

coordinate indicates the distance to the right (east) of the southwest corner of the 100,000 meter square and the last half indicates distance above (north of) the same corner of the 100,000 meter square.

When working within the area of a single 100,000 meter square, it is customary to omit the first four digits [3PNW in our example]. If there is any doubt as to the UTM Grid Zone or 100,000 meter square, give the entire coordinate.

For maps of the United States, the entire UTM grid system is not needed, and the U.S. Geological Survey has simplified the UTM coordinate system for its quadrangle maps. With everything in the U.S. located in the northern hemisphere, only the grid zone and the distance east and north of the starting point are needed to specify a location. The central meridian in each grid zone is assigned a "false easting" value of 500,000 meters and the Equator is assigned a "false northing" value of 0. Other than these changes, all standard conventions for using the UTM coordinate system are followed. Thus, there is a direct and translatable relationship between simplified UTM coordinates derived from a USGS quadrangle and the formal UTM coordinates of the full UTM system.

The U. S. Public Land Survey

The U.S. Public Land Survey grew out of the efforts of an emerging nation to establish an orderly way of defining legal boundaries of land ownership. The system derived for identifying land parcels and land ownership is important to anyone working in any natural resource field in the United States. It differs from both the State Plane and UTM coordinate systems in that its basic unit is an area, an acre, not a distance. Also, it is defined on the ground, and is not a mathematical grid which can be easily superimposed on a map projection.

The original responsibility for administration was assigned to the General Land Office when it was established in 1812. This assignment survived the reorganization of 1836. In 1946, the General Land Office and the Grazing Service were combined to form the Bureau of Land Management within the Department of Interior.

The general pattern of the Public Land Survey (PLS) is shown in Figure 2-8. The initial point [point of beginning] for Michigan is slightly northeast of Jackson. From this initial point, a **Principal Meridian** was established in a north-south direction. This was done by determining the location of the sun at its highest point in the sky, at noon, thereby establishing the direction of true south. A **Base Line** was then established in an east-west direction, perpendicular to the Principal Meridian. A set of **Standard Parallels** was then established 24 miles apart and parallel to the Base Line. Next, starting at the Principal Meridian, a set of **Guide Meridians** was established 24 miles apart along each Standard Parallel. Due to the convergence of true north lines towards the pole, the resulting "24x24" mile blocks are narrower on the north side than on the south.

Each of these nominally 24x24 mile blocks was then divided into sixteen **Townships**, each nominally six miles on a side. A specific township is identified by its location north or south of the Base Line, and east or west of the Principal Meridian. To minimize the chance of confusion, a township is always identified first by its location north or south of the Base Line, and then by its "range" east or west of the Principal Meridian. The shaded township in the diagram is correctly identified as Township 3 North, Range 2 West, or more simply as: T3N, R6W. Just as the nominally 24x24 mile blocks are somewhat less than 24 miles wide on the north side, so the townships are seldom exactly six miles across on their north sides.

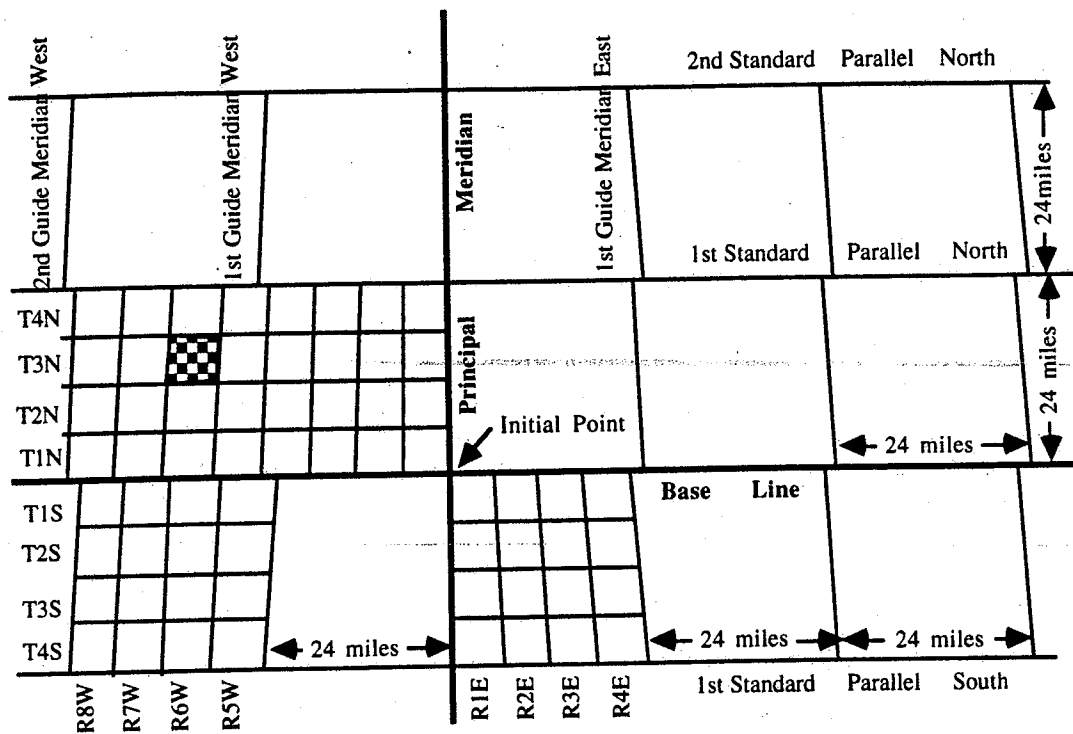


Figure 2-8. General organization of the system of public land surveys in the United States.

Townships are divided into **Sections**, nominally one mile on a side. Sections are numbered from one, in the northeast corner, to thirty-six, in the southeast corner, as shown in Figure 2-9. The small numbers on the section lines indicate the order in which they were surveyed. Note that Section 36 was surveyed first, and the surveyor then worked north and west, with Section 6, in the northwest corner, being surveyed last. Because of this, sections

6	60	5	44	4	33	3	22	2	11	1
59		58		43		32		21		10
7	57	8	42	9	31	10	20	11	9	12
56		55		41		30		19		8
18	54	17	40	16	29	15	18	14	7	13
53		52		39		28		17		6
19	51	20	38	21	27	22	16	23	5	24
50		49		37		26		15		4
30	48	29	36	28	25	27	14	26	3	25
47		46		35		24		13		2
31	45	32	34	33	23	34	12	35	1	36

Figure 2-9. Method of numbering sections within a township.

in the northern tier [1 through 6] and western column [6, 7, 18, 19, 30 & 31] are often larger or smaller than sections elsewhere in the same township. In some cases, sections may be missing altogether.

The Public Land Survey began when the standard way to measure horizontal distances was with a length of chain. A standard **chain** was, and is, 66 feet long and contains 100 links. Eighty chains is equivalent to a statute mile [5,280 feet]. Ten square chains was a convenient measure of area, and called an **acre**. A bit of simple arithmetic reveals that a full section, one mile on a side, contains 640 acres.

Because many land parcels are much smaller than a square mile, conventions developed for subdividing sections. The first subdivision divided a section into four parts by bisecting the section in both north-south and east-west directions. These quarter sections are referred to by their positions in the northeast, southeast, southwest, or northwest corners of the section. Each corner of a quarter section which is not a section corner is called a "quarter-corner," and there is a quarter-corner near the middle of each section line, and one near the center of the section which is not labeled in Figure 2-10.

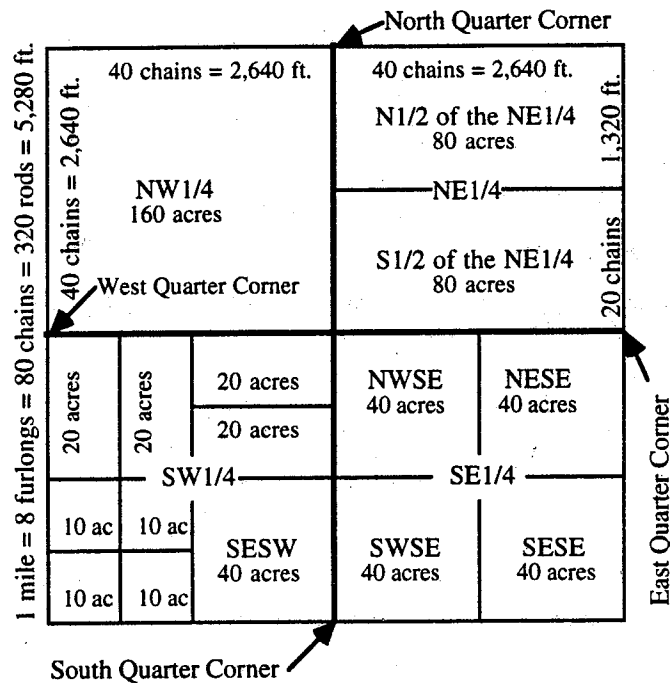


Figure 2-10. Subdivisions of a Public Land Survey section.

Each quarter section is further divided into quarters, identified in a similar manner. These quarters of quarters, or sixteenths, each contain 40 acres. One example of a 40-acre parcel is the Central Campus of The University of Michigan, bounded by State Street on the west, and by North, East, and South University Avenues on the other three sides. This "forty" is identified in the PLS as the northwest quarter of the southwest quarter of Section 28, Township 2 South, Range 6 East, but more commonly written as the:

NW 1/4 of the SW 1/4 of Sec. 28, T2S, R6E
 or simply as the: NWSW Sec. 28, T2S, R6E.

PLS descriptions can be confusing until you recognize that they are written "backwards," starting with the smallest unit and proceeding to the larger unit. It may seem trivial, but the descriptions are always given in the order shown above. **Land descriptions must be in legally acceptable terms.**

<u>Right</u>	<u>Wrong</u>	<u>Right</u>	<u>Wrong</u>
SW 1/4	WS 1/4	T2S, R6E	R6E, T2S

Additional information on land descriptions can be found in most surveying texts, and on the first few pages of any of the county Plat Books published by Rockford Map Publishers, Rockford, Illinois. Such Plat Books are a useful source of land ownership information and are available in many states.

Review Questions

1. How do the parallels and meridians relate to latitude and longitude?
2. Where is the starting point used to define longitude on most maps made in the western hemisphere?
3. What is a map projection?
4. What are the three qualities most users expect from a map?
5. How do the Mercator, Transverse Mercator, Lambert Conformal and Polyconic Projections compare with respect to the three qualities identified in your answer to Question 4?
6. Within the U.S. Public Land Survey, what is meant by a:
 - a. township?
 - b. section?
 - c. "forty"?
 - d. quarter-corner?
7. Using Figure 18 on page 2-6 as a guide, locate and outline each of the following land parcels:
 - a. NW $\frac{1}{4}$ of Section 15
 - b. SESW, Section 21
 - c. NENW, Section 28
 - d. E $\frac{1}{2}$ of the NENE of Section 27
8. How large is one acre?
9. Within the U.S. Public Land Survey system, how many acres are there in a perfect:
 - a. section?
 - b. quarter-section?
 - c. township?
10. What is the fundamental unit of the UTM grid system?
11. Where is the origin of the UTM grid system?
12. How large is one hectare?
13. What is the difference between an acre and a hectare?