Section Definitions

Public Land System Tutorial

Public Land System Study Guide

Public Land System Wikipedia

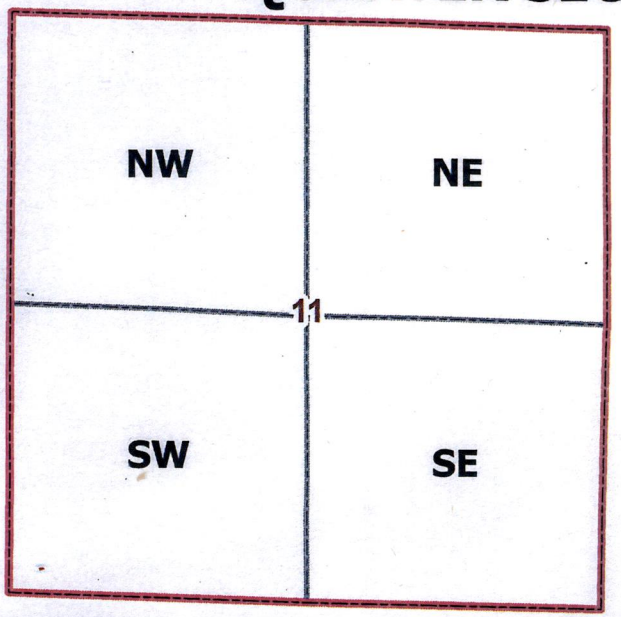
DANE COUNTY TOWNSHIP SECTION, QUARTER SECTION AND QUARTER QUARTER SECTION BREAKDOWN - PUBLIC LAND SURVEY SYSTEM (PLSS)

SECTIONS

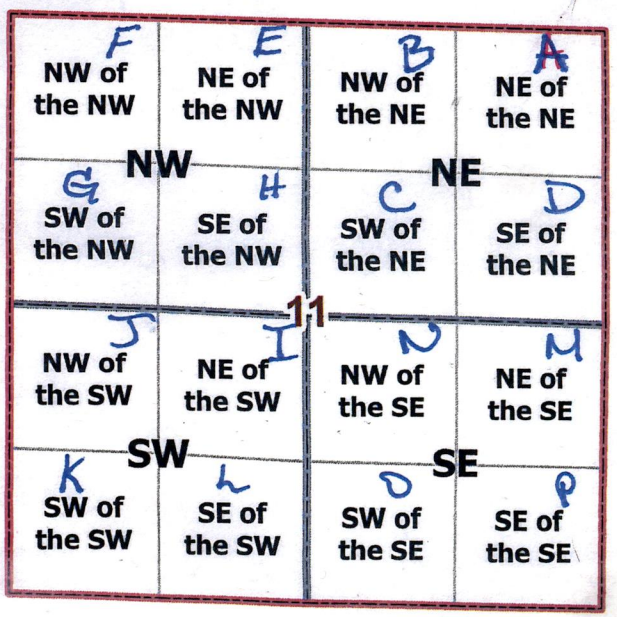
06	05	04	03	02	01
07	08	09	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

T07N R07E

QUARTER SECTIONS



QUARTER QUARTER SECTIONS



SECTION DEFINITIONS

SECTION DEFINITIONS FOR LAND SURVEYORS

section-[1] That portion of a line of levels which is recorded and abstracted as a unit. A section always begins and ends on a bench mark, either temporary or permanent. when in the main line of levels or on a spur line of levels. In the case of a spur to a point, the elevation of which is determined by means of an extra foresight, the section must begin on a temporary or permanent bench mark and end on the point on which the leveling rod was held when the extra foresight was taken.[2] [USPLS] The unit of subdivision of a township; normally a quadrangle one mile square. with boundaries conforming to meridians and parallels within established limits, and containing 640 acres as nearly as possible.

section, fractional [USPLS]—A section which, in its original form, contained one or more subdivisions of less than forty (40) acres due to irregular exterior boundaries, or due to the encroachment of a meandered body of water or other land which could not properly be surveyed or disposed of as an aliquot part of that section. Sections are also frequently rendered fractional in closing the surveys on the north and west boundaries of the township because deficiencies in measurement caused by error of survey or convergence of meridians are placed in the half-mile closing against these township boundaries. When a fractional section. where opposite corresponding quarter-section corners have not been or cannot be fixed, due to a meanderable body of water, Indian boundary line, or by an approved claim at variance with the regular legal subdivisions, as represented upon the official plat, are subdivided by use of due north and south or east and west lines, as the case may be. See also ***township fractional.*** **(https://learncst.com/township-definitions/)**

section, half [USPLS]—Any two quarter sections within a section which have a common boundary; usually identified as the north half, south half, east half, or west half of a particular ection.

section, normal–[1]The curve in which a plane through the normal at a specified point of a surface intersects that surface. [2] The intersection of a solid with a plane through a normal to the surface of the solid.

section, quarter [USPLS]—One-fourth of a normal section, formed by dividing a section into four parts by lines connecting the opposite quarter-section corners, and containing 160 acres as nearly as possible. The quarter section is a unit of description of the public lands; thus, the "northeast quarter, section 10" is the legal description of that portion of section 10 of a given township lying east of the north-south center line and north of the east-west center line of that section.

section, quarter-quarter [USPLS]—One-sixteenth of a normal section, formed by dividing a quarter section into four pans by lines connecting the midpoints of opposite sides, and containing 40 acres as nearly as possible. The quarter-quarter section is a unit of description of the public lands; thus the "northeast quarter of the northeast quarter, section 10" is the legal description for that portion of section 10 of z given township lying east of the north-south center line of the northeast quarter and north of the east-west center line of the northeast quartet of that section.

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Public Land System Tutorial

Tutorial on the Public Land Survey System Descriptions

From the Wisconsin Department of Natural Resources

When the land was first surveyed in Wisconsin, it was divided into a grid as shown in Figure 1. Each grid cell represents approximately 36 square miles (the measurements were not always precise due to the instruments the surveyors were using, among other limitations). This grid system is known as the Public Land Survey System (PLSS). An example of a legal description using the PLSS is given below.

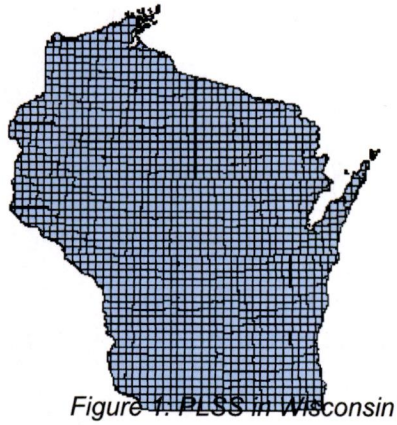


Figure 1: PLSS in Wisconsin

N 1/2 SE 1/4 SW 1/4, S24, T32N, R18E

The descriptions are generally read from front to back. For example, the description above would be read "The north 1/2 of the southeast quarter of the southwest quarter of section 24, township 32 north, range 18 east."

However, the easiest way to *interpret* descriptions is from ***back to front*** (or, right to left). To determine where the property is, we will break the description down into each of its elements, starting from the back and working our way to the front. We'll be starting with the most general labels and then move into the smallest, most specific labels.

Each cell in the grid is identified by a township and range number. The ***range number*** identifies how many cells the property is to the east or west of a starting point. Both eastern and western ranges are possible in Wisconsin, as shown in Figure 2. The range identified in our example legal description, R18E, is highlighted in Figure 3.

N 1/2 SE 1/4, SW 1/4, S24, T32N, **R18E**

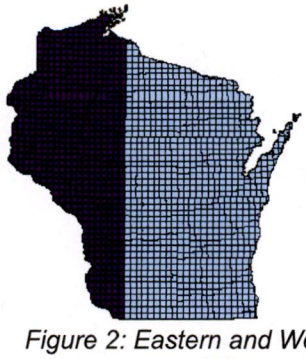


Figure 2: Eastern and Western Ranges in Wisconsin

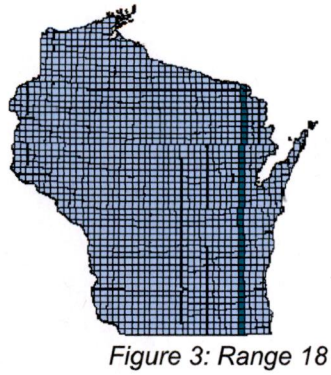


Figure 3: Range 18 East

The ***township number*** identifies how many cells the property is to north or south of a starting point. Only northern townships are possible in Wisconsin. The township identified in our example legal description, T32N, is highlighted in Figure 4.

N 1/2 SE 1/4, SW 1/4, S24, **T32N**, R18E

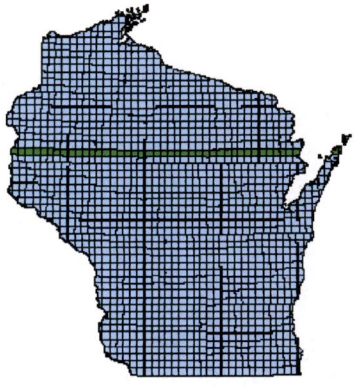


Figure 4: Township 32 North

Each 36-square-mile parcel identified by a township and range number is further divided into 36 ***sections***, each section theoretically being 1 square mile, or 640 acres. The cells are numbered "boustrophedonically", or "as the cow plows", which means that the numbers wrap around in an "s" shape. Such a numbering system was easier for the surveyors to use when they were doing the original surveying. Our example refers to section 24, which is highlighted in red in Figure 5.

N 1/2 SE 1/4, SW 1/4, **S24**, T32N, R18E

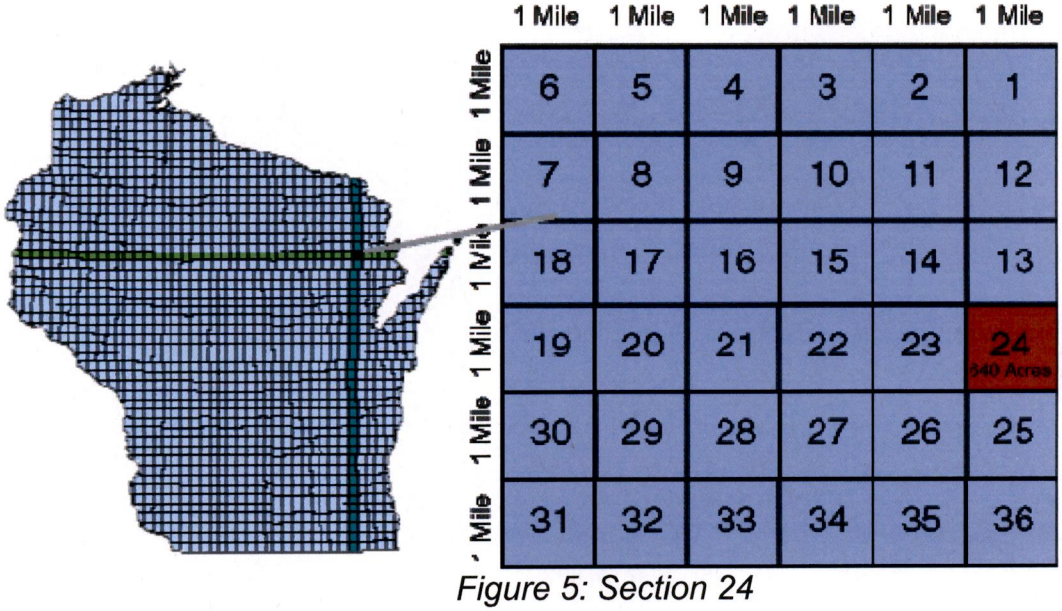


Figure 5: Section 24

Many parcels of land are smaller than an entire section. They sometimes are the size of a ***quarter section***. Each section is divided into 4 quarters, each being 1/4 square miles, or 160 acres. Each of the quarter sections is labeled with a quadrant direction. In our example, the description is referring to the southwest quarter section of section 24, which is highlighted in yellow in Figure 6. Again, be sure to read the description from back to front so you know to which quarter section the description is referring.

N 1/2 SE 1/4, **SW 1/4**, S24, T32N, R18E

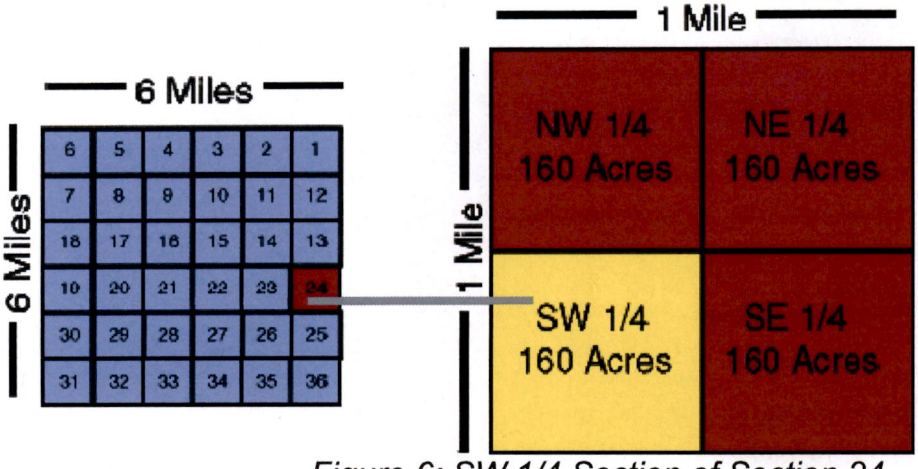


Figure 6: SW 1/4 Section of Section 24

Quarter sections can be further divided into 4 more parts (called the ***quarter-quarter section***), each being 1320 feet in length (1/4 of a mile), which results in 1,742,400 square feet, or 40 acres. Our description tells us that we are looking for the SE quarter-quarter section. Because we already know from our last step that we are in the SW quarter section, we know to now locate the SE quarter-quarter section in the SW quarter, as shown in blue in Figure 7.

N 1/2 **SE 1/4**, SW 1/4, S24, T32N, R18E

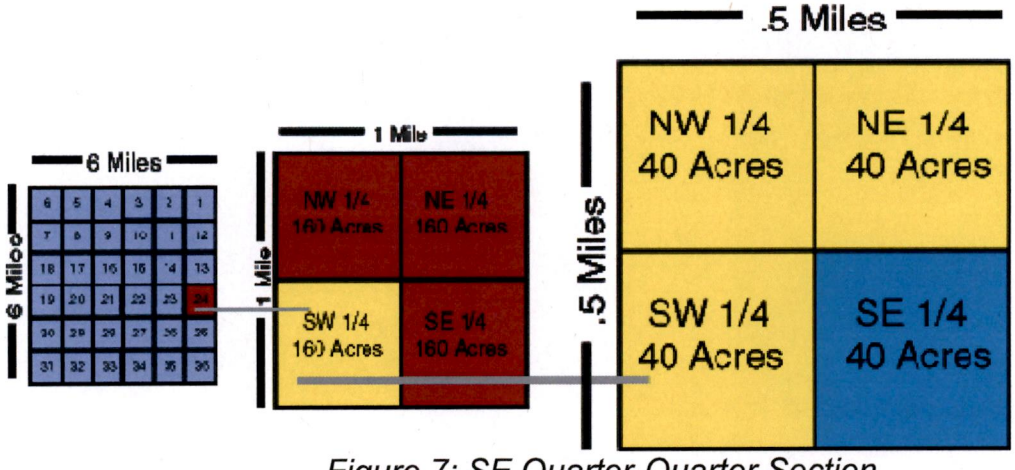


Figure 7: SE Quarter-Quarter Section

Finally, we also have a reference to a ***half*** of a quarter-quarter section in our example. Halves can be used instead of, or in addition to, quarters to describe property location. In the case of our example legal description, the half quarter-quarter section is 20 acres (though if the legal description had read N 1/2, S24, T32N, R18E, the area of the half would have been 320 acres). Halves can be north, south, east or west. The north half of the southeast quarter-quarter section is highlighted in orange in Figure 8.

N 1/2 SE 1/4, SW 1/4, S24, T32N, R18E

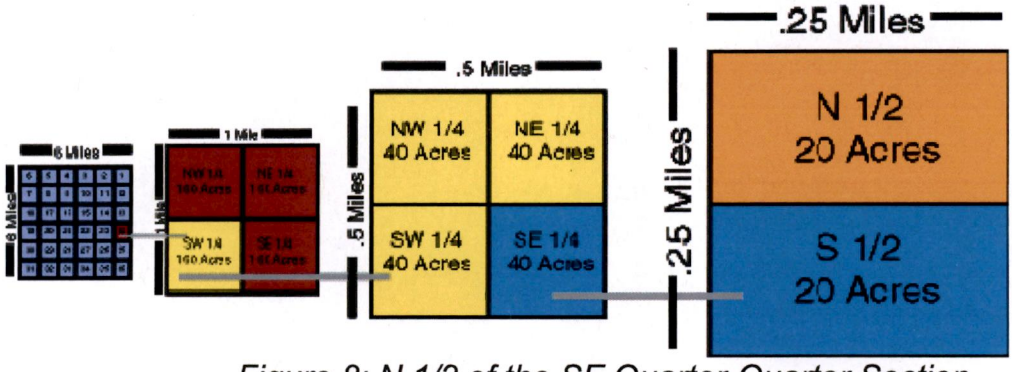


Figure 8: N 1/2 of the SE Quarter-Quarter Section

Figure 9 shows the location of the land we've been locating in context. You now know how to locate land using a PLSS description!

N 1/2 SE 1/4, SW 1/4, S24, T32N, R18E

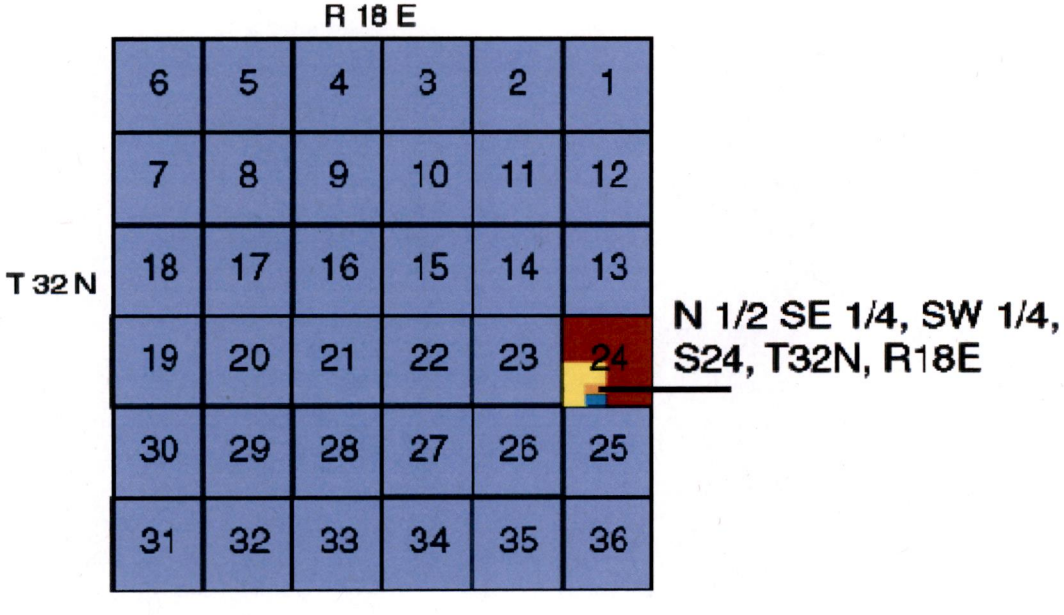
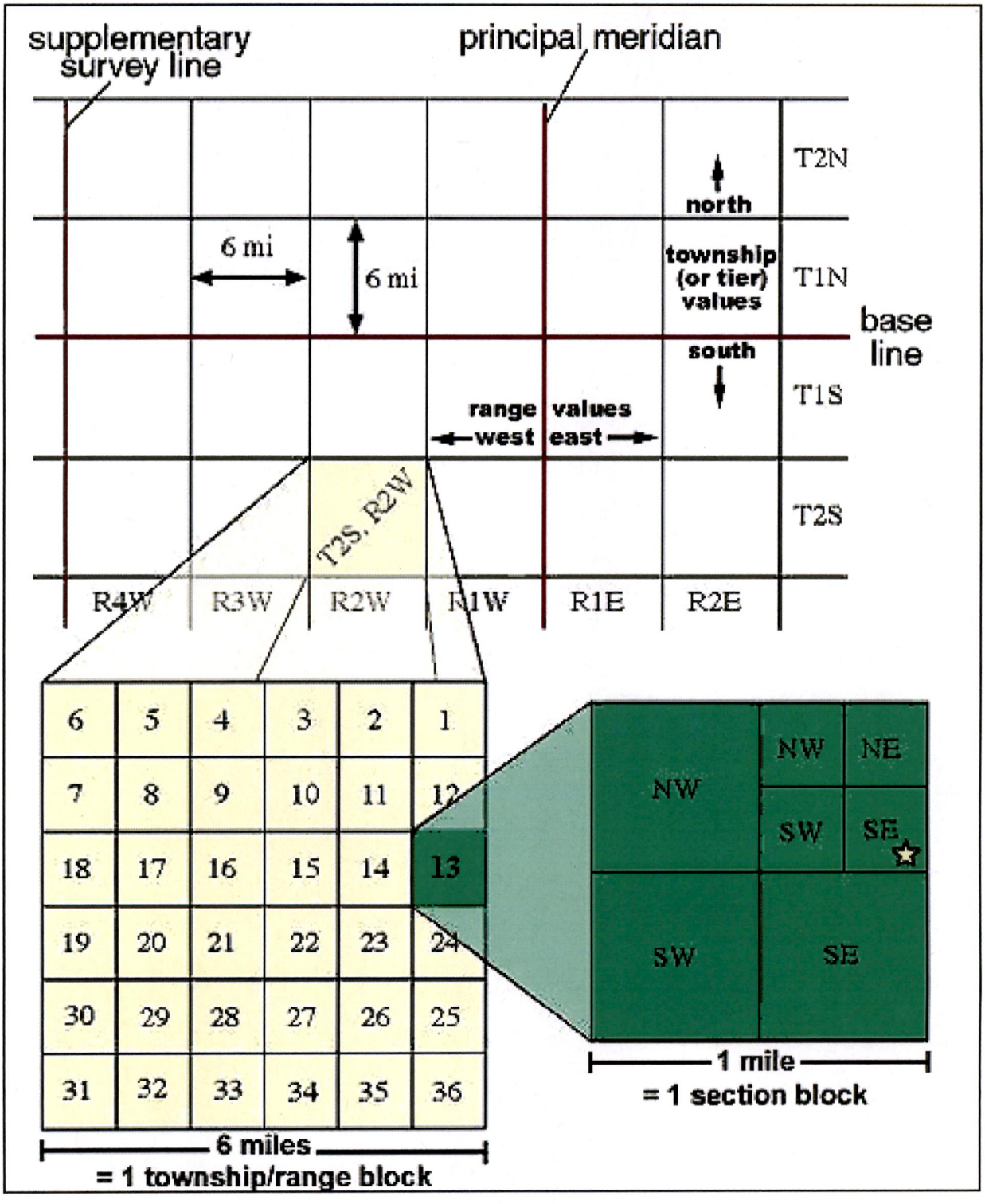


Figure 9: Location of N 1/2 SE 1/4, SW 1/4, S24, T32N, R18E

THE PUBLIC LAND SURVEY SYSTEM POSTER
TOWNSHIP AND RANGE



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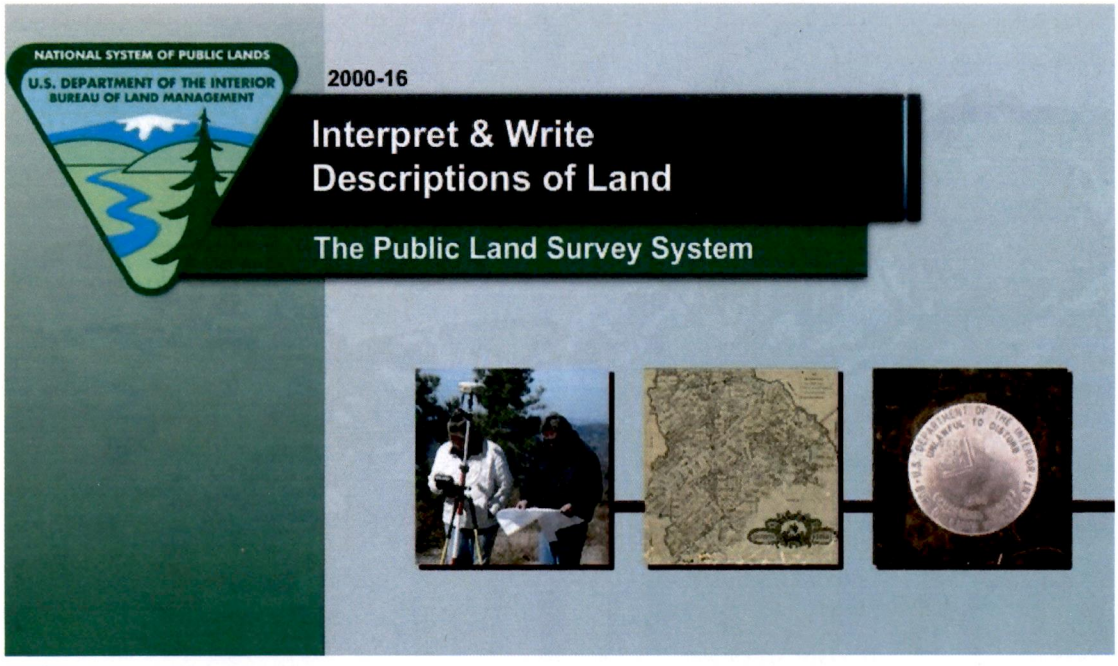

Interpret and Write Descriptions of Land: The Public Land Survey System

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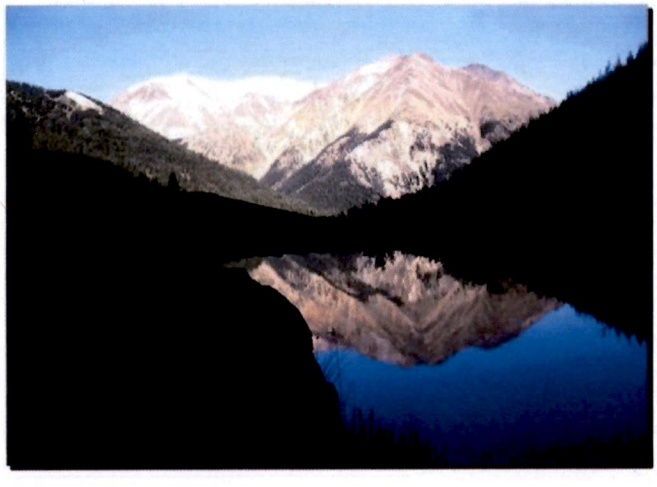
MODULE OVERVIEW



This module provides the foundational concepts and terminology of the Rectangular Survey System:

interpreting land location on a map, writing a description of the land using the nomenclature of the Public Land Survey System, and emphasizing the importance of punctuation placement.

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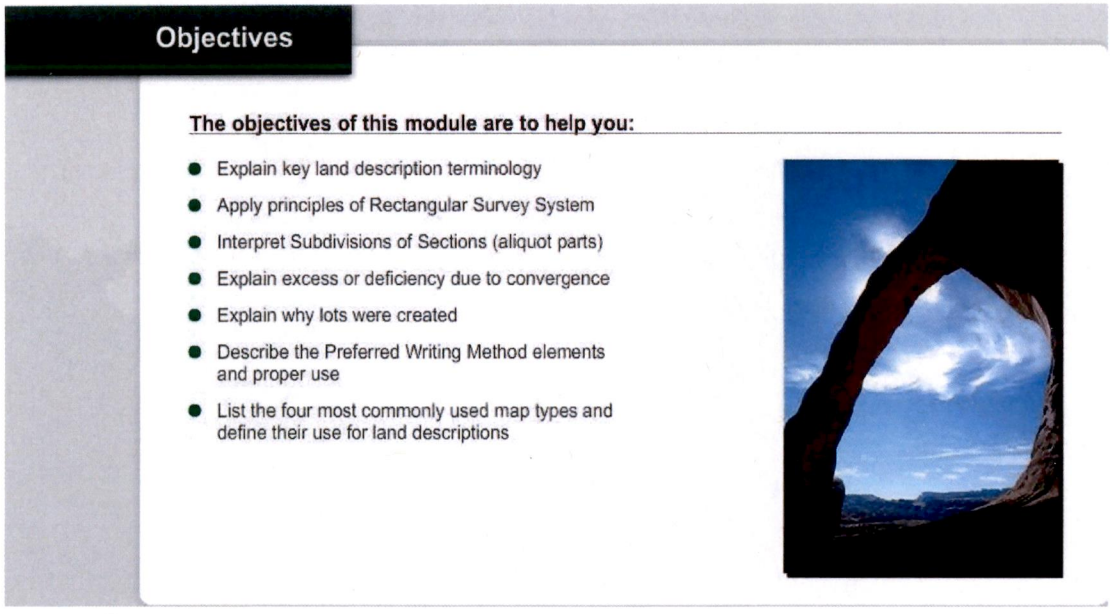
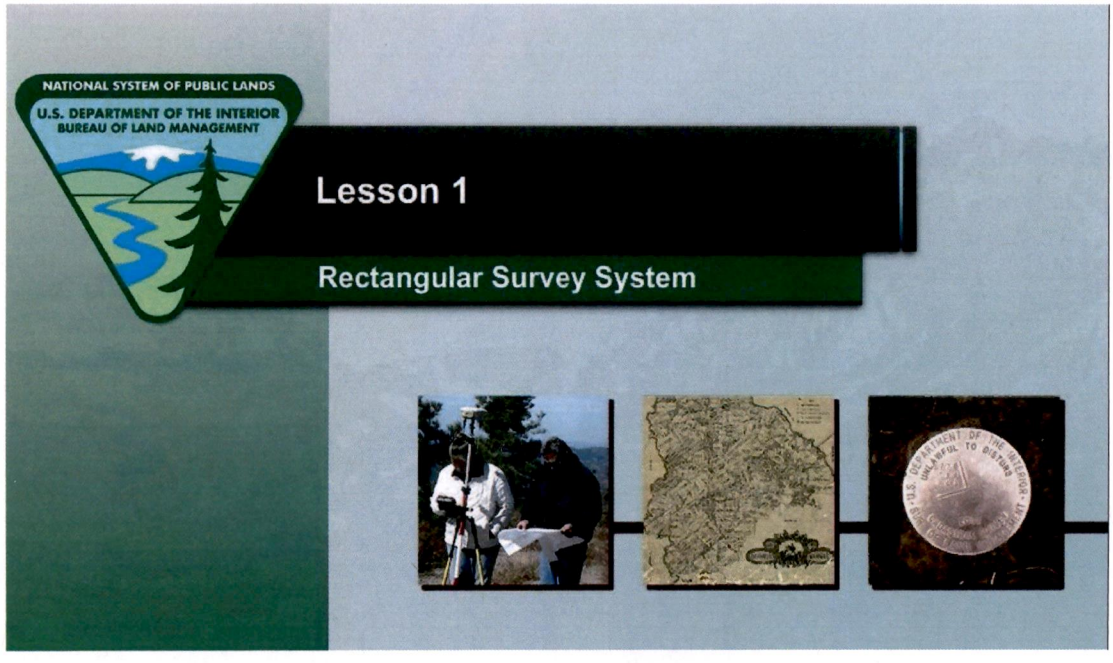


The objectives of this module are to help you: explain key land description terminology, apply principles of Rectangular Survey System, interpret subdivisions of sections (aliquot parts), explain excess or deficiency due to convergence, explain why lots were created, describe the preferred writing method elements and proper use, and list the four most commonly used map types and define their use for land descriptions.



Lesson 1: Rectangular Survey System

Objectives

After completing this lesson, you should be able to:

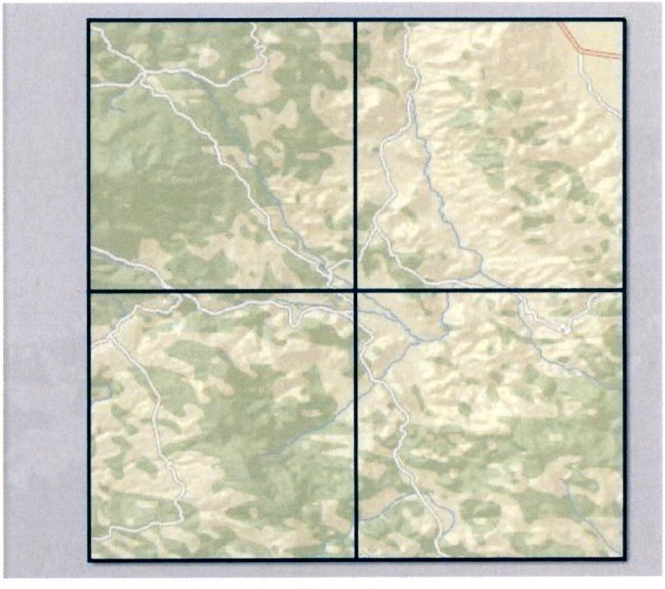
- Explain key land description terminology
- Apply principles of Rectangular Survey System
- Interpret Subdivisions of Sections
- Describe the Preferred Writing Method elements and proper use

After completing this lesson, you should be able to: explain key land description terminology, apply principles of Rectangular Survey System, interpret subdivisions of sections, and describe the preferred writing method elements and proper use.

Rectangular Survey System

- Provides simplicity to interpreting and describing any piece of land

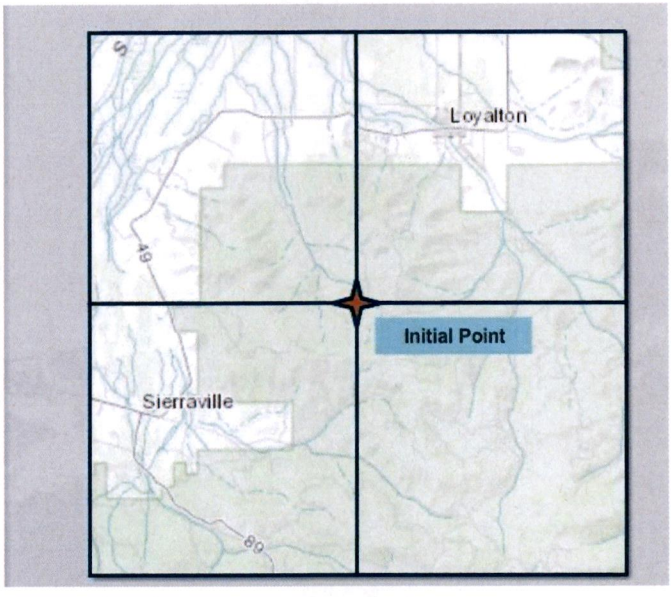
Specifications Reference: Chapter II



The Rectangular Survey System was created to provide simplicity to interpreting and describing any piece of land, located on a map or on the ground, and where practicable, its units are in a rectangular grid form. Rectangular Survey information can be found in Chapter II of the Specifications.

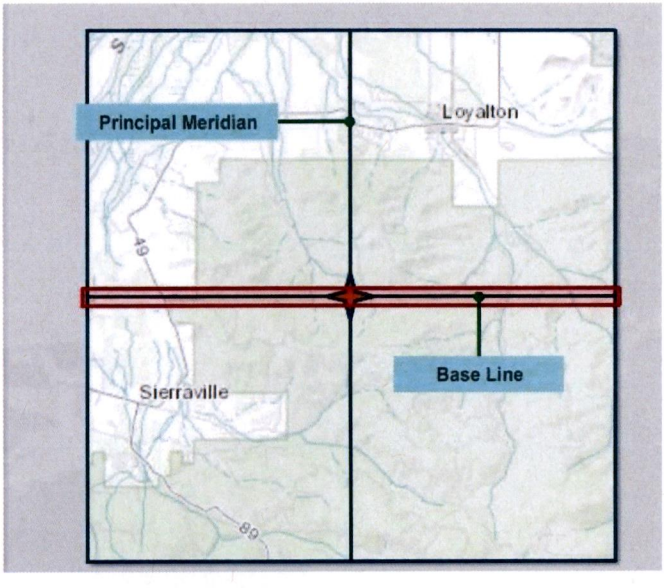
The Rectangular Survey System is a grid of lines based upon a true meridian and is originated from an ***initial point***.

The surveyor establishes an initial point.



The Rectangular Survey System is basically a grid of lines based upon a true meridian and is originated from an initial point. To begin the grid, the surveyor establishes an initial point from which to begin surveying.

From the initial point, the surveyor extends a north-south line called a ***Principal Meridian*** and a ***Base Line*** running east and west parallel to the equator.



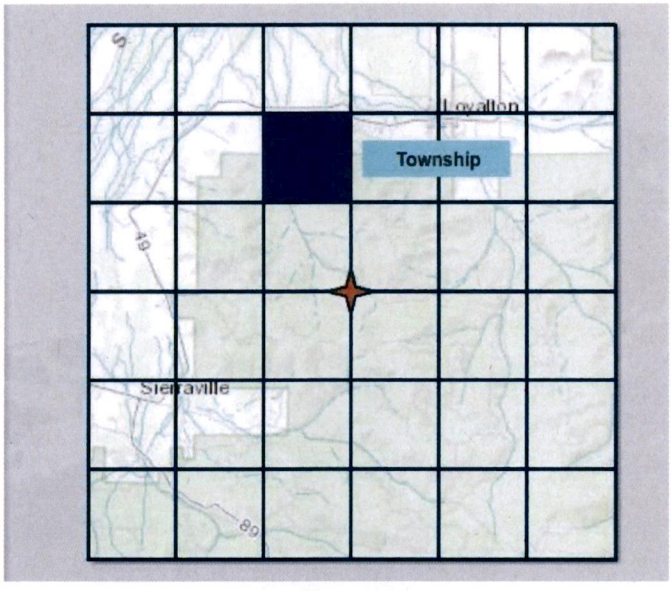
From the initial point, the surveyor extends a north-south line called a Principal Meridian and a Base Line running east and west parallel to the equator.

Along the north-south line, the surveyor establishes ***township lines*** north and south from the initial point.

Each line is created at 6 ***nominal mile intervals***.

Along the east-west line, the surveyor establishes ***range lines*** east and west from the initial point also at 6 nominal mile intervals.

Each of these 6 by 6 nominal mile squares is called a ***township***.

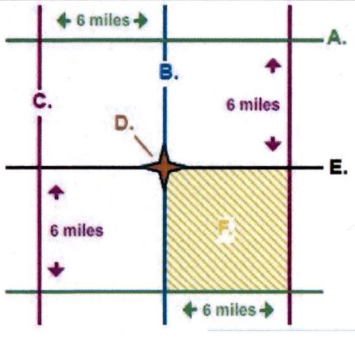


Along the north-south line, the surveyor establishes township lines north and south from the initial point. Each line is created at 6 nominal mile intervals. Along the east-west line, thesurveyor establishes range lines east and west from the initial point also at 6 nominal mile intervals. Each of these 6 by 6 nominal mile squares is called a township.

SkillCheck

Match the letter to its term.

	Township
	Base Line
	Township Line
	Initial Point
	Range Line
	Principal Meridian



Correct Answers: A. Township Line, B. Principal Meridian, C. Range Line, D. Initial Point, E. Base Line, and F. Township.

SkillCheck

A Township is how many nominal miles wide and high?

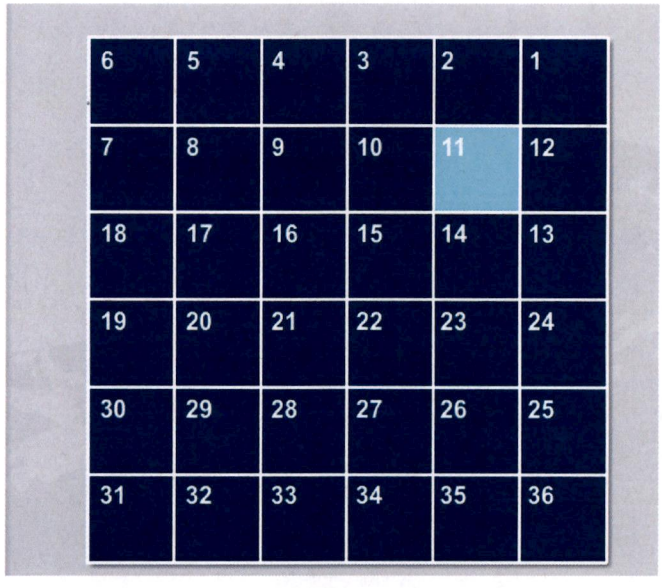
- A. 1
- B. 5
- C. 6
- D. 10

Correct Answer: B. 5

Each township is subdivided into 36 sections of one square nominal mile each.

Section numbering begins at number one in the upper right northeast.

Sections are numbered right to left and left to right down the rows until reaching the lower right southeast section.



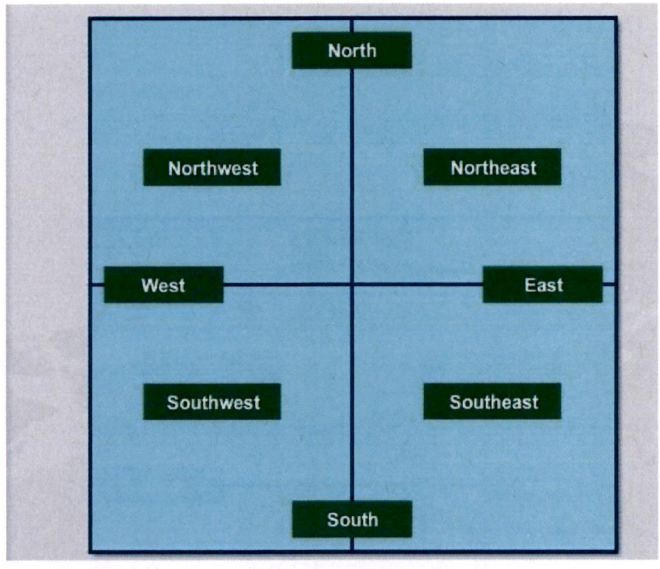
Each township is further subdivided into thirty-six sections of one square nominal mile each. Section numbering begins at number one in the upper right northeast. Sections are numbered right to left and left to right down the rows until reaching the lower right southeast section. This wandering arrangement is based on how farmers plowed their land or "as the ox plows." The benefits of this numbering system guarantee that a section is always adjoined by its preceding and succeeding section. A section will never end up next to a confusingly numbered section in an adjoining township.

Each township is subdivided into 36 sections of one square nominal mile each.

Section numbering begins at number one in the upper right northeast.

Sections are numbered right to left and left to right down the rows until reaching the lower right southeast section.

When describing portions of regular sections, ***aliquot*** parts, or exact divisions of the whole are used. Quarters are described in their relative position within the section.



When describing portions of regular sections, aliquot parts, or exact divisions of the whole are used. In other words, quarters are described in their relative position within the section. Any parcel listed as northeast, northwest, southwest, or southeast is a quarter part. A combination of aliquot parts, for example two equal quarters, can be described as half of a section. Aparcel reading north, south, east, or west is a half part. Later you will learn the use of "half of a half" descriptions that must be avoided in writing descriptions ofland.

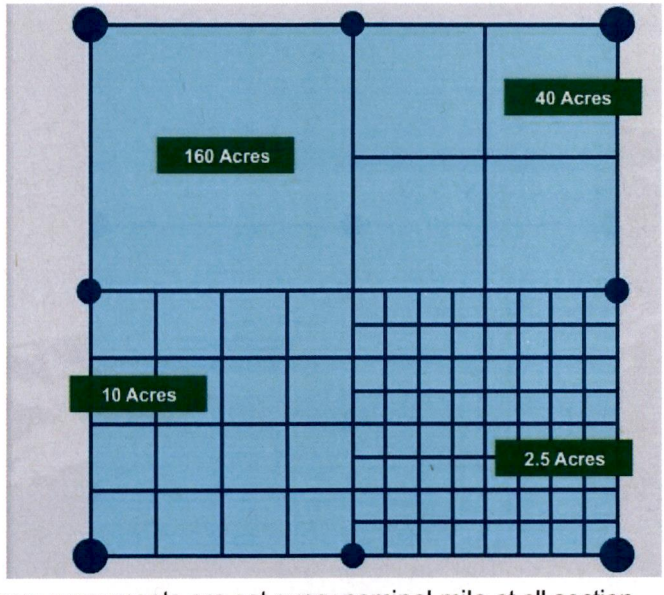
Along the township and range lines, ***corner monuments*** are set every nominal mile at all ***section corners***.

Monuments, called ***quarter corners***, are set at mid-point between each mile marker.

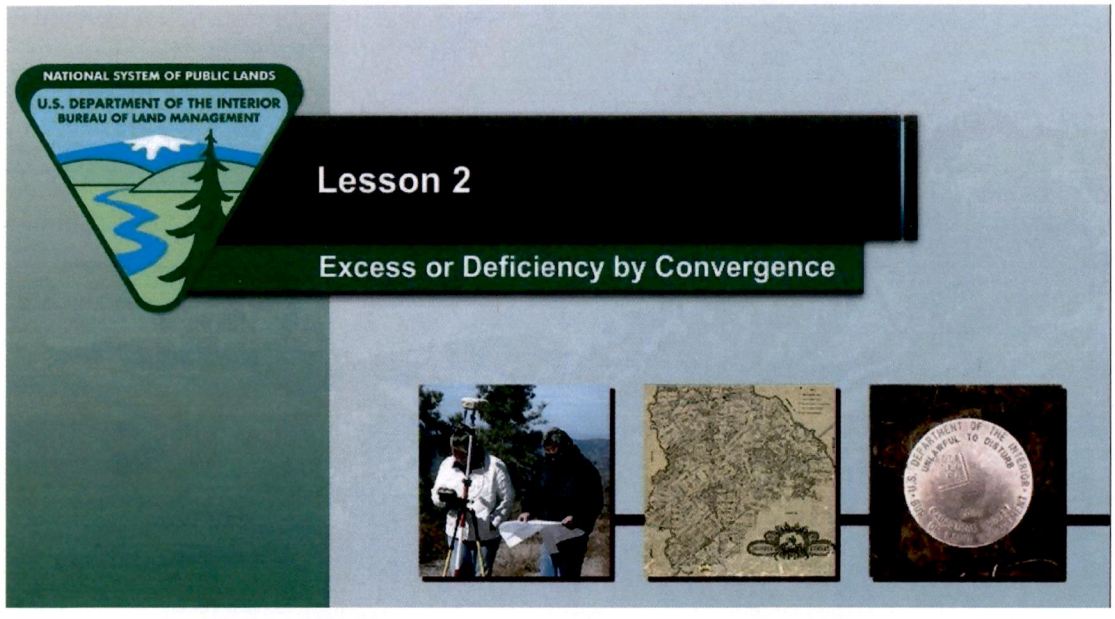
These monuments are called quarter corners because when connected, they form the legal boundaries that divide each section into quarters.

Quarter parts can be subdivided into quarters equal to 40 acres each. The 40 acre quarter-quarter is considered the standard land unit.

Quarters can then be subdivided into quarters equal to 10 acres each. These 10 acre quarters can be subdivided into quarters equal to 2 ½ acres each.



Along the township and range lines, corner monuments are set every nominal mile at all section corners. Monuments, called quarter corners, are set at mid-point between each mile marker. These monuments are called quarter corners because when connected, they form the legal boundaries that divide each section into quarters. Quarter parts can be further subdivided into quarters and each quarter equal to 40 acres. The 40 acre quarter-quarter is considered byBLM as the standard land unit for management purposes. However, these quarters can then be further subdivided into quarters and each quarter equals to 10 acres. These 10 acre quarters can then be further subdivided into quarters and each of these quarters is equal to 2 ½acres.



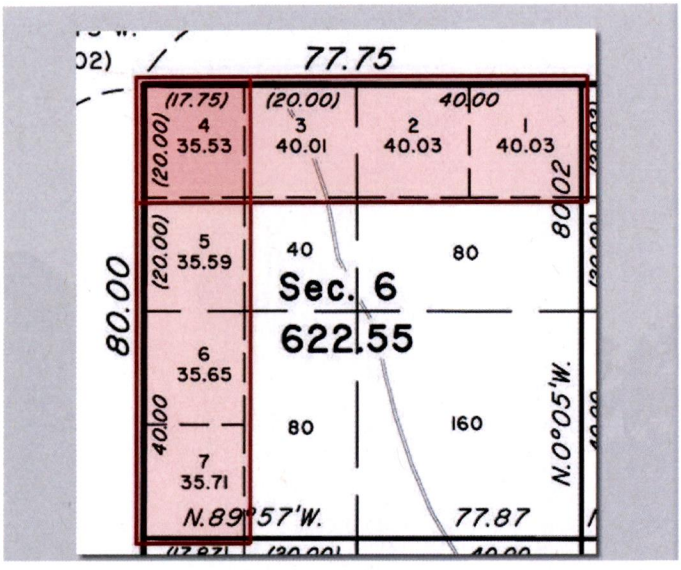
Lesson 2: Excess or Deficiency by Convergence

Objectives

After completing this lesson, you should be able to:

- Explain the principle of creating lots within the rectangular survey system due to excess or deficiency in land areas with a township or section.

After completing this lesson, you should be able to: Explain the principle of creating lots within the rectangular survey system due to excess or deficiency in land areas with a township or section.



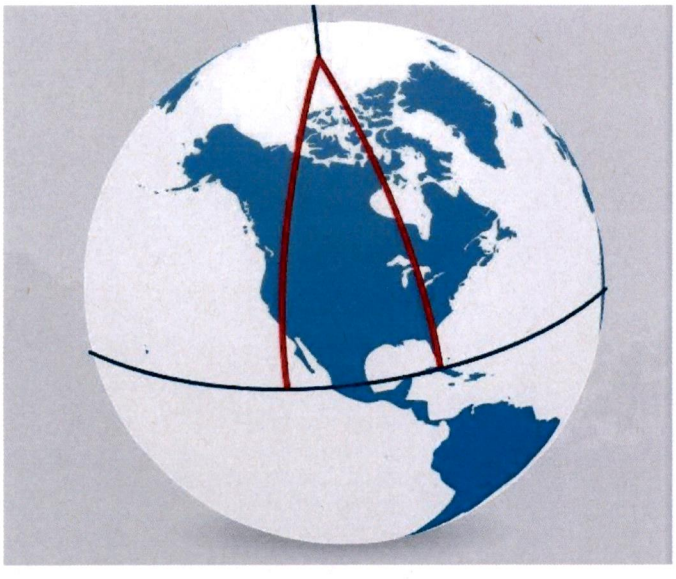
Not all sections contain 640 acres contrary to the plan of the rectangular system shown.

Sections along the north tier and west range of a regular township are often ***irregular sections*** and contain lots.

Lots:

- Designated by section
- Given a lot number
- May contain more or less than 40 acres
- Considered a subdivision unit of a section

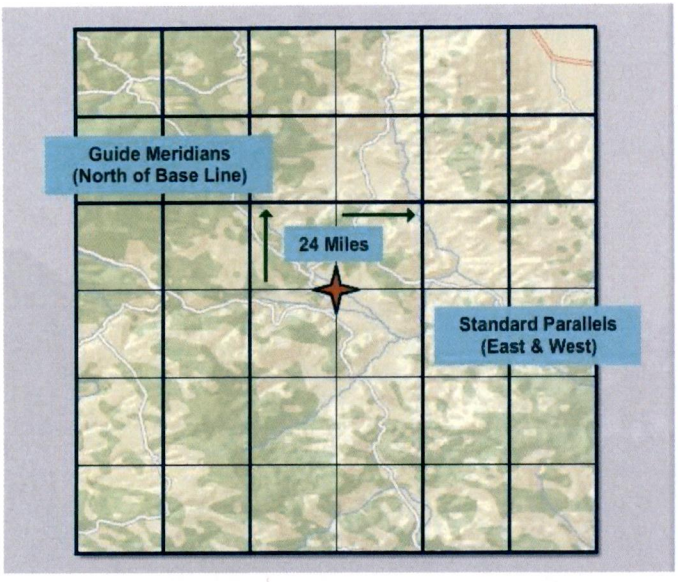
For various reasons, not all sections contain 640 acres, which is contrary to the plan of the rectangular system as shown here. The sections along the north tier and the west range of a regular township are often irregular sections and contain lots. These non-aliquot parts are designated by section and given a lot number. Though lots may contain more or less than 40 acres, they are considered a subdivision unit of a section.



Range lines do not continue in a straight line because of the curvature of the Earth's surface.

If not corrected, the township on the baseline would contain more area than one further north.

As a surveyor works north from the initial point, range lines do not continue in a straight line because of the curvature of the Earth's surface. If not corrected, the township on the baseline would contain more area than one further north.

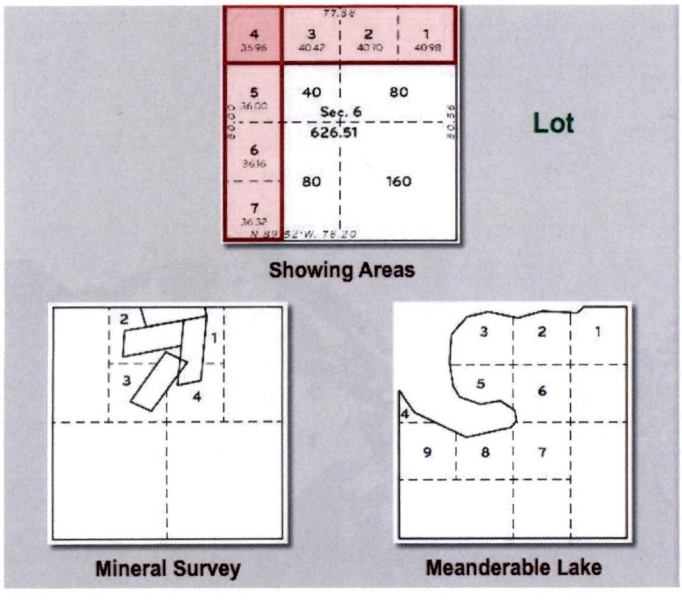


Range lines do not continue in a straight line because of the curvature of the Earth's surface.

If not corrected, the township on the baseline would contain more area than one further north.

To correct for this convergence, surveyors establish ***guide meridians*** and ***standard parallels*** every 24 miles in each direction from the initial point.

To correct for this convergence, surveyors establish guide meridians and standard parallels every 24 miles in each direction from the initial point.



A land unit called ***lots*** was created.

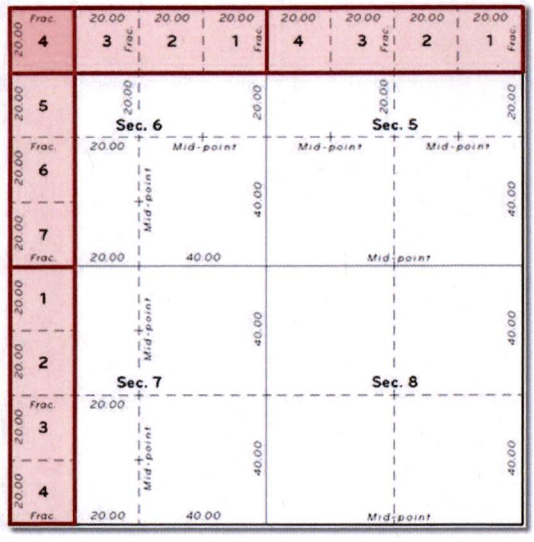
Lotting usually occurs in the north and west of each township due to:

- Excess and deficiency created by convergence
- Abutting a previously surveyed township
- Mineral surveys
- ***Meandering*** of rivers and lakes

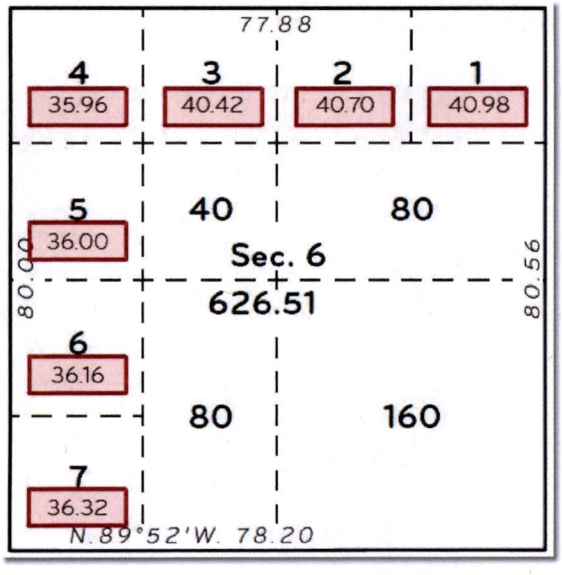
Reference: 2009 Manual of Survey Instructions Reference: Chapter 3, Subdivision of Sections

To compensate for loss in acreage to the convergence a land unit called lots was created. Lotting usually occurs in the north and west of each township. This is due to excess and deficiency in area created by convergence or because the township is abutting a previously surveyed township. Lotting also occurs when special surveys such as mineral surveys, and the meandering of rivers and lakes because the reduced land area around them cannot be described in aliquot parts. Lots are numbered similar to the 36 sections of a township. Lots are normally numbered starting in the northeast corner of the section in a counterclockwise direction but because of irregularities of land features lot numbering systems do vary. Following are visual examples of how a lotting scheme is portrayed on plats. Additional details can be found in Chapter 3, Subdivision of Sections in the 2009 Manual of Survey Instructions.

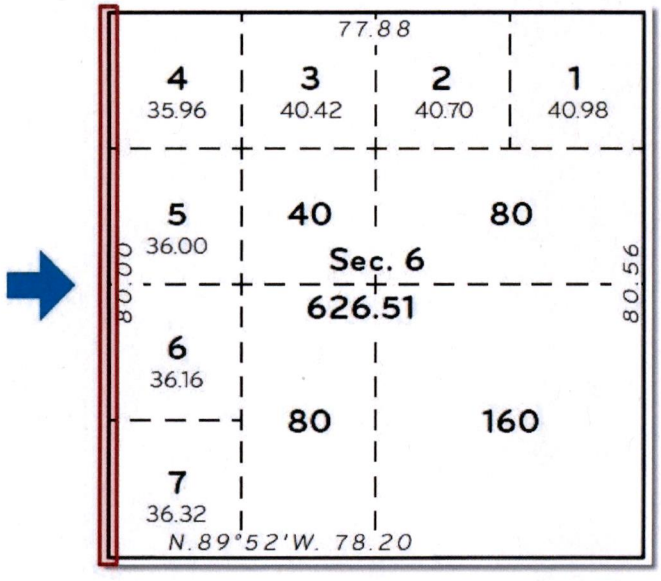
Aliquot Parts



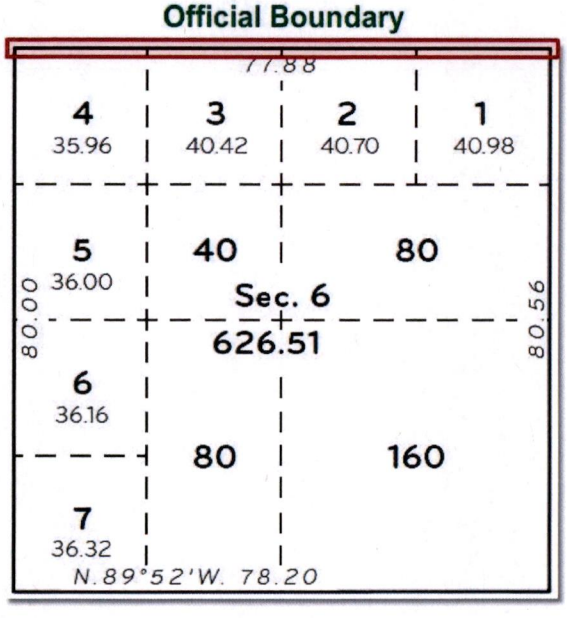
Displayed here is an example of typical lotting. Notice all quarters are aliquot parts. The lots displayed here are equal. Also, notice how the lots are numbered. In the northeast quarter, the lots are numbered right to left across the top. In the southwest quarter, the lots are numbered top to bottom. In the northwest quarter, the lots are numbered right to left across the top and then from the top down.



Again, you must consider the Earth curves moving north. To adjust for this, the boundary lines along the north and west sides of a township do not make a perfect square. Notice here each lot includes a differing acreage. Starting at lot seven and moving up to lot four, you will notice the acreage decreases as does lot one to lot four.

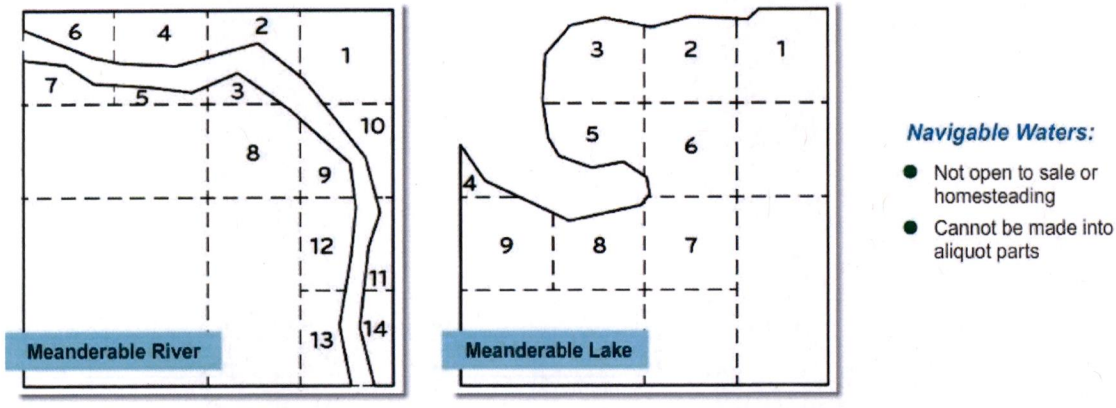


The reality is the lines running north and south are slowly moving to the right due to convergence.



The lines runningeast-west may be running into a previously surveyed area and therefore cannot move past the official boundary.

Numbering Varies from State to State

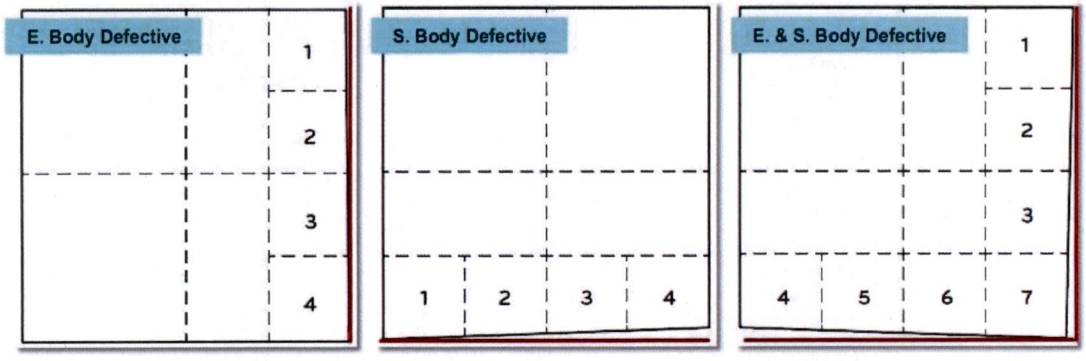


Navigable Waters:

- Not open to sale or homesteading
- Cannot be made into aliquot parts

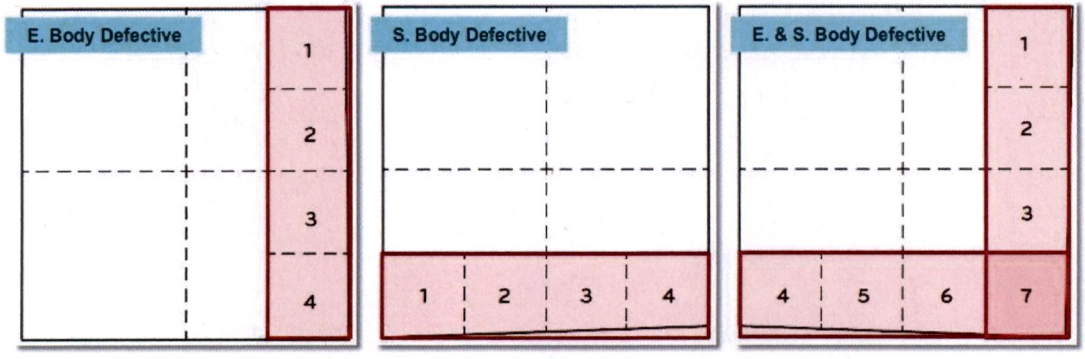
When navigable bodies of water are involved, such as a meandered river or lake, lots are used to define those areas. The beds of those waters are not open to sale or homesteading and cannot be made into aliquot parts within the section. It is important to note lot numbering procedures vary from state to state.

Runs into Previously Surveyed Area
Surveyed under 2009 Manual of Survey Instructions



In these examples, the borders have been exaggerated so that you can see the defects in border alignment. These are cases where the township runs into a previously surveyed area or have been resurveyed under the rules set forth in the 2009 Manual of Survey Instructions. In the first example, the east border is defective, in the second the south, and in the third both the east and south borders.

Lots Identified by Unique Number



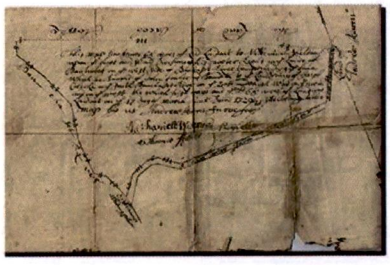
With few exceptions, lots are identified and described by the unique number it is assigned within the section. You will learn how to reference lots in writing land descriptions in the next lesson, Preferred Order and Preferred Writing Method.

SkillCheck

True or False: Like aliquot parts, lots within a section contain equal acreage.

- A. True
- B. False

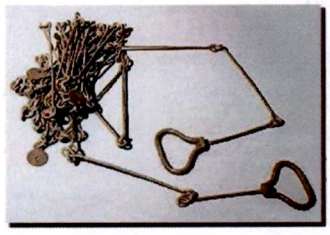
Correct Answer: B. False.



Various Units of Measures:

- Linear
- Area

Chain Unit

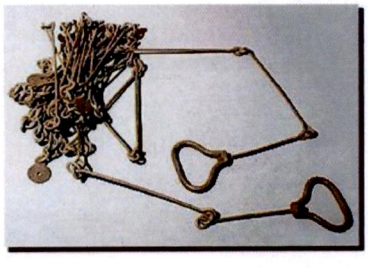


- Invention of Edmund Gunter
- 100 links measure 66 feet

Referenced on Plats and Maps Today

When reading from a map or plat, you will notice various units of measures: units of linear measure and units of area measure. These will most likely be represented by the terminology used at the time the plat was created. During the early growth of our nation, the United States adopted the use of a linear measurement called the chain unit. It was the 17th-century invention of Edmund Gunter, an English astronomer. Gunter's link chain was 66 feet long and divided into 100 equal links. The chain unit term and measurement is still referenced on plats and maps today.

Units of Linear Measure	Units of Area
1 chain = 100 links = 66 feet (U.S. Survey Foot) 1 mile = 80 chains = 5,280 feet (U.S. Survey Foot)	1 acre = 43,560 square feet (U.S. Survey Foot) 1 square mile = 640 acres = 80 chains by 80 chains



As you see here in the chart, the chain measurement is used both in linear and area measures. Regarding linear measure, a chain includes 100 links with each link being 7.92 inches. The 100 links measure 66 feet with 1 mile being equivalent to 80 chains when strung end to end. Regarding area measure, one acre is equivalent to 43,560 square feet formed into a square. One square mile equates to 640 acres or 80 chains by 80 chains.

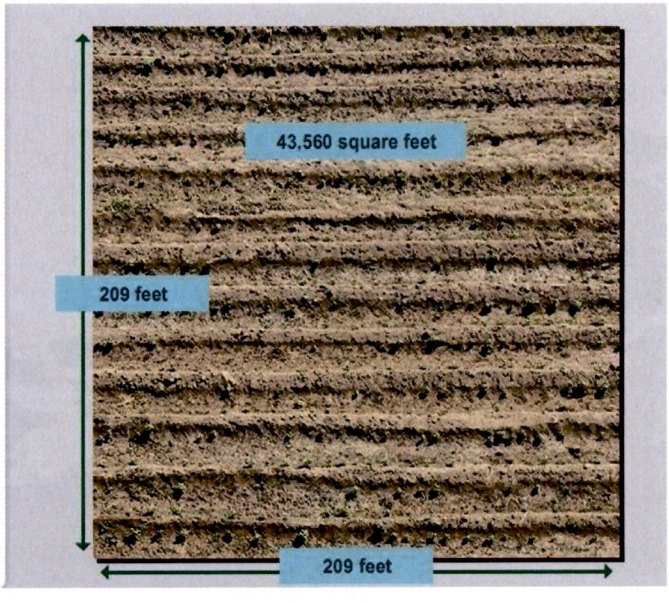
Arizona BLM Standard Yard - courtesy Az. State Office

Colonial Unit of Measure:

- Pole or rod
  - Can be used as a standard unit of measure
- Perch
  - Derived from Latin meaning pole or staff

Another historic unit of measure was the pole or rod or perch. Like the acre, common units of linear measure were brought to the American Colonies from Europe. A pole or rod of an exact length can be used as the "standard" like other identical forms measuring tools can be copied. The word perch is derived from the Latin word meaning a pole or staff.

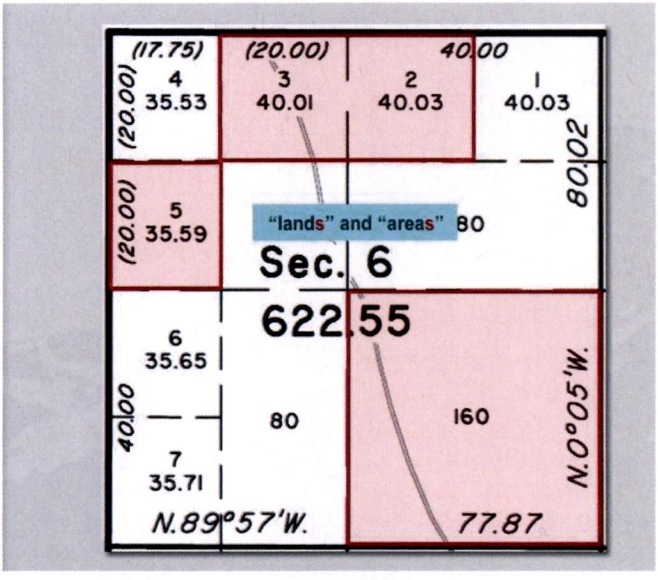
The quantity of land within the bounds of a description is most commonly expressed in "acres."



The quantity of land within the bounds of a description is most commonly expressed in "acres." It is said that during the Middle Ages, an acre was the amount of land that could be ploughed in one day with a yoke of oxen. One acre equals 43,560 square feet, and is approximately the land contained in a 209 foot by 209 foot square.

The quantity of land within the bounds of a description is most commonly expressed in "acres."

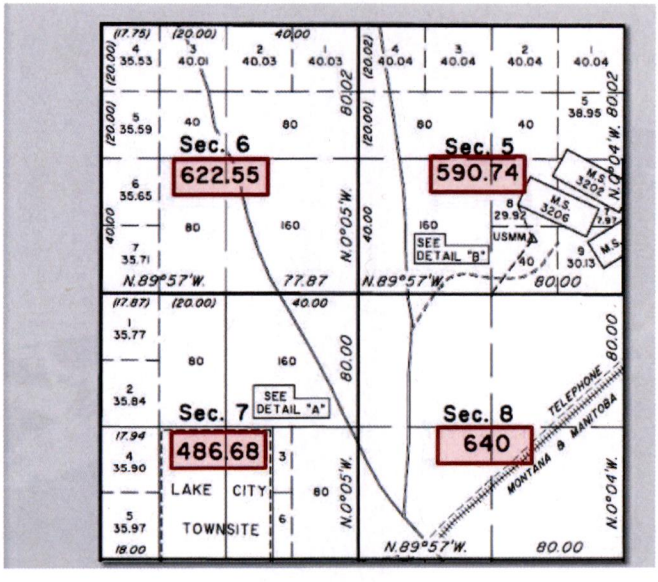
The terms "land" and "***area***" are used when referring to a group of parcels that have common boundaries.



When preparing land descriptions in accordance to the "Specifications," the terms "land" and "area" are used when referring to a group of parcels that have common boundaries. The terms "lands" and "areas" are used when referring to a group of parcels being described that do not have common boundaries.

Where ***unsurveyed land*** is included, the acreage as shown upon the official ***protraction diagrams*** of the township will be used.

Where land is not returned on an official survey plat and there is no official protraction diagram, an approximate area will be given in even acres.



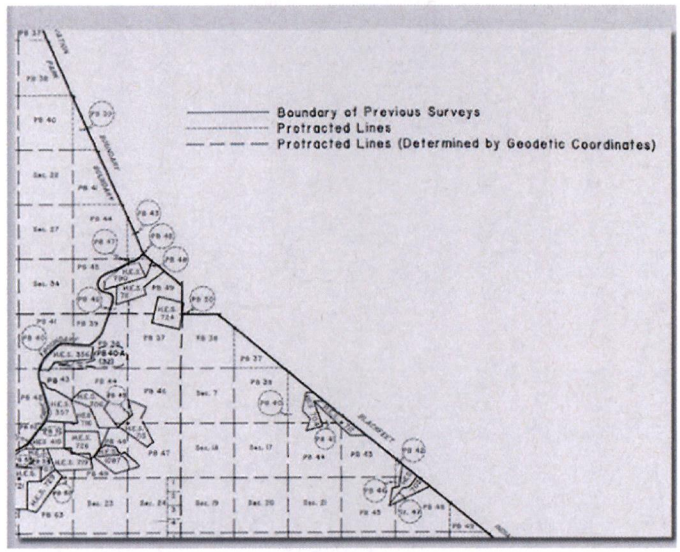
If the lands described are entirely surveyed, the legal acreage as shown upon the official plats of survey is used. Where unsurveyed land is included, the acreage as shown upon the official protraction diagrams of the township will be used. Where land is not returned on an official survey plat and there is no official protraction diagram, an approximate area will be given in even acres.

Where ***unsurveyed land*** is included, the acreage as shown upon the official ***protraction diagrams*** of the township will be used.

Where land is not returned on an official survey plat and there is no official protraction diagram, an approximate area will be given in even acres.

Protraction diagrams serve as a plan of survey for if an Official Cadastral Survey were to be performed over unsurveyed land.

Specifications Reference: Area, Chapter II



Protraction diagrams serve as a plan of survey for if an Official Cadastral Survey were to be performed over unsurveyed land. See Area in Chapter II of the Specifications for more information.

SkillCheck

One chain unit is equivalent to how many feet?

- A. 66 feet
- B. 80 feet
- C. 100 feet
- D. 5,280 feet

Correct Answer: A. 66 feet

SkillCheck

BLM considers how many acres to be the standard land unit for management purposes?

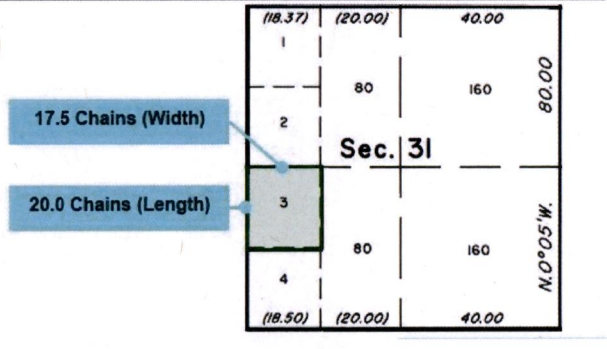
- A. 160 acres
- B. 40 acres
- C. 10 acres
- D. 2.5 acres

Correct Answer: 40 acres

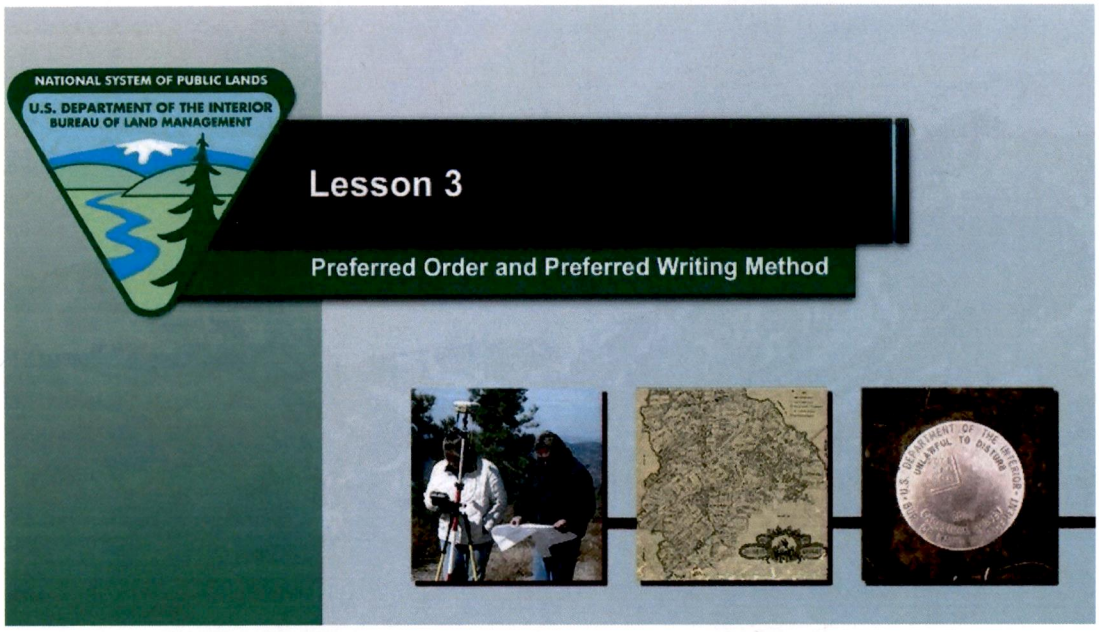
SkillCheck

Using the example plat measurements, what is the width and length in feet?

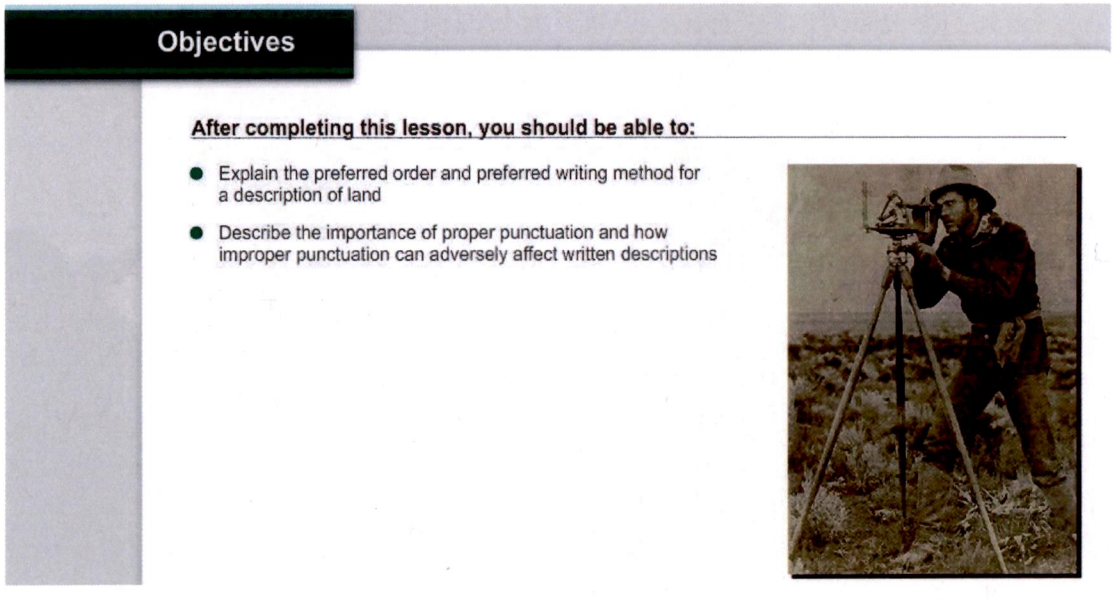
- A. 1,055 feet x 1,320 feet
- B. 1,155 feet x 1,220 feet
- C. 1,255 feet x 1,220 feet
- D. 1,155 feet x 1,320 feet
- E. 1,055 feet x 1,220 feet



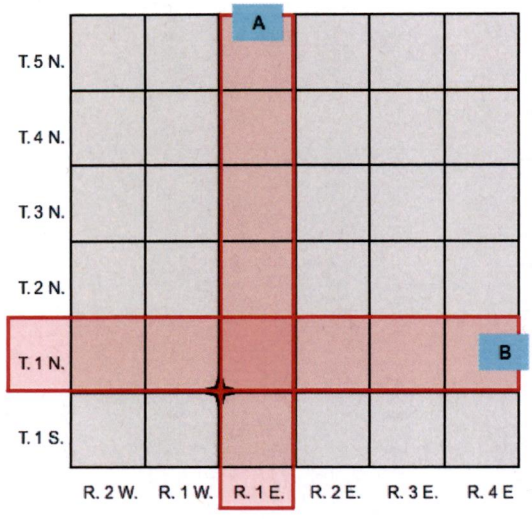
Correct Answer: D. 1,555 feet x 1,320 feet



Lesson 3: Preferred Order and Preferred Writing Method



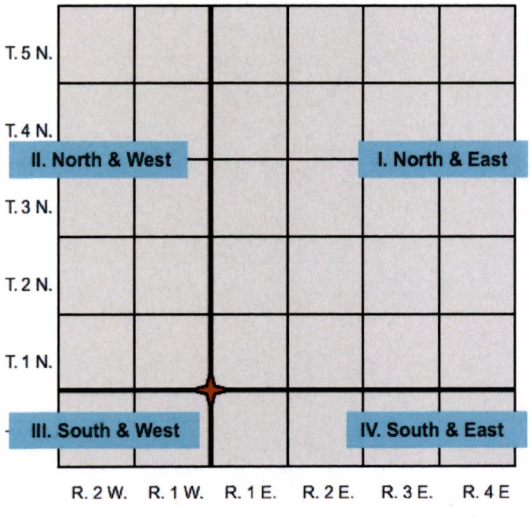
After completing this lesson, you should be able to: explain the preferred order and preferred writing method for a description of land and describe the importance of proper punctuation and how improper punctuation can adversely affect written descriptions.



Preferred (Numerical) **Order:**

A. Lowest Range number
B. Lowest Township number

The preferred numerical order of listing of a land description is to begin with the lowest range number. Also start with the lowest number within each range by the township numbers.



Preferred (Numerical) **Order:**

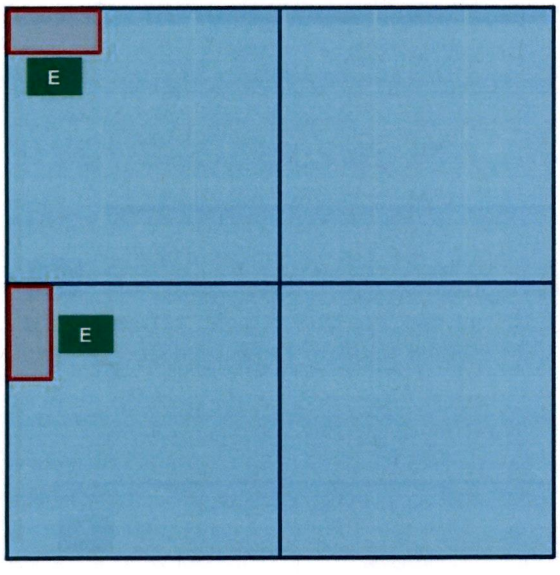
A. Lowest Range number
B. Lowest Township number
C. Principal Meridian/Base Line
   I. North & East
   II. North & West
   III. South & West
   IV. South & East

Where townships east and west of the principal meridian or north and south of the base line or both are involved, first list those north and east of the initial point, followed by those north and west, south and west, and finally south and east. Describe all the parts of each township and range before proceeding to the next township and range.

Preferred (Numerical) **Order:**

A. Lowest Range number
B. Lowest Township number
C. Principal Meridian/Base Line
   I. North & East
   II. North & West
   III. South & West
   IV. South & East
D. Lowest Section number

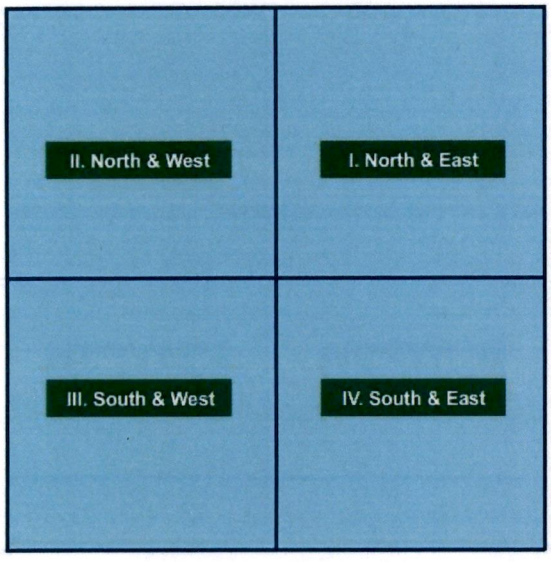
For sections, begin with the lowest-numbered section in each township.



Preferred (Numerical) **Order:**

A. Lowest Range number
B. Lowest Township number
C. Principal Meridian/Base Line
   I. North & East
   II. North & West
   III. South & West
   IV. South & East
D. Lowest Section number
E. Lot numbers

First, give the lot numbers in order.



Preferred (Numerical) **Order:**

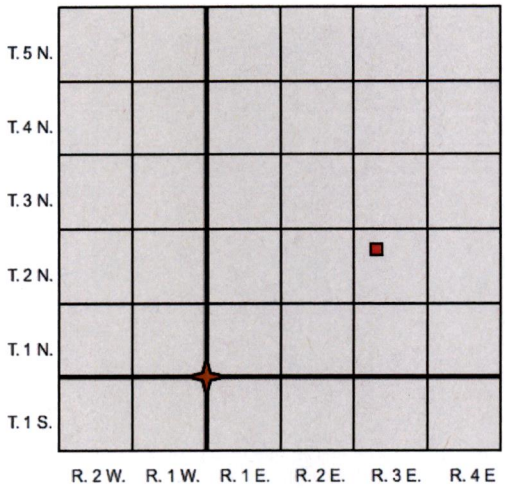
A. Lowest Range number
B. Lowest Township number
C. Principal Meridian/Base Line
   I. North & East
   II. North & West
   III. South & West
   IV. South & East
D. Lowest Section number
E. Lot numbers
F. Subdivisions
   I. North & East
   II. North & West
   III. South & West
   IV. South & East

Then list the subdivisions within each quarter section in the order NE, NW, SW, and SE. If parts of the quarter-sections are to be described, follow the same order and describe all the parts of each quarter section before proceeding to the next quarter-section.

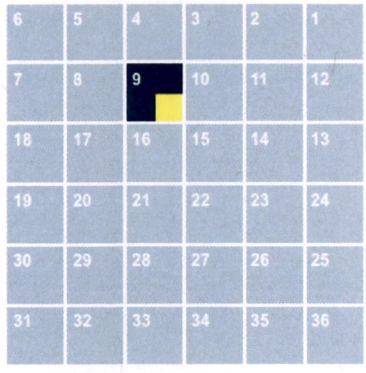
Preferred (Numerical) **Order:**

A. Lowest Range number
B. Lowest Township number
C. Principal Meridian/Base Line
   I. North & East
   II. North & West
   III. South & West
   IV. South & East
D. Lowest Section number
E. Lot numbers
F. Subdivisions
   I. North & East
   II. North & West
   III. South & West
   IV. South & East
G. ***Tracts***

Tracts should follow the sections because a tract is part of a township, as is a section. It is numbered the same as a section, beginning with 37 or the next highest unused numerical designation to avoid confusion with section numbers. Tracts should be listed before nonrectangular surveys, such as mineral surveys or donation land claims.



BLM Meridian, (State)
T. 2 N., R. 3 E.,
sec. 9, SE1/4
The area described contains 160 acres.

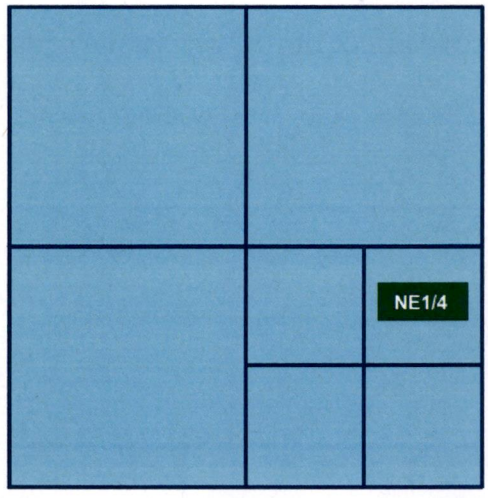


Specifications Reference: Preferred Writing Method, Chapter II

Before you can write a description of land, you must first understand what the references mean. A proper aliquot part description should contain all of the reference elements within it: principal meridian, the state the land is in, township and range, section, and lots or aliquot parts. In this lesson, you will learn some of the basic abbreviations and the order in which a description of land is written. In this example, we begin with the fictitious Bureau of Land Management Principal Meridian or BLM Meridian, (the State the land is in). Next, comes the township and range. Thisis written as T. 2 N., R. 3 E.. and pronounced township two north, range three east. Next is the section and any subdivision. Continuing with our example, this is written as sec. 9, SE1/4 and pronounced as section nine, the southeast quarter. Finally, the area in acres is described. This happens to be a quarter of one section and therefore is equivalent to 160 acres. See Preferred Writing Method in Chapter II of the Specifications for more information.

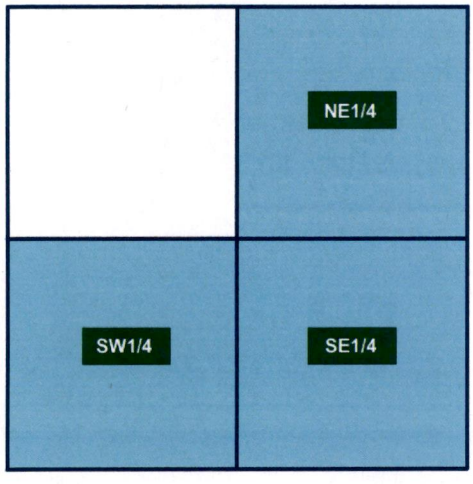
Land Description Part	Abbreviation	Example
Township(s)	T. or Tps.	T. 3 N.
Range(s)	R. or Rs.	R. 2 W.
Section(s)	sec. or secs.	sec. 19
North South East West	N. S. E. W.	T. 3 N., R. 2 W.
Northeast Southeast Northwest Southwest	NE SE NW SW	NE1/4
Lot(s)	lot or lots	lot 1 or lots 1, 2, and 4
Tract(s)	tract or tracts	tract 43 or tracts 43, 44, and 46

Please take a few moments now and review the abbreviations with their references.

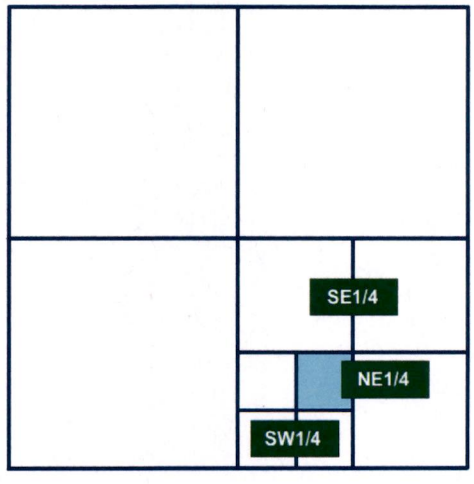


The usual punctuation is omitted in the aliquot part description. The period is omitted after N, NE, S, SE, etc., within the aliquot parts description, and there is no comma and no space between symbols indicating a quarter-quarter section (NE1/4SE1/4).

Comma Means AND THE
NE1/4, SW1/4, SE1/4 = 480 Acres

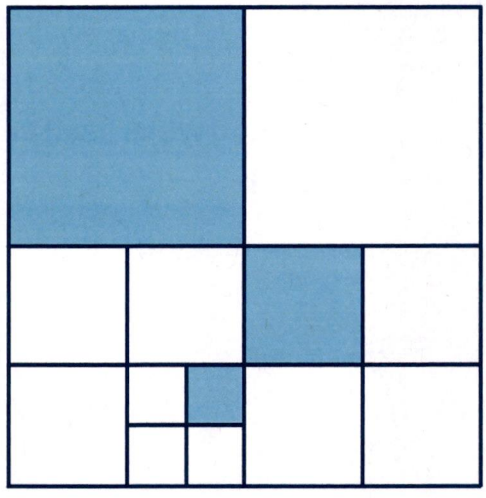


No Comma Means OF THE
NE1/4SW1/4SE1/4 = 10 Acres



The use of a comma is significant in writing the descriptions of the subdivisions of a section. A comma means AND THE and the absence of a comma means OF THE. The improper use or placement of a comma could drastically change an aliquot description and the intended acreage to be described. For example, given the description NE1/4SW1/4SE1/4 without a comma describes an aliquot part of 10 acres. With a comma, as such NE1/4, SW1/4, SE1/4 describes three aliquot parts totaling 480 acres.

NW1/4, NE1/4SE1/4SW1/4, NW1/4SE1/4 = 210 Acres



The proper use of the comma in an aliquot description is as follows: The NW1/4, NE1/4SE1/4SW1/4, NW1/4SE1/4, describes three aliquot parts containing 210 acres.

SkillCheck

Which of the following should you begin with when writing a land description in the preferred numerical order?

- A. Highest tract number
- B. Lowest range number
- C. Highest township number
- D. Lowest township number

Correct Answer: B. Lowest range number.

SkillCheck

True or False: The use of a comma is significant in writing the descriptions of the subdivision of a section. A comma means OF THE and the absence of a comma means AND THE.

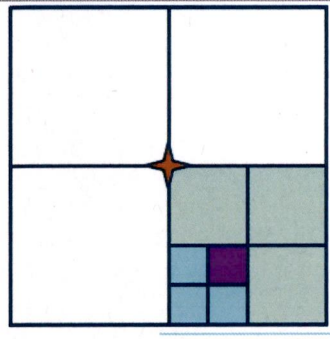
- A. True
- B. False

Correct Answer: B. False

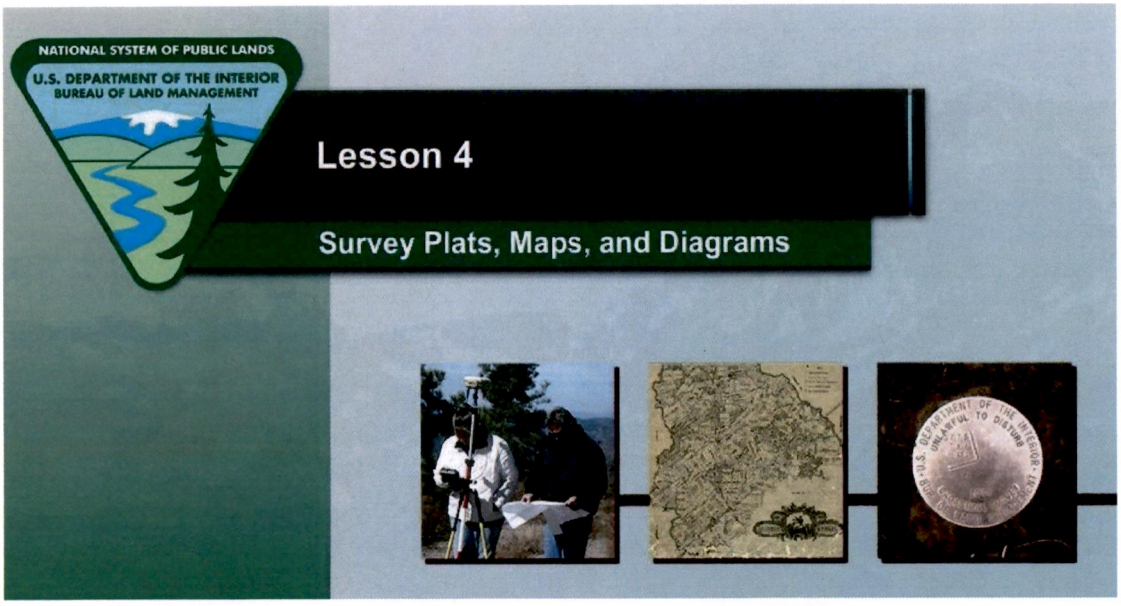
SkillCheck

Which of the following descriptions is written correctly based on the graphic displayed?

- A. NE 1/4, SW 1/4, SE 1/4
- B. NE1/4SW1/4SE1/4
- C. N.E.1/4 of the S.W. 1/4 of the S.E. 1/4
- D. E 1/4 SW 1/4 SE 1/4
- E. NE1/4SE1/4SW1/4



Correct Answer: B. NE1/4SW1/4SE1/4



Lesson 4: Survey Plats, Maps, and Diagrams

Objectives

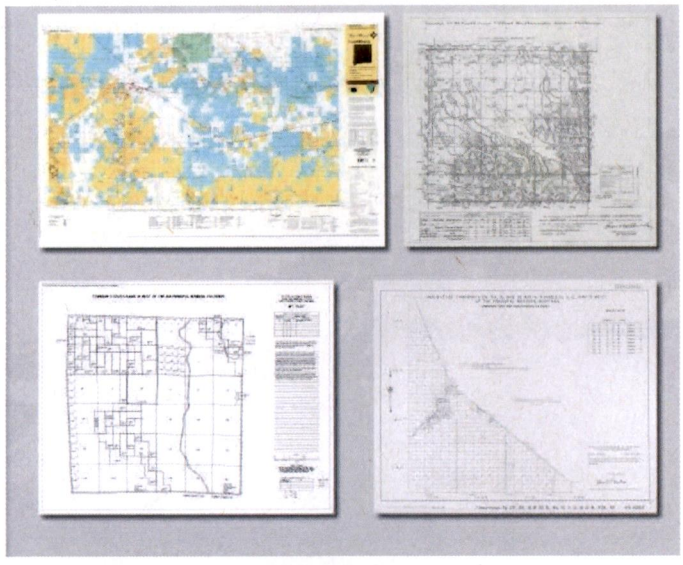
After completing this lesson, you should be able to:

- List the four most commonly used map types
- Define their use for land descriptions

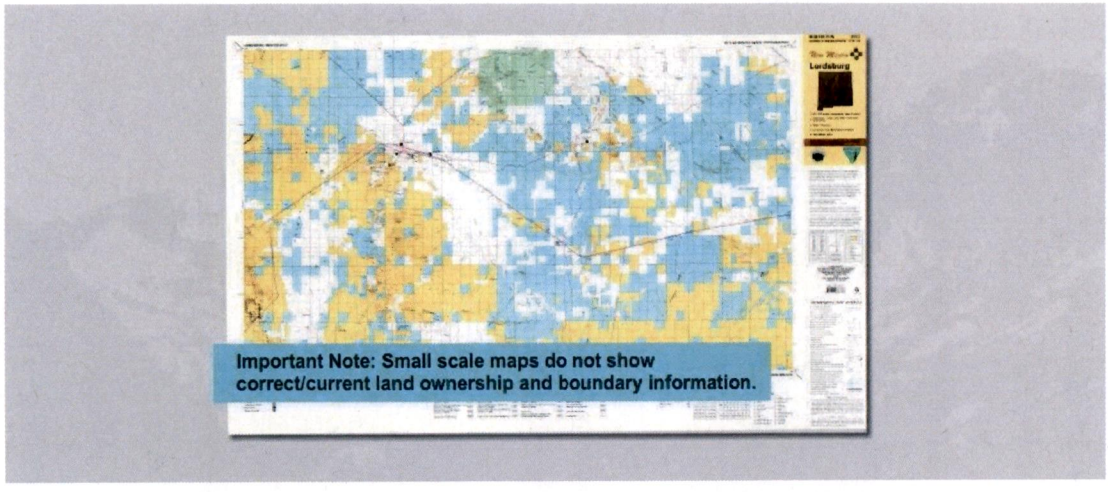
After completing this lesson, you should be able to: list the four most commonly used map types and define their use for land descriptions.

Four most common *map* types:

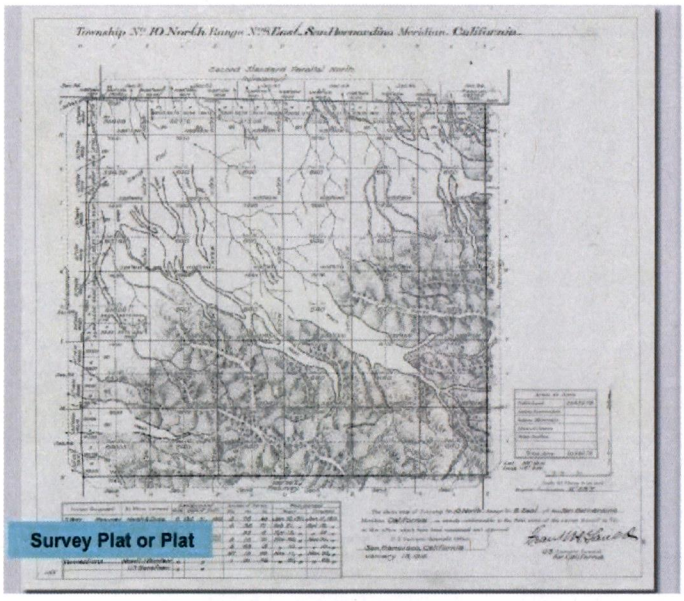
- The Surface Management Areas Map
- Official Plat of Survey
- The Master Title Plat or MTP
- Protraction Diagram



In this lesson, you will be introduced to the four most common map types you will use when interpreting and writing descriptions of land. These are: the Surface Management Areas Map, Official Plat of Survey, the Master Title Plat or MTP, and Protraction Diagram. Please note that there is a legal distinction between the terms of map and plat. Official surveys are always referred to as a plat. Let's begin with an overview of the Surface Management Areas map.



The small scale map, BLM Surface Management Map, can be used to find the general area of a parcel of land and its relation to major landmarks and transportation routes. Small scale maps also are a handy way to find a location using the PLSS grid. But it is important to know that small scale maps DO NOT necessarily show the correct and current land ownership and boundary information! Displayed here is an example of a Surface Management Map.



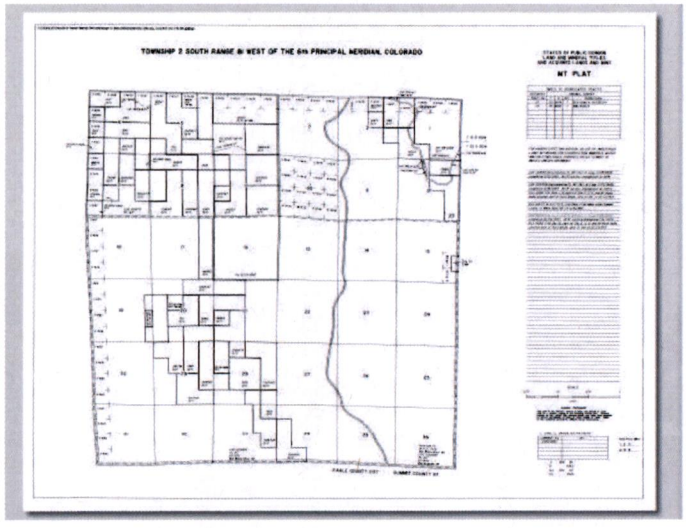
Record of Official Government Survey:

- Survey measurements
- Calculated acreage
- Land parcels that do not conform to rectangular survey system

Plats Found at:

- BLM State Office Public rooms
- BLM State Office web sites
- GLO Records Automation web site

The Official Plat of Survey is commonly called a survey plat or plat. This is the record of official government survey and includes the survey measurements and calculated acreage. It also displays land parcels that do not conform to the rectangular survey system. These plats can be found at BLM State Office Public rooms, online at some BLM State Office web sites or General Land Office (GLO) Records Automation web site (The Official Federal Land Records Site). An example of a survey plat is shown here.



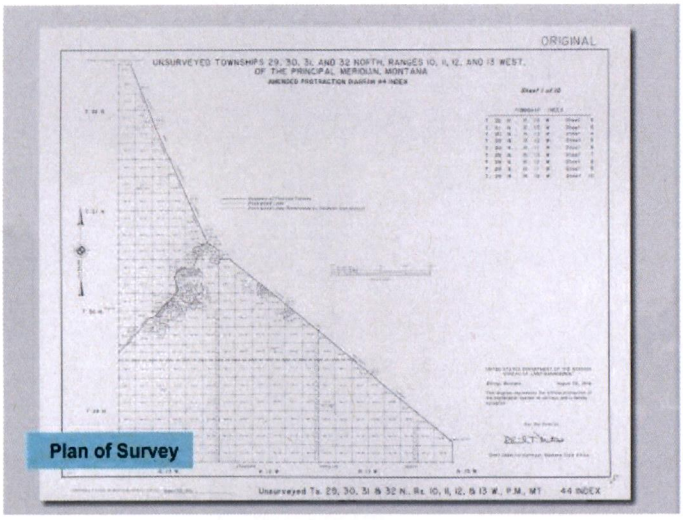
Master Title Plat (MTP):

- Federal land ownership information
- Rights and reservations (patented) to private individuals

Plats Found at:

- BLM State Office Public rooms
- BLM State Office web sites
- GLO Records Automation web site

The Master Title Plat or MTP shows Federal land ownership information, including rights and reservations the Government retained on lands convey (patented) to private individuals. These plats can be found at BLM State Office Public rooms, online at some BLM State Office web sites or General Land Office (GLO) Records Automation web site (The Official Federal Land Records Site). An example of an MTP is shown here.



Protraction Diagram:

- Describes un-surveyed land areas
- Governs until an official survey is performed

Where to access:

- Respective State Offices of the BLM

A Protraction Diagram is prepared for the purpose of describing unsurveyed land areas. In essence, the protraction diagram can be considered a "plan of survey" for if and when an on-the-ground survey was performed (i.e. it governs until an official survey is performed). The diagram is approved for the Director by the Chief, Division of Cadastral Survey, and filed in the respective state offices of the BLM. An example of a Protraction Diagram is shown here.

SkillCheck

Match the map type to its description.

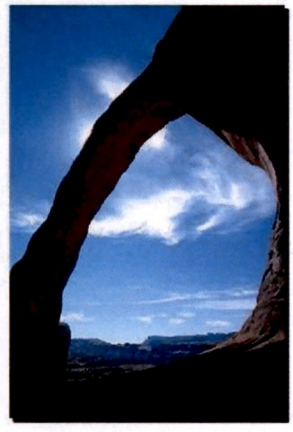
▾ **Surface Management Map**	**A. Used to find the initial reference area of the parcel of land in question.**
▾ **Official Plat of Survey**	**B. Used to find the survey measurements and calculated acreage and is commonly referred to as a survey plat or plat.**
▾ **Master Title Plat**	**C. Used to find Federal land ownership information.**
▾ **Protraction Diagram**	**D. Prepared for the purpose of describing un-surveyed land areas.**

Correct Answers: A. Surface Management Map, B. Official Plat of Survey, C. Master Plat Title, and D. Protraction Diagram.

Summary

Having completed this module, you should now be able to:

- Explain key land description terminology
- Apply principles of Rectangular Survey System
- Interpret Subdivisions of Sections (aliquot parts)
- Explain excess or deficiency due to convergence
- Explain why lots were created
- Describe the Preferred Writing Method elements and proper use
- List the four most commonly used map types and define their use for land descriptions



Having completed this module, you should now be able to: explain key land description, terminology, apply principles of Rectangular Survey System, interpret subdivisions of sections (aliquot parts), explain excess or deficiency due to convergence, explain why lots were created, describe the preferred writing method elements and proper use, and list the four most commonly used map types and define their use for land descriptions.

Quiz Answer Key

1. Review the graphic. Match the letter to its corresponding part on the image.

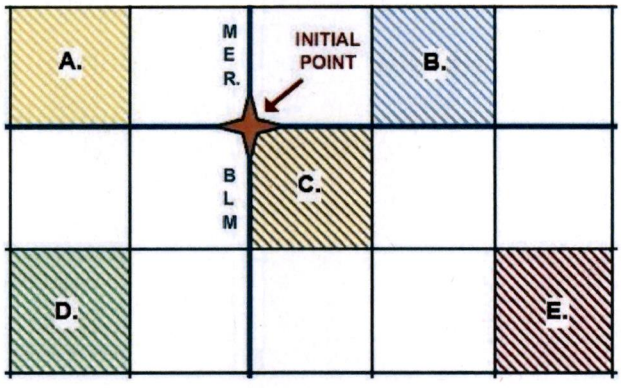
T. 2 S., R. 3 E.

T. 1 N., R. 2 W.

T. 1 N., R. 2 E.

T. 1 S., R. 1 E.

T. 2 S., R. 2 W.



Correct Answers: A. T. 1 N., R. 2 W.; B. T. 1 N., R. 2 E.; C. T. 1 S., R. 1 E.; D. T. 2 S., R. 2.W.; and E. T. 2 S., R. 3 E.

2. Match the letter to its term.

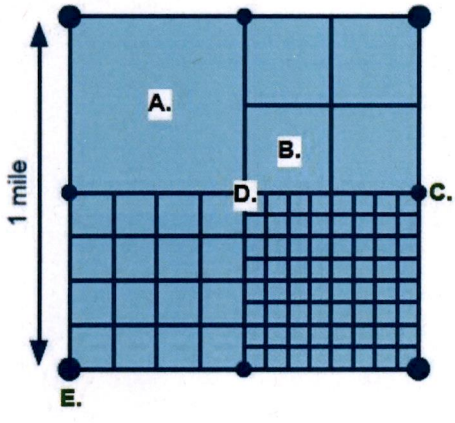
Section

Aliquot Part

Section Corner

Quarter Corner

40-acre Quarter-Quarter



Correct Answers: A. Aliquot Part, B. 40- acre Quarter-Quarter, C. Quarter Corner, D. Section, and E. Section Corner.

3. How many nominal miles wide and high is a Township versus a Section?

A. **Township: 1 mile and Section: 6 miles**
B. **Township: 10 miles and Section: 4 miles**
C. **Township: 5 miles and Section: 1 mile**
D. **Township: 10 miles and Section: 5 miles**
E. **Township: 6 miles and Section: 1 mile**

Correct answer: E. Township: 6 miles and Section: 1 mile

4. True or False: For management purposes, BLM considers 160 acres to be the standard land unit.

Correct Answer: False

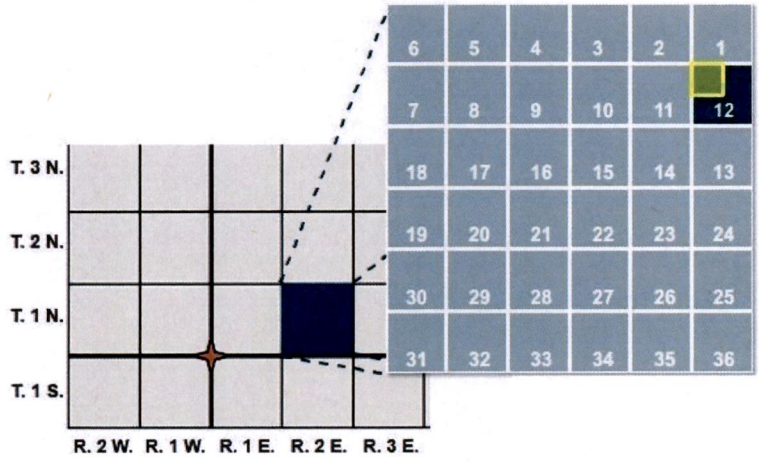
5. 132 feet is equivalent to how many chain units and how many feet is the equivalent of 5 chains?

- **A. 2 chain units and 330 feet**
- **B. 4 chain units and 165 feet**
- **C. 3.3 chain units and 200 feet**

Correct Answer: A. 2 chain units and 330 feet

6. Which written description of land is represented in the graphic?

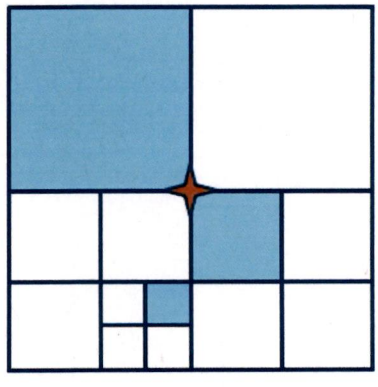
- A. BLM Meridian, Idaho T. 3 N., R. 2 E., sec. 12, SW1/4
- B. BLM Meridian, Idaho T. 1 S., R. 2 E., sec. 12, SW1/4
- C. BLM Meridian, Idaho T. 1 N., R. 2 E., sec. 12, NW1/4



Correct Answer: C. BLM Meridian, Idaho T. 1 N., R. 2 E., sec. 12, NW1/4

7. Which is the correctly written description for aliquot parts displayed in the graphic?

- A. NW1/4, NE1/4SE1/4SW1/4, NW1/4SE1/4
- B. NW1/4, SW1/4SE1/4NE1/4, SE1/4NW1/4



Correct Answer: A. NW1/4, NE1/4SE1/4SW1/4, NW1/4SE1/4

8. What is used to find the initial reference area of the parcel of land in question?

- **A. Surface Management Map**
- **B. Map of Official Survey**
- **C. Master Title Plat**
- **D. Protraction Diagram**

Correct Answer: A. Surface Management Map

9. What is used to review the survey measurements and calculated acreage and is commonly referred to as a survey plat or plat?

- **A. Surface Management Map**
- **B. Official Survey**
- **C. Master Title Plat**
- D. **Protraction Diagram**

Correct Answer: B. OfficialSurvey

10. What is used to review Federal land ownership information?

- **A. Surface Management Map**
- **B. Official Survey Plat**
- **C. Master Title Plat**
- D. **Protraction Diagram**

Correct Answer: C. Master Title Plat

11. How many miles in each direction from the initial point do surveyors establish guide meridians and standard parallels to correct for convergence?

- **A. 1 mile**
- **B. 6 miles**
- **C. 24 miles**
- **D. 36 miles**

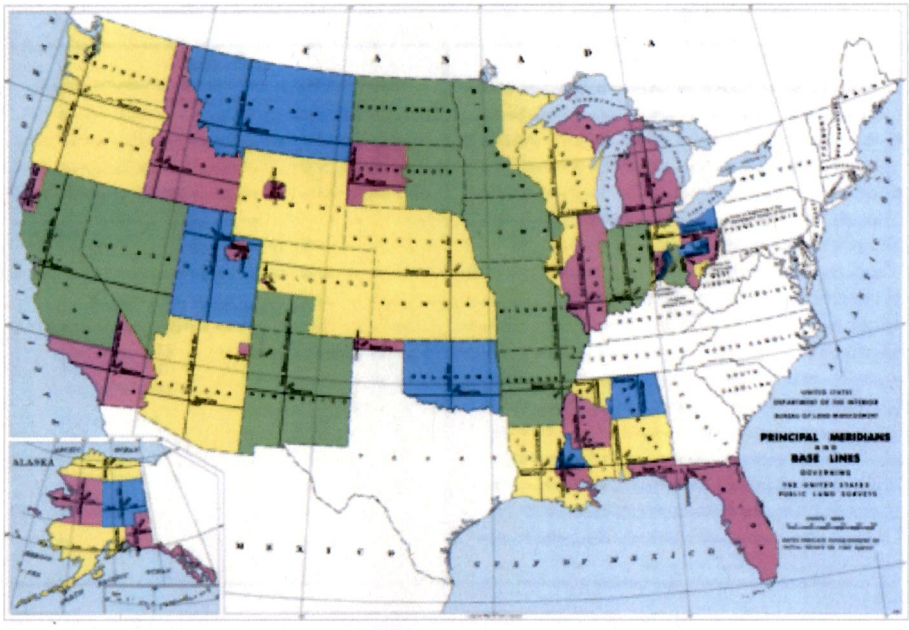
Correct Answer: C. 24 miles

12. True or False: When bodies of water are involved, such as a meandered river or lake, lots are used to define those areas that cannot be made into aliquot parts.

Correct Answer: True

Public Land System Wikipedia

Public Land Survey System



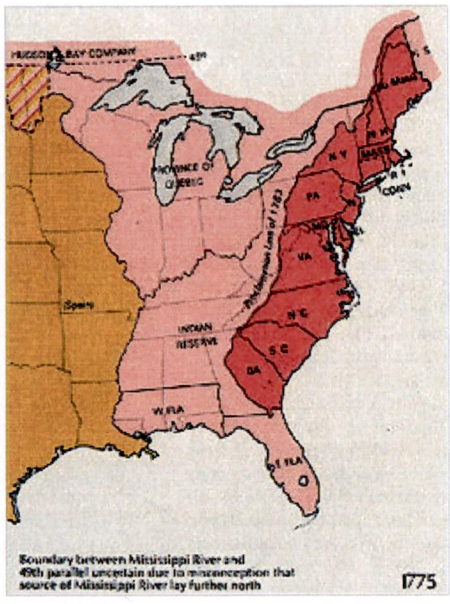
This 1988 BLM map depicts the principal meridians and baselines used for surveying states (colored) in the Public Land Survey System.

The **Public Land Survey System (PLSS)** is the surveying method developed and used in the United States to plat, or divide, real property for sale and settling. Also known as the **Rectangular Survey System,** it was created by the Land Ordinance of 1785 to survey land ceded to the United States by the Treaty of Paris in 1783, following the end of the American Revolution. Beginning with the Seven Ranges in present-day Ohio, the PLSS has been used as the primary survey method in the United States. Following the passage of the Northwest Ordinance in 1787, the Surveyor General of the Northwest Territory platted lands in the Northwest Territory. The Surveyor General was later merged with the United States General Land Office, which later became a part of the U.S. Bureau of Land Management (BLM). Today, the BLM controls the survey, sale, and settling of lands acquired by the United States.

History

Originally proposed by Thomas Jefferson to create a nation of "yeoman farmers",[1] the PLSS began shortly after the American Revolutionary War, when the federal government became responsible for large areas of land west of the original thirteen states. The government wished both to distribute land to Revolutionary War soldiers in reward for their services and to sell land as a way of raising money for the nation. Before this could happen, the land needed to be surveyed.[2]

The Land Ordinance of 1785 marks the beginning of the Public Land Survey System. The Confederation Congress was deeply in debt following the Declaration of Independence. With little power to tax, the federal government decided to use the sale of the Western Territories to pay off war debt. The PLSS has been expanded and slightly modified by Letters of Instruction and Manuals of Instruction, issued by the General Land Office and the Bureau of Land Management, and is still in use in most of the states west of Pennsylvania, south to Florida, Alabama, and Mississippi, west to the Pacific Ocean, and north into the Arctic in Alaska.



Map of territorial growth, 1775

Origins

The original colonies (including their derivatives Maine, Vermont, Tennessee, Kentucky and West Virginia) continued the British system of metes and bounds. This system describes property lines based on local markers and bounds drawn by humans, often based on topography. A typical, yet simple, description under this system might read "From the point on the north bank of Muddy Creek one mile above the junction of Muddy and Indian Creeks, north for 400 yards, then northwest to the large standing rock, west to the large oak tree, south to Muddy Creek, then down the center of the creek to the starting point."[3]

Northwest territory

Particularly in New England, this system was supplemented by drawing town plats. The metes and bounds system was used to describe a town of a generally rectangular shape, 4 to 6 miles (6.4 to 9.7 km) on a side. Within this boundary, a map or plat was maintained that showed all the individual lots or properties.

There are some difficulties with this system:

- Irregular shapes for properties make for much more complex descriptions.
- Over time, these descriptions become problematic as trees die or streams move by erosion.
- It was not useful for the large, newly surveyed tracts of land being opened in the west, which were being sold sight unseen to investors.

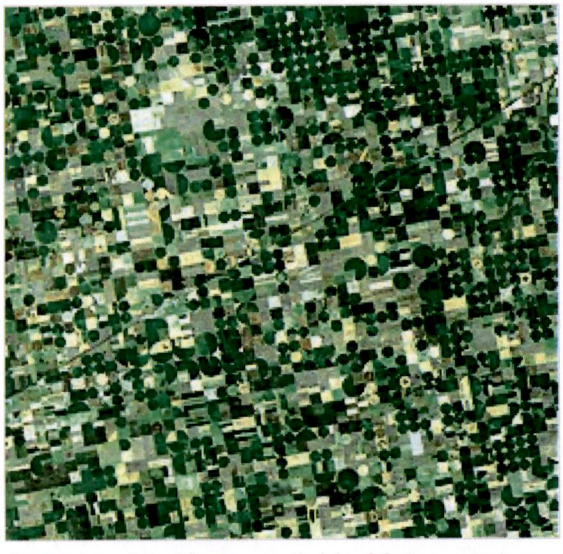
In the 1783 Treaty of Paris recognizing the United States, Britain also recognized American rights to the land south of the Great Lakes and west to the Mississippi River. The Continental Congress passed the Land Ordinance of 1785 and then the Northwest Ordinance

in 1787 to control the survey, sale, and settling of the new lands. The original 13 colonies donated their western lands to the new union, for the purpose of giving land for new states. These include the lands that formed the Northwest Territory, Kentucky, Tennessee, Alabama, and Mississippi. The state that gave up the most was Virginia, whose original claim included most of the Northwest Territory and Kentucky. Some of the western land was claimed by more than one state, especially in the northwest, where parts were claimed by Virginia, Pennsylvania, and Connecticut, all three of which had claimed lands all the way to the Pacific Ocean.

Monument referencing the beginning point of the PLSS

Application

The first surveys under the new rectangular system were in eastern Ohio in an area called the Seven Ranges. The Beginning Point of the U.S. Public Land Survey is at a point on the Ohio-Pennsylvania border between East Liverpool, Ohio, and Ohioville, Pennsylvania, on private property. A National Historic Landmark marker commemorating the site lies on the side of a state highway, exactly 1,112 feet (339 m) to the north of the point.[4]



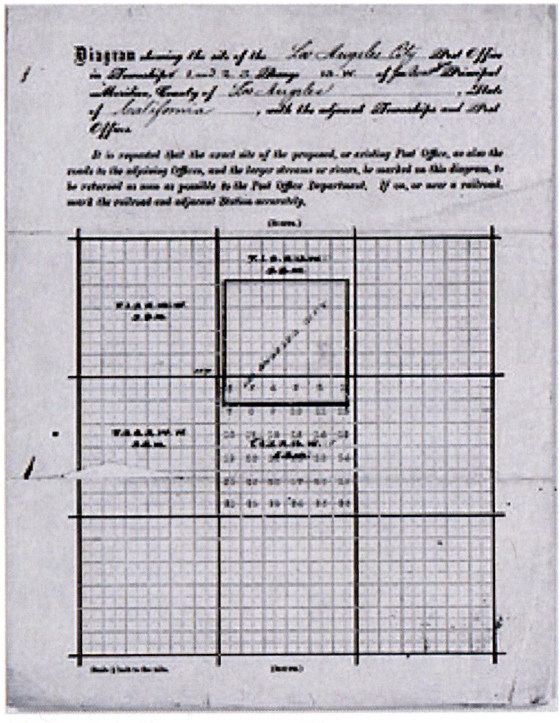
Farmland in Kansas divided into quarter sections

Ohio was surveyed in several major subdivisions, collectively described as the Ohio Lands, each with its own meridian and baseline. The early surveying, particularly in Ohio, was performed with more speed than care, with the result that many of the oldest townships and sections vary considerably from their prescribed shape and area. Proceeding westward, accuracy became more of a consideration than rapid sale, and the system was simplified by establishing one major north–south line (principal meridian) and one east–west (base) line that control descriptions for an entire state or more. For example, a single Willamette Meridian serves both Oregon and Washington. County lines frequently follow the survey, so there are many rectangular counties in the Midwest and the West.

Non-PLSS regions

The system is in use in some capacity in most of the country, but large portions use other systems. The territory under the jurisdiction of the Thirteen Colonies at the time of independence did not adopt the PLSS, with the exception of the area that became the Northwest Territory and some of the southern states. This territory comprises Georgia, Connecticut, Delaware, Kentucky, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, North Carolina, Pennsylvania, Rhode Island, South Carolina, Tennessee, Vermont, Virginia, and West Virginia. The old Cherokee lands in Georgia use the term *section* as a land designation, but it does not define the same area as the *section* used by the PLSS. Maine uses a variant of the system in unsettled parts of the state. Parts of Texas, western New York, northwest Pennsylvania, western Georgia, western Kentucky, middle and western Tennessee,[5] and northern Maine use state-developed survey systems similar to PLSS.[6]

1860 survey of Louisiana showing "Davenport Claims" and "Rejected Claim of the Baron de Bastrop", among others


This post office application from 1866 shows the four square Spanish leagues of the pre-statehood Los Angeles Pueblo within the township-range system.

Other major exceptions to PLSS are:

- California, before statehood in 1850, was only crudely surveyed with the boundaries of Spanish and Mexican land grants (*ranchos*); since statehood the PLSS was used to convey government lands.
- Georgia surveyed its remaining central and western lands into a grid of land lots. Most were surveyed from 1819 through 1821 immediately upon the cession of all former Spanish lands to the U.S.
- Hawaii adopted a system based on the Kingdom of Hawaii native system in place at the time of annexation.
- Louisiana recognizes early French and Spanish descriptions called *arpents*, particularly in the southern part of the state, as well as PLSS descriptions.

- Alabama recognizes Spanish-era land claims, especially near the coast.
- New Mexico uses the PLSS but has several areas that retain original metes and bounds from Spanish and Mexican rule. These take the form of land grants similar to areas of Texas and California. As an extension, there are some New Mexico based Mexican land grants in south central Colorado.
- Ohio's Virginia Military District was surveyed using the metes and bounds system. Areas in northern Ohio (the Connecticut Western Reserve and United States Military District) were surveyed with another standard, sometimes referred to as Congressional Survey townships, which are five miles (8 km) on each side instead of the six miles standard implemented by the PLSS.
- Texas has a hybrid of its own early system, based on land grants made in Spanish Texas, and a variation of the PLSS.
- Wisconsin had French settlement prior to the PLSS in the areas of Green Bay and Prairie du Chien. Both areas were initially divided using the French *Long Lot* system along the water frontage. The most noticeable artifact of this system is visible on maps and satellite images in that the general street grids of Green Bay, Allouez, Ashwaubenon and De Pere are all aligned to the Fox River, being rotated about 25° from north, in contrast to the standard east-west grid of the surrounding townships in Brown County.
- Michigan had French settlement prior to the PLSS along the Detroit and St. Clair rivers, and near Sault Ste. Marie, Marquette, and Ypsilanti. These are all examples of the French *long lots*.
- Parts of Washington, Oregon, Idaho and Wyoming were settled as Donation Land Claims. Some were established before the Willamette Meridian, and those established after were often poorly surveyed and did not correspond to the PLSS.

Survey design and execution

Commonly used terms

- *Aliquot part*: A terse, hierarchical reference to a piece of land, in which successive subdivisions of some larger area are appended to the beginning of the reference. For example, SW1/4 NW1/4 S13, T1SR20E refers to the southwest quarter of the northwest quarter of section 13 of Township 1 South Range 20 East (a 40-acre parcel). See further discussion below.

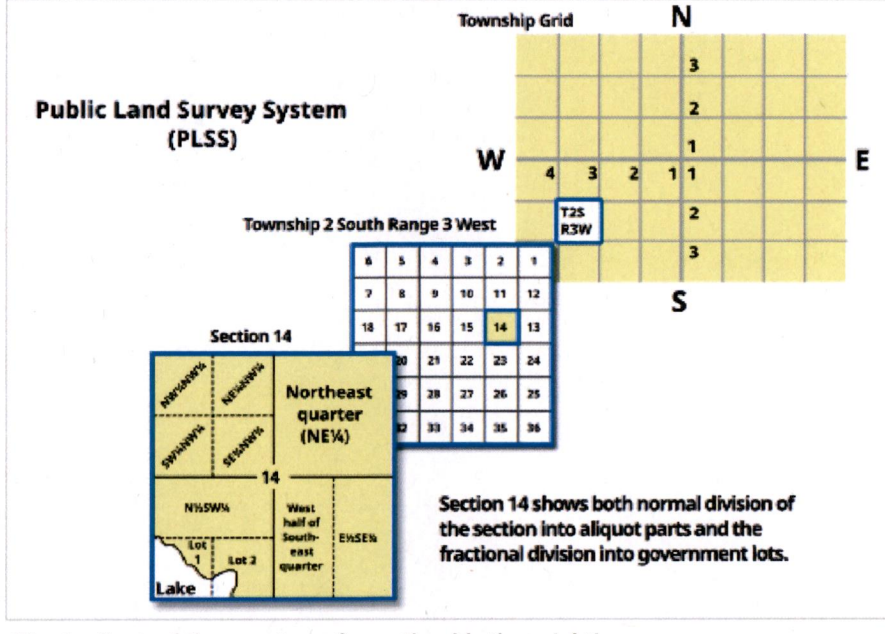


Illustration of the system from the National Atlas

- *Base Line*: A parallel of latitude, referenced to and established from a designated initial point, upon which all rectangular surveys in a defined area are based. Also spelled *baseline*.
- *BLM*: Bureau of Land Management, the successor agency to the General Land Office
- *Cadastral*: Having to do with the boundaries of land parcels.
- Corner: The point of intersection of any two actual or potential survey lines, defining one corner of a rectangular land parcel.
- *Lot*: A subdivision of a section which is not an aliquot part of the section but which is designated separately. A lot is typically irregular in shape, and its acreage varies from that of regular aliquot parts.
- *Initial point*: The starting point for a survey; the intersection point of the Principal meridian and the Base line in a given region.
- *Land grant*: Historically a land grant is an area of land to which title was conferred by a predecessor government, usually English/British, Spanish or Mexican, and confirmed by the U.S federal courts after the territory was acquired by the United States.
- Monumentation: Placement and/or marking of physical objects on the ground to mark survey points and lines.
- *Original survey:* The first official government survey in a given area. Unless fraud is proven, the original survey is legally valid and binding, regardless of any surveying errors that may have occurred. All subsequent subdivision, sale, etc. must proceed from the original survey. In the United States, most original surveys were done under contract with the General Land Office.
- *Principal meridian* (PM): A true meridian running through an initial point, which together with the baseline form the highest level framework for all rectangular surveys in a given area. The list of all principal meridians is given below.
- *Public domain (land)*: Land owned and managed by the Federal government. Synonymous with public lands. National Parks and National Forests are a large part of the public domain land today. The original public domain included the lands that were turned over to the Federal Government by the original thirteen states and areas acquired from the native Indian tribes or foreign powers.
- *Range* (Rng, R): A measure of the distance east or west from a referenced principal meridian, in units of six miles.
- *Section*: An approximately one-square-mile block of land. There are 36 sections in a survey township.
- *Township* (Twp, T): A square parcel of land of 36 square miles, or a measure of the distance north or south from a referenced baseline, in units of six miles.
- *Witness*: Any marker set on the ground that marks or represents some other nearby object or location of surveying importance, such as a corner. For example, a bearing tree is a witness to a survey corner.

Design

The surveying of any regional area, such as a state or multiple states, is a multi-step process. First, two controlling survey lines are established: a baseline which runs east–west and a principal meridian which runs north–south. The locations of the two are determined by a

previously chosen initial point, where they originate and thus intersect. Next, at a defined distance interval, commonly 24 or 30 miles (48 km) depending on the year and location, standard parallels of latitude are established parallel to the baseline. The meridian, baseline and standard parallels thus established form a lattice upon which all further surveying is then based. Subsequent work divides the land into survey townships of roughly 36 square miles (93 km^2) or 6 miles (9.7 km) on each side. This is done by the establishment of township and range lines. Township lines run parallel to the baseline (east-west), while range lines run north–south; each are established at 6-mile intervals. Lastly, townships are subdivided into 36 sections of approximately 1 square mile (640 acres; 2.6 km^2) and sections into four quarter-sections of 0.25 square miles (160 acres; 0.65 km^2) each. The intersection of a township line (or baseline) with a range line (or principal meridian) constitutes a *township corner*, of a section line with any other type of line a *section corner*, and a point halfway between any two section corners a *quarter corner*. The federal government typically surveyed only to this quarter-section level, the subdivision of smaller parcels being carried out subsequently by private surveyors after original sale.

Because the survey design is two-dimensional (rectangular), while the actual Earth is three-dimensional (approximately spherical and topographically), adjustments to land areas must be made periodically to prevent error propagation; not all sections can be one square mile nor can all townships be exactly 36 square miles. More specifically, all north–south running lines (all range lines and half of all section lines), as with the prime meridian, are always established with reference to true, geodetic north. But it is a physical impossibility to meet this condition and still maintain a rectangular land grid, because such lines converge on the north pole.

These adjustments are done at two different scales. At the small scale (within a township) it is done by starting the sectional surveys (township "subdivisions") in the southeast corner and moving progressively toward the northwest corner. The algorithm used is to move northward to establish the six easternmost sections (and quarter-sections), then move west at one mile intervals, parallel to the eastern boundary of the township, repeating this process, until the western side of the township is reached. The result of this is that the northernmost and westernmost tiers of sections—11 in all—are thus allowed to deviate from one square mile, but the other (southeasterly-most) 25 sections are not. This method accommodates the curvature problem within a township and also allows for any errors made during the surveying—which were nearly unavoidable because of the physical difficulty of the work and the crude equipment used—without overly compromising the basic rectangular nature of the system as a whole. At the larger multiple township scale, the standard parallels developed at the establishment of the baseline, so that townships widths do not continually decrease as the grid proceeds north (and is in fact the primary reason for their establishment). Thus, corrections for curvature of the Earth exist at two separate spatial scales—a smaller scale within townships and a larger scale between multiple townships and within standard parallels.

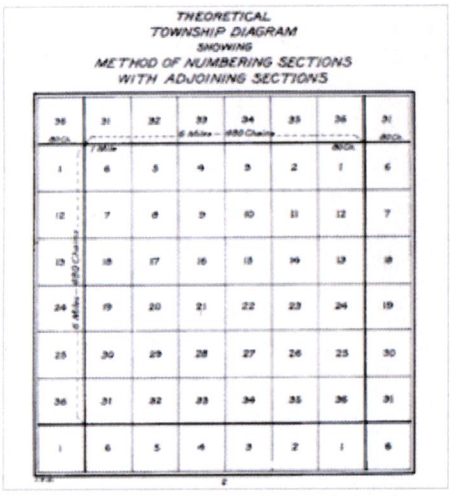


Figure 2. This United States General Land Office diagram shows the theoretical sectioning of a standard survey township.

A specific and terse location descriptor is always used, in which the townships and sections are indexed based on (1) the township's position relative to the initial point, (2) the section's location within the designated township, and (3) the principal meridian reference. Township, range, and section are abbreviated as T, R, and S, respectively, and cardinal bearings from the initial point by N, S, E, and W; each principal meridian also has its established abbreviation. Thus, for example, the description "T1SR20E S13 MDM" reads as follows: Township 1 South, Range 20 East, Section 13, Mount Diablo Meridian. That is, the 13th section in the first township south of the baseline (in this case, the Mount Diablo Baseline) and the 20th township east of the principal meridian (the Mount Diablo Meridian). Since township and range lines are six miles apart, the "T1SR20E" part of the designation instantly places the location somewhere between zero and six miles south of the baseline, and 114 and 120 miles east of the principal meridian. Knowing how sections are numbered within townships, section 13 is identified as therefore occupying the one square mile located 2 to 3 miles south, and 119 to 120 miles east, of the Mount Diablo initial point (in central California). Note that the sections within a township are numbered in an unconventional, Boustrophedon pattern (Fig. 2), in which alternating rows are numbered in opposite directions, starting from section 1 in the northeast corner and ending with section 36 in the southeast corner, as per Figure 2. Therefore, section 13 is adjacent to the eastern range line of the designated township. Numbering in this pattern ensures that numerically sequential sections within the same township are physically adjacent and share colinear boundaries.

Measurement

Distances were always measured in chains and links, based on Edmund Gunter's 66-foot measuring chain. The chain – an actual metal chain – was made up of 100 links, each being 7.92 inches (201 mm) long. Eighty chains constitute one U.S. survey mile (which differs from the international mile by a few millimeters). There were two chainmen, one at each end, who physically made the measurements, one of them typically also acting as "compassman" to establish the correct bearing at each chain placement. In forested areas, it was essential for rapid progress and accuracy that the lead chainman follow the correct bearing at all times, since no straightening of the chain was possible without backtracking around trees and re-measuring. It was also necessary to keep the chain level, since all surveying distances are based on the horizontal, not slope, distance. In steep terrain, this meant shortening the

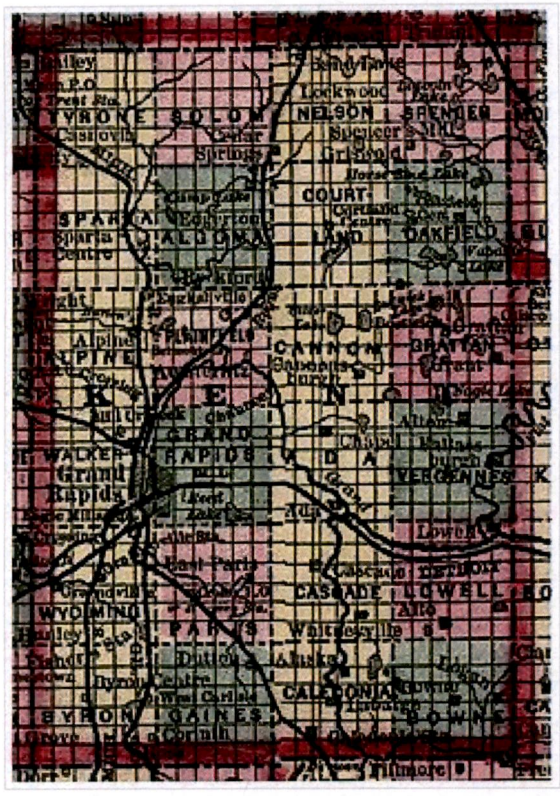


Figure 3. Kent County, Michigan in 1885 as a PLSS example, showing 24 named townships and sectional subdivisions.

chain, raising one end of the chain relative to the other, or both. In areas where measuring by chain was not possible, such as extremely steep terrain or water obstructions, distances were calculated by triangulation.

Monumentation

Monumentation is the establishment of permanent on-the-ground objects that mark exact locations of surveyed points and lines. They are the legally binding markers used for setting property lines and as such are the culminating work of any survey. They consist of both corner monuments as well as nearby accessory objects that "witness" to them. Witness objects allow subsequent surveyors and landowners to find the original corner monument location should the monument be destroyed. It was not uncommon for squatters or homesteaders to destroy corner monuments if they felt the patenting of the land would threaten their residence on it. For this reason, destruction of corner monuments, or their accompanying witness objects was, and still is, a federal offense.

At corners, *corner monuments* are established to mark their exact location on the ground. As with most PLSS specifications, those for corner monumentation also changed over time. In the 19th century, monuments were commonly a rock pile, a wooden post, or a combination of the two. Trees could be used if the corner happened to fall at the exact spot where one grew. In the 20th century, steel pipes with caps, supported by mounds of rock, became required (for example, see Fig. 4). Witnesses can be trees, rocks, or trenches dug in the ground; their exact locations relative to the corner, and the markings made on them, are also recorded in the surveyor's official fieldnotes. Witness trees at corners are more commonly referred to as bearing trees because the exact distance and bearing from the corner, to them, was required to be recorded (as well as the taxon and diameter).

On each bearing tree, two blazes were typically required, one about chest height and easily visible, and one at ground level (in case the tree were illegally cut, the stump remaining). On the exposed wood of the blaze, surveyors were required to inscribe, with wood chisels, township, range and section information, on typically either two or four bearing trees, if they were within some reasonable distance of the corner (unspecified early on but later set at a maximum of 3 chains (178 feet, 60 meters) away). Bearing trees are of vital importance not just for these land boundary purposes but also for their use by ecologists in the estimation of

historic forest vegetation conditions before settlement and large scale human disturbance of the land. The data provided in these surveys provide a definitive estimate of original forest composition and structure, and the data have accordingly been used heavily.

Along survey lines, monumentation was much less elaborate, consisting primarily of only the blazing and some simple scribing of trees directly on, or very close to, the survey line. The purpose was to help retrace a surveyed line should that become necessary. It was also additional proof that the line had in fact been run correctly, especially in those cases where the blazed line tree's pertinent information (species, diameter and distance from previous corner) was recorded in the fieldnotes, as was often required.

Figure 4. The cast and stamped cap on a corner monument pipe, in western Yosemite National Park, placed in 1905 during the Park boundary resurvey.

Information to be recorded

Records kept by the surveyors during the execution of the work varied over time. Furthermore, how well individual surveying parties actually met the requirements or recommendations at the time, also varied. The following is a list[7] of the more commonly required landscape and surveying items that were either required or requested be noted, over much of the nineteenth century.

- The precise length of every line run, noting all necessary offsets therefrom, with the reason and mode thereof.
- The species and diameter of all "bearing trees", with the course and distance of the same from their respective corners; and the precise relative position of witness corners to the true corners.
- The kinds of materials (earth or stone) of which mounds are constructed—the fact of their being conditioned according to instructions—with the course and distance of the "pits", from the centre of the mound, where necessity exists for deviating from the general rule.
- The name, diameter, and distance on line to all trees which the line intersects.
- The distance at which the line first intersects and then leaves every settler's claim and improvement; prairie; river, creek, or other "bottom"; or swamp, marsh, grove, and wind fall, with the course of the same at both points of intersection; also the distances of ascents, summits, and descents of all remarkable hills and ridges, with their courses and estimated height, in feet, above the level land of the surrounding country, or above the bottom lands, ravines, or waters near which they are situated.
- All streams of water which the line crosses; the distance on line at the points of intersection and their widths on line. In cases of navigable streams, their width will be ascertained between the meander corners, as set forth under the proper head.

- The land's surface, whether level, rolling, broken, or hilly.
- The soil, whether first, second, or third rate.
- The several kinds of timber and undergrowth, in the order in which they predominate.
- Bottom lands were to be described as wet or dry, and if subject to inundation, state to what depth.
- Springs of water, whether fresh, saline, or mineral, and the course of the stream flowing from them.
- Lakes and ponds, describing their banks and giving their height, and also the depth of water and whether it be pure or stagnant.
- Towns and villages; Indian towns and wigwams; houses or cabins; fields, or other improvements; sugar tree groves, sugar camps, mill seats, forges, and factories.
- Coal banks or beds; peat or turf grounds; minerals and ores; with particular description as to quality and extent, and all diggings therefore; also salt springs and licks. All reliable information that could be obtained respecting these objects, whether they be on the immediate line or not, was to appear in the general description at the end of the notes.
- Roads and trails, with their directions, whence and whither.
- Rapids, cataracts, cascades, or falls of water, with the height of their fall in feet.
- Precipices, caves, sink-holes, ravines, stone quarries, ledges of rocks, with the kind of stone they afford.
- Natural curiosities, interesting fossils, petrifactions, organic remains; ancient works of art, such as mounds, fortifications, embankments, ditches, or objects of like nature.
- The variation of the needle must be noted at all points or places on the lines where there is found any material change of variation, and the position of such points must be perfectly identified in the notes.

The following table indicates some distance and area conversions in the PLSS:

	Dimensions (miles)	Area (mi^2)	(acres)	(m^2)	(km^2)	Notes
Quadrangle/check	24 by 24	576	368,640		1,490	Usually 16 townships
Township	6 by 6	36	23,040		93.2	Usually 36 sections
Section	1 by 1	1	640		2.59	
Half-section	1 by ½	½	320	1,290,000	1.29	
Quarter-section	½ by ½	¼	160	647,000		
Half of quarter-section	½ by ¼	⅛	80	324,000		
Quarter of quarter-section	¼ by ¼	1/16	40	162,000		

List of meridians

Name	Adopted	Initial point	State(s)
Black Hills Meridian	1878	43°59′44″N 104°03′16″W	South Dakota
Boise Meridian	1867	43°22′21″N 116°23′35″W	Idaho
Chickasaw Meridian	1833	35°01′58″N 89°14′47″W	Mississippi
Choctaw Meridian	1821	31°52′32″N 90°14′41″W	Mississippi
Cimarron Meridian	1881	36°30′05″N 103°00′07″W	Oklahoma
Copper River Meridian	1905	61°49′04″N 145°18′37″W	Alaska
Fairbanks Meridian	1910	64°51′50.048″N 147°38′25.94″W	Alaska
Fifth Principal Meridian	1815	34°38′45″N 91°03′07″W	Arkansas, Iowa, Minnesota, Missouri, North Dakota & South Dakota
First Principal Meridian	1819	40°59′22″N 84°48′11″W	Ohio & Indiana
Fourth Principal Meridian	1815	40°00′50″N 90°27′11″W	Illinois
Fourth Principal Extended Meridian	1831	42°30′27″N 90°25′37″W	Minnesota & Wisconsin
Gila and Salt River Meridian	1865	33°22′38″N 112°18′19″W	Arizona
Humboldt Meridian	1853	40°25′02″N 124°07′10″W	California
Huntsville Meridian	1807	34°59′27″N 86°34′16″W	Alabama & Mississippi
Indian Meridian	1870	34°29′32″N 97°14′49″W	Oklahoma
Kateel River Meridian	1956	65°26′16.374″N 158°45′31.01″W	Alaska
Louisiana Meridian	1807	31°00′31″N 92°24′55″W	Louisiana
Michigan Meridian	1815	42°25′28″N 84°21′53″W	Michigan & Ohio
Mount Diablo Meridian	1851	37°52′54″N 121°54′47″W	California & Nevada
Navajo Meridian	1869	35°44′56″N 108°31′59″W	Arizona
New Mexico Principal Meridian	1855	34°15′35″N 106°53′12″W	Colorado & New Mexico

Name	Adopted	Initial point	State(s)
Montana Principal Meridian	1867	45°47′13″N 111°39′33″W	Montana
Salt Lake Meridian	1855	40°46′11″N 111°53′27″W	Utah
San Bernardino Meridian	1852	34°07′13″N 116°55′48″W	California
Second Principal Meridian	1805	38°28′14″N 86°27′21″W	Illinois & Indiana
Seward Meridian	1911	60°07′37″N 149°21′26″W	Alaska
Sixth Principal Meridian	1855	40°00′07″N 97°22′08″W	Colorado, Kansas, Nebraska, South Dakota & Wyoming
Saint Helena Meridian	1819	30°59′56″N 91°09′36″W	Louisiana
Saint Stephens Meridian	1805	30°59′51″N 88°01′20″W	Alabama & Mississippi
Tallahassee Meridian	1824	30°26′03″N 84°16′38″W	Florida & Alabama
Third Principal Meridian	1805	38°28′27″N 89°08′54″W	Illinois
Uintah Meridian	1875	40°25′59″N 109°56′06″W	Utah
Umiat Meridian	1956	69°23′29.654″N 152°00′04.55″W	Alaska
Ute Meridian	1880	39°06′23″N 108°31′59″W	Colorado
Washington Meridian	1803	30°59′56″N 91°09′36″W	Mississippi
Willamette Meridian	1851	45°31′11″N 122°44′34″W	Oregon & Washington
Wind River Meridian	1875	43°00′41″N 108°48′49″W	Wyoming

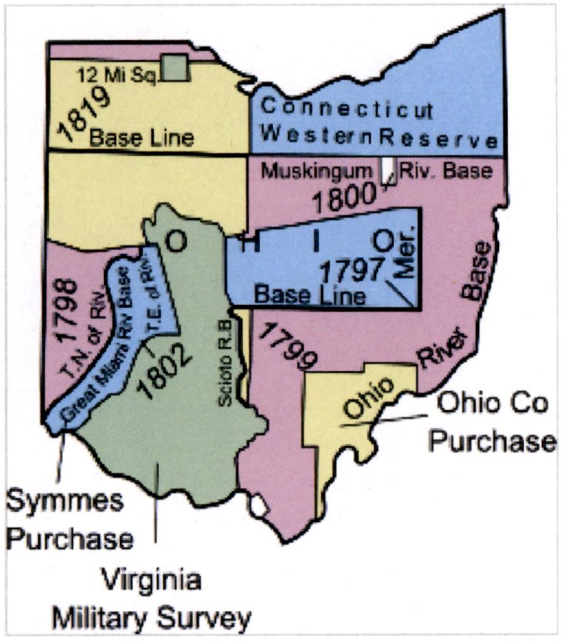
Based on the BLM manual's 1973 publication date, and the reference to Clarke's Spheroid of 1866 in section 2-82, the coordinates listed are believed to be in the NAD27 datum.

List of surveys having no initial point

These public land surveyed had no initial point as an origin for both township and range.[8]

- Between the Miamis, north of Symmes Purchase (Ohio)
- Muskingum River Survey (Ohio)

- Ohio River Base (Indiana)
- Ohio River Survey (Ohio)
- Scioto River Base (Ohio)
- Twelve-Mile-Square Reserve (Ohio)
- United States Military Survey (Ohio)
- West of the Great Miami (Ohio)



Ohio Lands

Social impact

Railroad land grants

The Pacific Railroad Act of 1862 (signed by President Abraham Lincoln) was the first major land grant specifically for the transcontinental railroad. This act provided surveyed, public lands for a railroad right-of-way to build rail systems, and millions of acres to raise the capital needed to build and maintain the future railways.

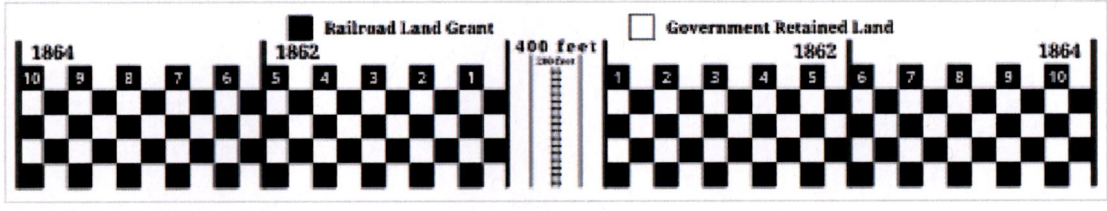


Illustration of railroad land grant layout

Ten square miles of land on each side of the proposed rail track were granted for every one mile of completed railway. The PLSS was utilized for measurement. Every one-mile length of railway completed was akin to a section. If the railway ran predominantly east and west, a 10-mile (16 km) range of one square mile sections was allotted on each side of the 400-foot (120 m) right-of-way. If the railway ran predominantly north and south, a 10-mile (16 km) township of one square mile sections was allotted on each side of the 400-foot (120 m) right-of-way. The land was granted in alternating sections (one square mile), with each odd numbered section going to the railroad company and each even numbered section kept by the government. This created a checkerboard pattern along proposed railways. This was supposed to guarantee that railroad access would increase the value of both the railroad-granted sections and the government-owned sections in the checkerboard. The system was devised by Senator Stephen A. Douglas, with political support from Senator Jefferson Davis.[9]

Education

Under the 1785 act, section 16 of each township was set aside for school purposes and as such was often called the *school section*. Section 36 was also subsequently added as a school section in western states.[10] The various states and counties ignored, altered or amended this provision in their own ways, but the general (intended) effect was a guarantee that local schools would have an income and that the community schoolhouses would be centrally located for all children. An example of land allotments made specifically for higher education is Ohio's College Township.

Survey fraud

There were numerous incidents of fraudulent or bad surveying reported, arguably in nearly every state. The remote nature of the land being surveyed certainly enabled the opportunity for fraud to occur. The most notorious, large scale, and costly fraud was perpetrated by the Benson Syndicate, operating primarily in California in the 1880s.[11]

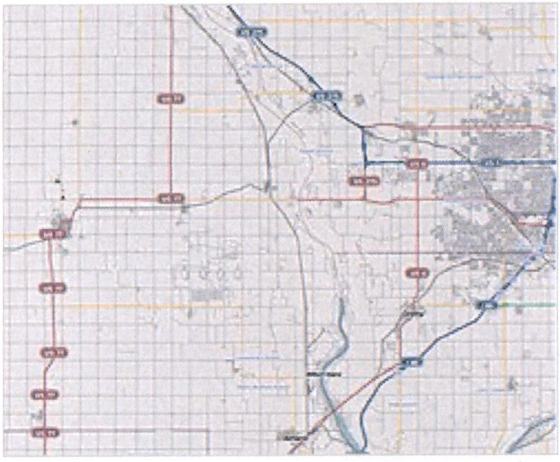
Metric system adoption

The PLSS is considered one of the major points of contention in the adoption of the metric system in the United States. The PLSS has used the Gunter's chain as a basic measurement. In Canada, however, where the land survey is based on the same units of measure as the U.S. land survey, the metric system was adopted without issue.

"...the measurements of every plot of ground in the United States have been made in acres, feet, and inches, and are publicly recorded with the titles to the land according to the record system peculiar to this country." —Franklin Institute of Philadelphia (1876). Because of this, redefining property boundaries could create a large amount of legal issues and property owner confusion. Many local zoning laws are defined in feet/square feet. Conversion of units for surveyors are not simple, and complex decisions are frequently required (such as non-universal conversion factors, soft/hard conversions, number rounding).

Urban design

As roads have typically been laid out along section boundaries spaced one mile (1.6 km) apart, growing urban areas have adopted road grids with mile-long "blocks" as their primary street network. Such roads in urban areas are known as *section line roads*, usually designed primarily for automobile travel and limited in their use for non-motorized travel. In post-World War II suburbs, commercial development has largely occurred along and at intersections of arterials, while the rest of the former square-mile sections have generally filled with residential development, as well as schools, religious facilities, and parks. One example of this is the Mile Road System of Detroit, Michigan.



Example of road system in a PLSS area; Nebraska

Example of road system in a non-PLSS area; North Carolina

Occasionally, and more frequently in a metropolitan region's inner postwar suburbs than in outer areas, arterials are at approximately half-mile intervals. This strictly regimented urban (or suburban) structure has coincided with the similarly strict practice of Euclidean zoning (named after the town of Euclid, Ohio, which won a 1926 Supreme Court case *Village of Euclid, Ohio v. Ambler Realty Co.*, which established the constitutionality of zoning). In Euclidean zoning, use of a property is dictated and regulated by zoning district, the boundaries of which are often based on locations of arterials.

West of the Appalachians, road systems frequently follow the PLSS grid structure. The results can be 90-degree intersections and very long stretches of straight roads.[12][13]

Popular culture

The land system is an important part of American history and culture. Among other things, the stock phrases "lower 40", "front 40", "back 40", and "40 acres and a mule", which are sometimes heard in American movies, reference the quarter-quarter section. The "lower 40" in a quarter-section is the one at lowest elevation, i.e. in the direction that water drains. The "lower 40" is frequently the location of or the direction of a stream or a pond. The phrase "40 acres and a mule" was the compensation apocryphally promised by the Freedmen's Bureau following the American Civil War.

Homesteading, a staple of American western culture, was dependent on the PLSS. In the original Homestead Act of 1862, during the Lincoln administration, each settler was allocated 160 acres (0.65 km^2) of land, a quarter-section. Later amendments of the Homestead Act allocated more land, as much as 640 acres (2.6 km^2), a section. This was a good revision to apply to land that was drier or more desolate than the earlier, more desirable lands that had already been settled. Many times, this land was more suited to ranching than to farming.

See also

United States portal

- Cadastre#United States
- Dominion Land Survey (Canada)
- Great Trigonometrical Survey (Indian subcontinent)
- Groma surveying
- Louisiana Purchase State Park (beginning point of the Louisiana Purchase survey)
- Lot and Block survey system
- *Indian Land Cessions in the United States*
- History of surveying in the United States
- Hydrologic unit system (United States)

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Further reading

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External links

- LSD + GPS + UTM coordinates (batch) conversion (https://web.archive.org/web/20160420031308/http://www.baseloc.com/dls/) - free map converters & tools
- Bureau of Land Management (https://www.blm.gov/)
  - Manual of Instructions for the Survey of the Public Lands of the United States, 2009 (http://www.blmsurveymanual.org/index.html)
  - Manual of Instructions for the Survey of the Public Lands of the United States, 1973 (https://web.archive.org/web/20070607224548/http://www.blm.gov/cadastral/Manual/73man/) (as PDF (https://web.archive.org/web/20070607114423/http://www.blm.gov/az/cadastral/manual/manindex.htm)) - official manual for PLSS
  - Resources page of the U.S. Department of the Interior, Bureau of Land Management (https://web.archive.org/web/20081011172949/http://www.blm.gov/wo/st/en/prog/more/cadastralsurvey/tools.html)
  - National Land Information System (NILS) (https://web.archive.org/web/20071026123617/http://www.blm.gov/wo/st/en/prog/more/nils.html) - cadastral records and land parcel information including GeoCommunicator below
  - NILS GeoCommunicator (https://web.archive.org/web/20080421183747/http://www.geocommunicator.gov/) - cadastral records and land parcel information
- U.S. Geological Survey (https://www.usgs.gov/)
- National Geodetic Survey (http://www.ngs.noaa.gov/)
- American Congress on Surveying & Mapping (https://web.archive.org/web/20040518123445/http://www.acsm.net/)

- TRS data to latitude/longitude calculator (https://web.archive.org/web/20051124051429/http://www.esg.montana.edu/gl/trs-data.html) - for 17 western U.S. states
- www.resurvey.org (http://www.resurvey.org/) - reference for land surveyors working in the PLSS
- Federal Township Plats of Illinois, 1804-1891 from the Illinois State Archives (http://landplats.ilsos.net/) Archived (https://web.archive.org/web/20100407082341/http://landplats.ilsos.net/) 2010-04-07 at the Wayback Machine
- Researching New Mexico Land Grants (https://web.archive.org/web/20111128012948/http://www.nmcpr.state.nm.us/archives/land_grants.htm)
- IIC Minnesota Historical Vegetation (https://web.archive.org/web/20050907043623/http://iic.gis.umn.edu/finfo/land/histveg2.html)
- The Minnesota Bearing Tree Database (http://files.dnr.state.mn.us/eco/nhnrp/brgtree.pdf)
- The Principal Meridian Project (http://www.pmproject.org/index.htm)
- Locating oil or gas wells using the federal township and range system (http://www.geomore.com/locating-wells/)
- Lists of the coordinates used for section corners in Kansas City, Missouri (https://archive.today/20130415111804/http://www.kcmo.org/CKCMO/Depts/PublicWorks/engSurvey2/gisSurvey/index.htm)
- Wisconsin State Cartographer's Office - Curiosities and trivia about the PLSS (https://web.archive.org/web/20151017133532/http://www.sco.wisc.edu/plss/curiosities-and-trivia.html?qh=YToxOntpOjA7czo2OiJ0cml2aWEiO30%3D)
- Public Land Survey System in Google Earth (http://www.metzgerwillard.us/plss/plss.html) - a free Google Earth implementation of the National Integrated Land System (NILS) GeoCommunicator map service
- Sample of PLSS in ESRI ArcGIS (https://web.archive.org/web/20100618004807/https://maps.alabama.gov/ALGOGIS/rest/services/PLSS/MapServer?f=jsapi) - Alabama PLSS
- Convert PLSS to latitude and longitude (http://legallandconverter.com/p43.html)
- Tools and APIs to convert PLSS to geographic locations and display it on a map (https://www.townshipamerica.com/)
