "degrees, minutes, and seconds" notation. Instead, the responders plotted the coordinates using a different notation, and they directed emergency crews to a location that was 30 miles away from the actual crash site. Meanwhile, a seriously injured survivor was waiting for rescue and wasn't attended to for two hours.

Given the complexity of referring to longitude and latitude, this an easy mistake to make, especially in a pressure situation. Even the National Transportation Safety Board's Accident Report inadvertently confused two different longitude and latitude notations; the report was later amended with an errata sheet to correct the error.

THE SPACE SHUTTLE COLUMBIA THE I-ET BRIDGE COLLAPSE

When the space shuttle Columbia disintegrated over a wide swath of the southern U.S., the recovery effort was slowed because of the inherent complexities of longitude and latitude. There were thousands of people involved in locating wreckage and the astronauts' remains, but many had little to no training on the different latitude or longitude notations. This led to confusion and delays—a serious problem since many shuttle components presented public health hazards. To make matters worse, the various local, state and federal agencies each had their own way mapping standards.

A similar incident occurred during the recovery effort for the I-35 bridge collapse in Minneapolis. While on a much smaller scale than the Columbia disaster, Swazee notes that the grid system used to coordinate search and rescue was redrawn four times.

AN OUTDATED SYSTEM

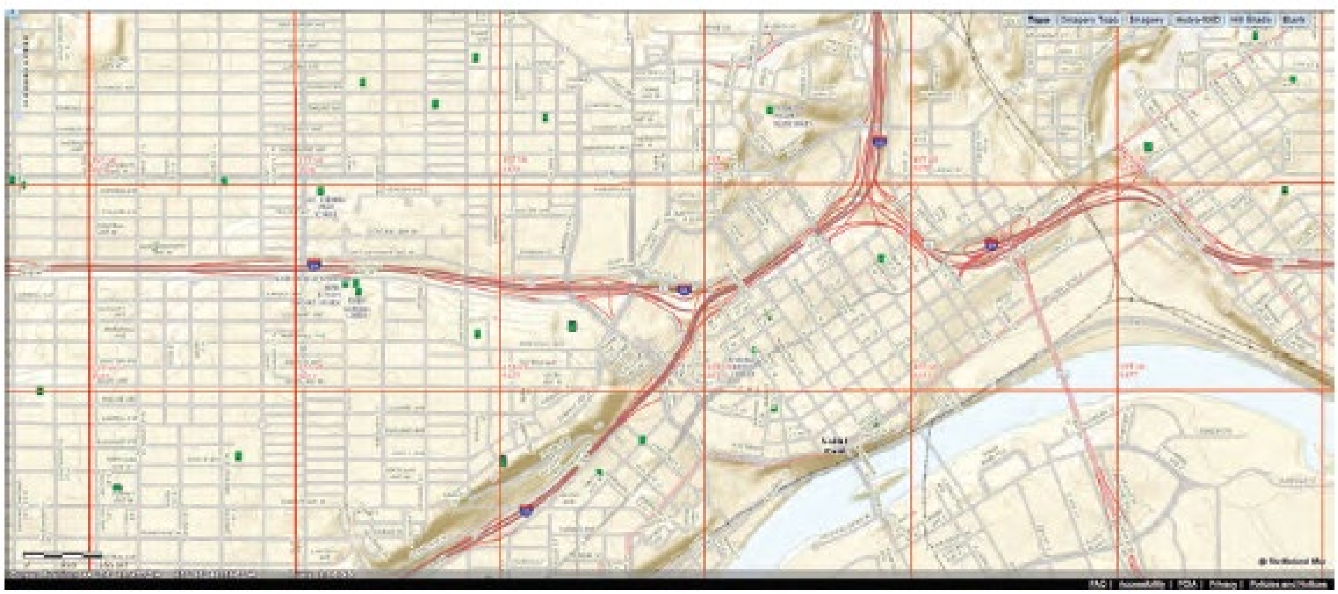
According to Swazee, the problem with longitude and latitude is much more than a notation issue. The system is essentially a relic of sea-faring navigation and was originally created to assist in navigation over long distances. When it's used on this scale, it's fairly straightforward, but most everyday uses are much more specific. More often than not, we're interested in knowing about a destination that is meters wide, not miles wide.

On a small scale, longitude and latitude become ever more difficult to use, largely because its coordinates consist of a base-60 system. Each degree of longitude and latitude can be broken into 60 minutes, which are further divisible into 60 seconds. Simply put, a base-60 system isn't intuitive.

ABOUT THE GRID

To avoid the inherent problems with the use of longitude and latitude, we need a new system altogether. Military planners realized this after World War II, so they created the Military Grid Reference System (MGRS), which covers the entire globe and provides users with a consistent system for obtaining a unique spatial address, with absolute precision, no matter the scenario. The U.S. National Grid is an offshoot of this system and covers only U.S. territories.

In this example, the regional code is VK and taking a quick look at the National Grid map gives us a pretty good idea of where our site is located—somewhere near the Twin Cities metropolitan area in Minnesota.



Local coordinates can have either four, six, eight or ten digits. The more coordinates you have, the more precise your measurement.

HOW IT WORKS

All National Grid coordinates consist of three simple parts: a grid zone designation, a regional code, and local area coordinates.

Consider the following National Grid coordinate: 15TVK919779.

The first part is a grid zone designation, which is a combination of a number (10-19) and a single letter (R-U). In all, there are about 35 grid zones in the contiguous U.S. Once you know your location's grid zone, you've got a pretty good idea of its geographic context nationwide.

In the example National Grid coordinate on page 32, the grid zone is 15T. Zones in the western portion of the country have lower numbers. Similarly, the farther south an area is, the closer its letter is to the beginning of the alphabet; areas further north are closer to the end of the alphabet.

REGIONAL CODES

Grid designations give you a rough idea of where you are; a reginal code gets you a lot closer. It locates a position within an area of 100,000 square meters. Regional codes consist of a combination of two letters; these combinations were ordered and labeled carefully to avoid repetition as much as possible. (Regional codes only repeat every 1,00 miles, or so. Making it highly unlikely that responders will mistake one nearby region code for another.)

In our example on page 33, the regional code is VK. Taking a quick look at the National Grid map gives us a pretty good idea of where our site is located—somewhere near Twin Cities metropolitan area in Minnesota.

ABSOLUTE PRECISION

The real power of the National Grid System comes from its local coordinates, which make up the last portion of a national grid coordinate and consists of a number with and even number of digits. Local coordinates can have either four, six, eight or ten digits. The more coordinates you have, the more precise your measurement. Each subsequent grid square is divided into ever smaller—more precise—squares.

A coordinate with four digits places you within a 1,000-meter square. Six digits place you within an area the size of a football field. (100 meters). Eight digits locate you within a ten-meter square (the size of an average house). And if you use ten digits, it'll place you within one square meter—the size of a manhole cover.

That's the real power of the National Grid System: With a number that's only one digit longer than a phone number (sans area code) you can locate a site within a 10-meter square.

READING THE MAP

In our example on the opposite page, the local coordinates read: 919779. Our coordinates are six digits long, so we'll be locating a site within 100 meters. It's helpful to think of these coordinates as two halves; there is an eastern component (919) and a northern component (779).

In a digital map-viewing program, like the free National Map software produced by the United States Geological Survey, one can simply zoom in from level to level. In our case, we start by looking for VK 97. Then we can zoon in even closer by zooming to VK 9177.

Finally, we simply need to zoom in even closer and find VK 919779. (Note that going from one level to the next simply involves taking one digit from half of the area coordinate.)

When we do, we find our destination: the Minnesota State Capital Building.

The local coordinates read: 919779. Our coordinates are six digits long, so we'll be locating a site within 100 meters. When we do, we find out destination: the Minnesota State Capital Building.

NOT JUST DIGITAL

Of course, in an emergency situation, we won't always have access to digital maps. Thankfully, National Grid coordinates are easy to use on paper maps that incorporate a Universal Transverse Mercator projection. This map projection style is quite common and is used by the U.S. armed services., and on many other maps.

Using the National Grid coordinates on a paper map is simple. The first rule in important: When reading a local area map you always read right (east) first, then up (north). When reading on a local map, it's often helpful to think of the coordinates as decimals. So, in our example, the numbers would read 91.9 and 77.9. The first numbers of each are half are very important; they are referred to as principal digits, and they tell you the specific grid line to look for in the local map. So, we need to read right (east) first, and we need to look for the eastern gridline 91. Then we simply have to look 90 meters further east. From there, we read up to northern gridline 77. This is fairly easy to do with just a map alone, but the National Grid folks have also produced specific rules to make things even easier.

WHY USE THE GRID?

Without question, the National Grid is a better option than latitude and longitude in an emergency response situation, but what about the rest of us? Why should the average citizen care? According to Swazee, there are two primary reasons: First of all, in a largescale disaster zone, common geographic landmarks (street signs and the like) are often obliterated. If you're familiar with the National Grid System, you can still reliably convey geographic information. This is important, because in many such disasters, the U.S. National Guard and other U.S. Armed Forced are often involved in the recovery effort, and they are well-versed in the National Grid System.

In addition, in many of the-end-of-the-world-as-we-know-it situations, not a given GPS technology will survive. Like any other type of technology, it needs to be carefully maintained. Even if the system remains up and running, it's not necessarily a given that you'll be able to access it.
After all, GPS units are power-hungry devices, and it's not a given that your hardware will survive a disaster or the rough-and-tumble-weeks and months after one.

More than anything, the biggest argument in favor of the National Grid is its simplicity. As a base-10 system, it's intuitive and easy to use. Better yet, it's free. You can download and print maps from the U.S. Geological Survey's National Map project at: http://viewer.nationalmap.gov/viewer.

The Minnesota Marker System and Implementation of the National Grid Unfortunately, the National Grid System is not fully implemented nationwide. The U.S. Armed Services use it, but on the state and local level, there is a patchwork of different systems in place. According to Swazee, the biggest is institutional inertia. When organizations have used the same format for years—they are unlikely to change willingly.

Thanks to the benefits of the U.S. National Grid system, that's starting to change, however. Some states have begun adopting the U.S. National Grid as their preferred mapping system, and a pilot program in northern Minnesota has recently garnered a good deal of attention.

Launched in northern Minnesota's arrowhead region, the Minnesota Marker is a pilot program where signs with U.S. National Grid coordinates were placed on far-flung snowmobile trails. Stranded snowmobilers who happened upon the signs were instructed to call 911 and simply read the number on the sign. The project has received a good deal of positive attention and has already aided in at least one rescue.

While Swazee emphasized that the program was only a trail, it is already serving as a model for several others, and it seems indicative for the future of the National Grid program as a whole. Given its power and simplicity, the U.S. National Grid seems destined to become a staple for emergency responders and preppers alike.

Brett Ortler is a writer and editor based in Minnesota.

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