THE
PUBLIC LAND SURVEY SYSTEM
FOR THE
CADASTRAL MAPPER

FLORIDA ASSOCIATION OF CADASTRAL MAPPERS

In conjunction with

THE FLORIDA DEPARTMENT OF REVENUE

Proudly Presents

COURSE 2

THE PUBLIC LAND SURVEY SYSTEM FOR THE CADASTRAL MAPPER

Objective:

Upon completion of this course the student will:

Have an historical understanding of the events leading up to the PLSS.

Understand the basic concepts of Section, Township, and Range.

Know how to read and locate a legal description from the PLSS.

Have an understanding of how boundaries can change due to nature.

Be presented with a basic knowledge of GPS, Datums, and Map Projections.

Encounter further subdividing of land thru the condominium and platting process.

Also, they will:

Perform a Case Study where the practical applications of trigonometry and coordinate calculations are utilized to mathematically locate the center of the section.

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This information has been collected from many sources including online sources such as Wikipedia. We have endeavoured to be original, accurate and complete, however if any material used herein is previously copyrighted, please contact the Florida Association of Cadastral Mappers for removal and/or recognition.

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Michael Garcia & Matthew Kalus

Day 1

What is the

Public Land Survey System?

The Public Land Survey System for the Cadastral Mapper

Day 1

Introduction and Overview to the PLSS

On September 30, 1785, Thomas Hutchins, first Geographer of the United States, began the Geographer's Line of the Seven Ranges. Thus, in a remote spot on the boundary between Pennsylvania and the Northwest Territories, began an odyssey that continues to this day. Earlier in the year, a congressional ordinance proposed by Thomas Jefferson, was formally adopted by Colonial States initializing the PLSS. The concept began shortly after the Revolutionary War, when the Federal government became responsible for large areas west of the thirteen original colonies. The government wished both to distribute land to Revolutionary War soldiers in reward for their service, as well as to sell land as a way of raising money for the nation. Before this could happen, the land needed to be surveyed.

The Land Ordinance of 1785, providing for the systematic survey and monumentation of public domain lands, and the Northwest Ordinance of 1787, providing for a governmental system which facilitated the rapid transfer of Federal lands to private citizens, were the beginning of the PLSS. Under Congressional mandate, cadastral surveys (surveys of the boundaries of land parcels) of public lands were undertaken to create parcels suitable for disposal by the Government. The extension of the rectangular system of surveys over the public domain has been in progress since 1785, and, where it applies, the PLSS forms the basis for most land transfers and ownership today. The current official document that deal with the procedures for surveying using the PLSS method is the Manual of Instructions for the Survey of the Public Lands Of The United States, 1973.

Certain lands were excluded from the public domain and were not subject to survey and disposal. These lands include the beds of navigable bodies of water, national installations such as military reservations and national parks, and areas such as land grants that had already passed to private ownership prior to subdivision by the Government. France, Spain, and Mexico all conferred land grants in territory they claimed; many of these grants were confirmed by the U.S Government when the territory in which they were situated was acquired by the United States, and the land was then excluded from the public domain.

Over the past two centuries, almost 1.5 billion acres have been surveyed into townships and sections. The Bureau of Land Management (BLM) is the Federal Government's official record keeper for over 200 years' worth of cadastral survey records and plats. In addition, the BLM is still completing numerous new surveys each year, mostly in Alaska, as well as conducting resurveys to restore obliterated or lost original survey corners.

"The rectangular survey system extends across the land in huge networks of lines. These are not imaginary lines; they are real lines that have been surveyed by many men. They cross open prairies, swamps, canyons, and mountains. They are blazed through forests and cut narrowly through nearly impenetrable brush. They are marked by stakes, pits, mounts, marked stones or iron posts."

(Cazier - http://www.nationalcad.org/onlineed/gis/PartOneHistory.html)

Day 1

Surveying in Colonial America Prior to the PLSS

Land titles in North America are largely based upon the “Right of Discovery” by European explorers. In 1498, in the name of the King of England, John Cabot laid claim to the east coast of North America between the 38th and the 67th degree of latitude, after making landfall at Cape Bonavista in Newfoundland. In 1512, Ponce De Leon claimed Florida in the name of the Spanish sovereign. In 1680, LaSalle claimed the Louisiana Territory in the name of the King of France.

The United States of North America, with the British territories (Charing Cross, 1793)
Library of Congress Geography and Map Division Washington, D.C.

Day 1

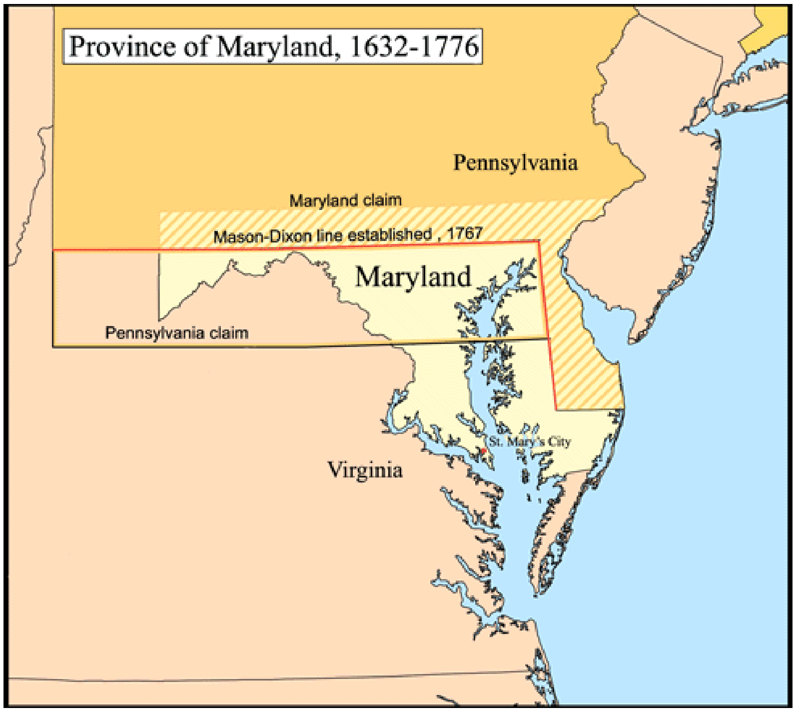
The London Virginia Company

In the seventeenth century several attempts were made, mostly by the British, to start settlements in North America. Large portions of land along the Atlantic coast were granted by the British Crown to various companies. These often conflicting royal grants were usually bounded by a parallel of latitude that extended from the Atlantic Ocean to the Mississippi River. The first successful English colony was Jamestown, Virginia, established in 1607 on a small river near Chesapeake Bay. The venture was financed and coordinated by the London Virginia Company, a joint stock company looking for gold. The territory granted to the London Company included the coast of North America from the 34th parallel (Cape Fear) north to the 41st parallel.

Captain John Smith’s Map of Virginia (dated 1606).

Day 1

Mason–Dixon Line



The Mason-Dixon Line was surveyed between 1763 and 1767 by Charles Mason and Jeremiah Dixon in the resolution of a border dispute between the colonies of Maryland, Pennsylvania, Virginia, and eventually Delaware. It forms a demarcation line among four U.S. states, forming part of the borders of Maryland, Delaware, Pennsylvania, and West Virginia (then part of Virginia).

Maryland's charter granted the land north of the entire length of the Potomac River up to the 40th parallel. A problem arose when Charles II granted a charter for Pennsylvania. Pennsylvania's grant defined the colony's southern boundary as following Twelve Mile Circle counter-clockwise from the Delaware River until it hit "the beginning of the fortieth degree of Northern latitude." From there the boundary was to follow the 40th parallel due west for five degrees of longitude. But the 40th parallel does not in fact intersect the Twelve Mile Circle, instead lying significantly farther north. Thus Pennsylvania's southern boundary as defined in its charter was contradictory and unclear. The most serious problem was that the Maryland claim would put Philadelphia, the site of which Penn had already selected for his colony's capital city in Pennsylvania, within Maryland.

Negotiations ensued after the problem was discovered in 1681. The issue remained unresolved until the Crown intervened in 1760, ordering that Maryland's border with Delaware was to be based on the Transpeninsular Line and the Twelve-Mile Circle around New Castle. The Pennsylvania-Maryland border was defined as the line of latitude 15 miles south of the southernmost house in Philadelphia. As part of the settlement, the Penn’s and Calvert’s commissioned the English team of astronomer Charles Mason and surveyor Jeremiah Dixon to survey the newly established line.

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The Mason-Dixon Line was marked by stones every mile and "crownstones" every five miles, using stone shipped from England. The Maryland side says (M) and the Delaware and Pennsylvania sides say (P). Crownstones include the two coats-of-arms. Today, while a number of the original stones are missing or buried, many are still visible, resting on public land and protected by iron cages.

A "crownstone" boundary monument on the Mason-Dixon Line. The coat of arms of Maryland's founding Calvert family is shown. On the other side are the arms of William Penn.

In April 1765, Mason and Dixon began their survey of the more famous Maryland-Pennsylvania line; there being four distinct segments, or lines, that made up the terms of the settlement between the Calverts and the Penns. They were commissioned to run it for a distance of five degrees of longitude west from the Delaware River, fixing the western boundary of Pennsylvania. However, in October 1767, at Dunkard Creek near Mount Morris, Pennsylvania, nearly 244 miles (393 km) west of the Delaware, a group of Native Americans forced them to quit their progress.

In 1784, surveyors David Rittenhouse and Andrew Ellicott and their crew completed the survey of the Mason-Dixon line to the southwest corner of Pennsylvania, five degrees from the Delaware River.

David Rittenhouse (April 8, 1732 – June 26, 1796) was a renowned American astronomer, inventor, clockmaker, mathematician, surveyor, scientific instrument craftsman and public official. Rittenhouse was a member of the American Philosophical Society and the first director of the United States Mint.

David Rittenhouse made many breakthroughs during his life, which were great contributions to the U.S. His 1763-1764 survey of the Delaware-Pennsylvania border was a 12-mile circle about the Court House in New Castle, Delaware, to define the northern border of Delaware. Rittenhouse's work was so precise and well-documented that it was incorporated without modification into Charles Mason and Jeremiah Dixon's survey of the Pennsylvania-Maryland border.

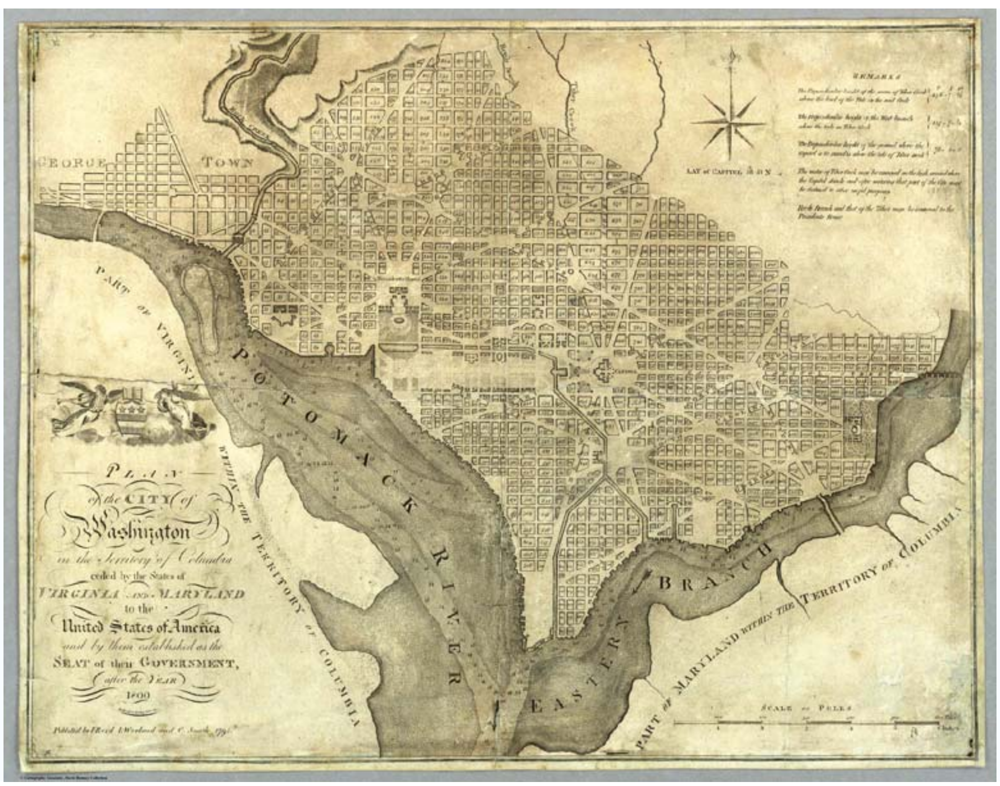
Benjamin Franklin named Rittenhouse in his will, leaving him a telescope in return for the use of Rittenhouse's observatory.

Day 1

Andrew Ellicott (January 24, 1754 – August 28, 1820) was a U.S. surveyor who helped map many of the territories west of the Appalachians, completed the plan and surveyed the boundaries of Washington D.C and served as a teacher in survey methods for Meriwether Lewis.

In 1784 he worked alongside David Rittenhouse extending the survey of the Mason-Dixon line. Then in 1786, he was called upon for a survey to define the western border of Pennsylvania. This "Ellicott Line" (running north-south at longitude 80°31'12" W) later became the base line for the surveys of the Northwest Territory.

In surveying the boundaries of the District of Columbia, he was assisted by the free African-American astronomer Benjamin Banneker. Ellicott's team put into place forty boundary stones approximately one mile apart from each other that marked the borders of the 100 square mile Territory of Columbia. Most of these stones remain in their original positions.



John Reid’s 1795 Map of Ellicott's "Plan of the City of Washington in the Territory of Columbia". David Rumsey Collection

Day 1

Southern U.S.-Spanish Boundary

(Territory of Florida)

In 1796, George Washington commissioned Ellicott as the U.S. representative on the commission for the survey of the border between the Spanish territories in Florida and the United States. "Ellicott's Line" from this survey, running along latitude 31°N, still defines the border between Alabama and Florida. One of his markers for the boundary line survives to this day and bears his name, Ellicott's Stone.

The Public Lands of the United States

After the American Revolution, a new nation was now born. The claims to the vacant lands west of the Appalachian Mountains, east of the Mississippi River and north of Florida were claimed by seven of the original thirteen colonies. The seven colonies ceded their claims in accordance with the October 10, 1780 resolution of the Continental Congress.

“Lands ceded to the United States by the Colonial States shall be disposed of for the common benefit of the United States, and shall be granted or settled at such time and under such regulations as shall hereafter be agreed on by the United States in Congress assembled.”

These ceded lands, now forming the states of Ohio, Michigan, Indiana, Illinois, Wisconsin, part of Minnesota, Alabama and Mississippi were thereafter called “The Public Lands of the United States.

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History of the Public Land Survey System

The first rectangular surveys were conducted in Ohio beginning where the west boundary of Pennsylvania crossed the north shore of the Ohio River. By 1805 the survey system was stabilized and surveys spread westward. In 1812 Congress created the General Land Office to manage the surveying and focus on land conveyance. The first consolidation of officially authorized Federal surveying procedures, the Oregon Manual of Surveying Instructions, was published in 1851. Nine subsequent revisions have led to the Manual of Instructions for the Survey of the Public Lands Of The United States, 1973, which itself is currently in revision. Today, the rectangular survey, also known as the Public Land Survey System (PLSS), is overseen by the U. S. Department of the Interior, Bureau of Land Management.

The PLSS is based upon three principles in land administration:

1. Survey the land before it is conveyed
2. A mathematically designed plan to be followed throughout the entire area of the public domain
3. Creation of a standard land unit (the Township), a tract of uniform shape and with boundaries physically marked on the ground.

Surveying, in general, is the art of measuring and locating lines, angles, and elevations on the surface of the earth, within underground workings, and on the beds of bodies of water. A 'cadastral survey' creates (or re-establishes), marks, and defines boundaries of tracts of land. In the general plan this includes a field-note record of the observations, measurements, and monuments descriptive of the work performed and a plat that represents the cadastral survey, all subject to approval of the Director, Bureau of Land Management." (Manual of Surveying Instructions, 1973)

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Edmund Gunter, and his Chain:

“For plotting of ground, I hold it fit to use a chaine of foure perches in length, divided into an hundred links.” so states Edmund Gunter in his1624 book describing the practical aspects of a device that was to revolutionize the concept of surveying forever. The perch, also known as a pole or rod, was typically 16 ½ feet in length, with four square perches being the amount on farmer could work in one day. Note also that 40 of these one day plots yielded an acre, and 640 acres comprised a square mile, all of which could easily be quartered up, or factored by a unit of 4. Gunter’s Chain was unique, not only that it could measure these odd types of land units, but that it was also capable of figuring measurements in a newly developed type of numeric system, the decimal or 10 based system, thereby allowing for both types of systems to be used simultaneously. An area 20 chains by 20 chains, or 400 square chains, when divided by 10 turns out to be 40 acres. 80 chains by 80 chains, or 1 square mile, returns 640 acres (80 x 80 /10).

A typical example of a Gunter’s chain: 66 feet long, made up of 100 links.

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The Land Ordinance of 1785

United States, and thereupon submit the following Resolution.[1]

FRIDAY, MAY 20, 1785.

Congress assembled. Present as yesterday.

Congress proceeded in the third reading of the Ordinance for ascertaining the mode of disposing of lands in the western territory, and the same being gone through, was passed as follows:

An Ordinance for ascertaining the mode of disposing of Lands in the Western Territory.

Be it ordained by the United States in Congress assembled, that the territory ceded by individual States to the United States, which has been purchased of the Indian inhabitants, shall be disposed of in the following manner:

A surveyor from each state shall be appointed by Congress, or a committee of the States, who shall take an Oath for the faithful discharge of his duty, before the Geographer of the United States, who is hereby empowered and directed to administer the same; and the like oath shall be administered to each chain carrier, by the surveyor under whom he acts.

The Geographer, under whose direction the surveyors shall act, shall occasionally form such regulations for their conduct, as he shall deem necessary; and shall have authority to suspend them for misconduct in Office, and shall make report of the same to Congress, or to the Committee of the States; and he shall make report in case of sickness, death, or resignation of any surveyor.

The Surveyors, as they are respectively qualified, shall proceed to divide the said territory into townships of six miles square, by lines running due north and south, and others crossing these at right angles, as near as may be, unless where the boundaries of the late Indian purchases may render the same impracticable, and then they shall depart from this rule no farther than such particular circum-

[1] This report, in the writing of John Lawrance, is in the *Papers of the Continental Congress*, No. 19, III, folio 623. It was read this day, according to the indorsement, and the resolve, as recommended, passed verbatim June 13. Ludwick's memorial is in No. 41, V, folio 411.

31864°—vol. 28—33——25

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376 *Journals of Congress*

stances may require; and each surveyor shall be allowed and paid at the rate of two dollars for every mile, in length, he shall run, including the wages of chain carriers, markers, and every other expense attending the same.

The first line, running north and south as aforesaid, shall begin on the river Ohio, at a point that shall be found to be due north from the western termination of a line, which has been run as the southern boundary of the state of Pennsylvania; and the first line, running east and west, shall begin at the same point, and shall extend throughout the whole territory. Provided, that nothing herein shall be construed, as fixing the western boundary of the state of Pennsylvania. The geographer shall designate the townships, or fractional parts of townships, by numbers progressively from south to north; always beginning each range with number one; and the ranges shall be distinguished by their progressive numbers to the westward. The first range, extending from the Ohio to the lake Erie, being marked number one. The Geographer shall personally attend to the running of the first east and west line; and shall take the latitude of the extremes of the first north and south line, and of the mouths of the principal rivers.

The lines shall be measured with a chain; shall be plainly marked by chaps on the trees, and exactly described on a plat; whereon shall be noted by the surveyor, at their proper distances, all mines, salt springs, salt licks and mill seats, that shall come to his knowledge, and all water courses, mountains and other remarkable and permanent things, over and near which such lines shall pass, and also the quality of the lands.

The plats of the townships respectively, shall be marked by subdivisions into lots of one mile square, or 640 acres, in the same direction as the external lines, and numbered from 1 to 36; always beginning the succeeding range of the lots with the number next to that with which the preceding one concluded. And where, from the causes before mentioned, only a fractional part of a township shall be surveyed, the lots, protracted thereon, shall bear the same numbers as if the township had been entire. And the surveyors, in running the external lines of the townships, shall, at the interval of every mile, mark corners for the lots which are adjacent, always designating the same in a different manner from those of the townships.

The geographer and surveyors shall pay the utmost attention to the variation of the magnetic needle; and shall run and note all lines

So begins the foremost document that begins to lay out the design for all future surveying and land conveyances in the United States. Initiated by the need to supply the Treasury of the newly created nation with much needed cash, this ordinance created the foundation for subdividing and selling of land to the general public.

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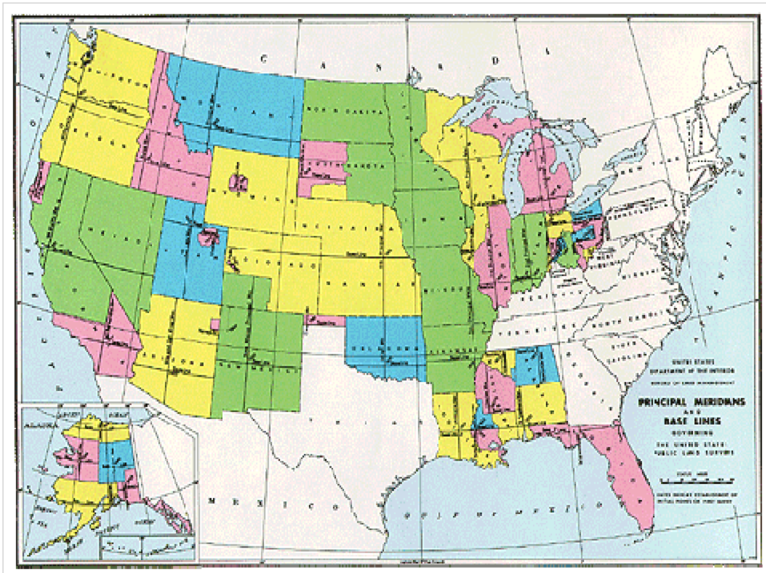
The Public Land Survey System (PLSS) defines a way of subdividing and describing land in the United States. All lands in the public domain are subject to subdivision by this rectangular system of surveys, which is regulated by the U.S. Department of the Interior, Bureau of Land Management (BLM).



The PLSS is used to divide public domain lands, which are lands owned by the Federal government for the benefit of the citizens of the United States. The original public domain included the land ceded to the Federal Government by the thirteen original States, supplemented with acquisitions from native Indians and foreign powers. It encompasses major portions of the land area of 30 southern and western States. Since the original PLSS surveys were completed, much of the land that was originally part of the public domain has been transferred to private ownership and in some areas the PLSS has been extended, following similar rules of division, into non-public domain areas. PLSS rules of division are explained below. For areas that were once part of the public domain, legal land descriptions are usually written in terms of PLSS descriptions.

The PLSS initially divides land into 6-mile-square townships, which is the level of information included in the National Atlas. Townships are then subdivided into 36 one-mile- square sections. Sections can be further subdivided into quarter sections, quarter-quarter sections, or irregular government lots. Normally, a permanent monument, or marker, is placed at each section corner. Monuments are also placed at quarter-section corners and at other important points, such as the corners of government lots. Today permanent monuments are usually inscribed tablets set on iron rods or in concrete. The original PLSS surveys were often marked by wooden stakes or posts, marked trees, pits, or piles of rock, or other less-permanent marker.

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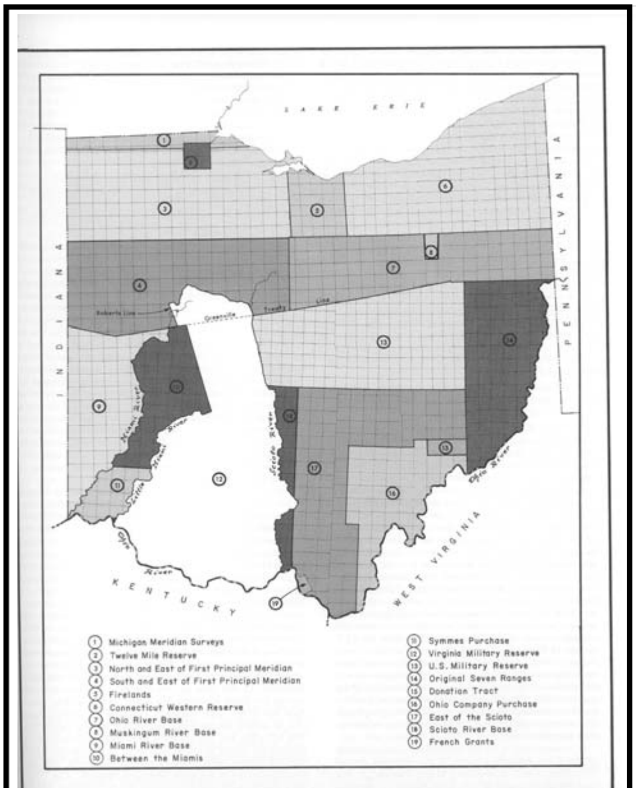
The PLSS actually consists of a series of separate surveys. Most PLSS surveys begin at an initial point, and townships are surveyed north, south, east, and west from that point. The north-south line that runs through the initial point is a true meridian and is called the Principal Meridian. There are 37 Principal Meridians, each is named, and these names are used to distinguish the various surveys. The east-west line that runs through the initial point is called a base line. This line is perpendicular to the Principal Meridian.

Each township is identified with a township and range designation. Township designations indicate the location north or south of the baseline, and range designations indicate the location east or west of the Principal Meridian. For example, a township might be identified as Township 7 North, Range 2 West, which would mean that it was in the 7th tier of townships north of a baseline, and in the 2nd column of townships west of a baseline. A legal land description of a section includes the State, Principal Meridian name, Township and Range designations with directions, and the section number: Nebraska, Sixth Principal Meridian T7N, R2W, Sec 5.

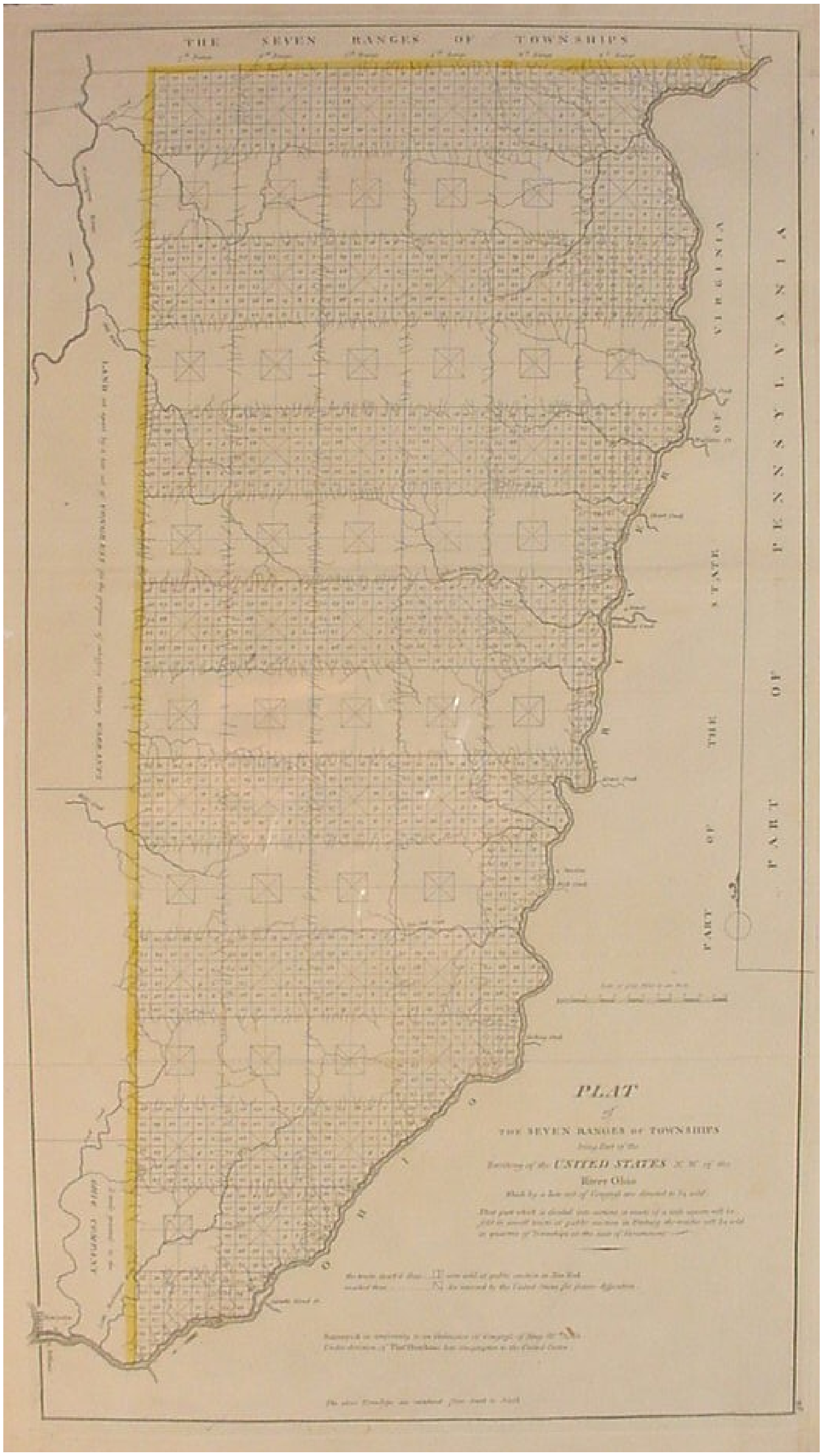
While the original PLSS surveys were supposed to conform to official procedures, some errors were made due either to honest mistakes or to fraudulent surveys. Existing surveys are considered authoritative, and any new surveys must work from existing corners and surveys, in spite of errors in the original surveys and variations from the ideal. This sometimes results in sections that are far from square, or that contain well over or under 640 acres.



Original Ohio Land Subdivisions.

The early surveys in Ohio and Indiana were done when the system currently in use had not yet been fully developed. While these surveys have townships that are 6 miles square, the numbering system used and the types of starting points for the surveys are different from those used elsewhere in the United States. These surveys are also named, although the names are not based on Principal Meridians.

Day 1

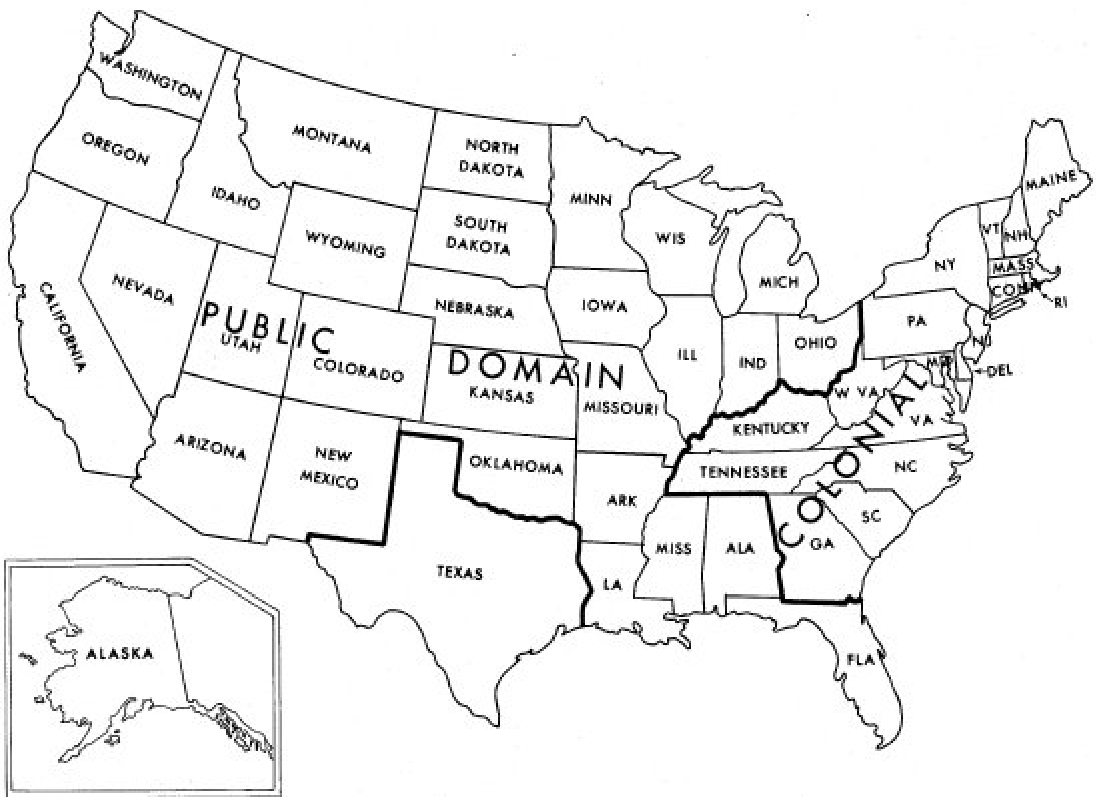


Map of the Seven Ranges

"Surveyed in conformity to an Ordinance of Congress of May 20th, 1785, Under the direction of Thos Hutchins late Geographer to the United States"

Day 1

The PLSS states are the Public Domain states shown below:



<u>The thirty states shown above created out of the public domain are</u>: Alabama, Alaska, Arizona, Arkansas, California, Colorado, Florida, Idaho, Illinois, Indiana, Iowa, Kansas, Louisiana, Michigan, Minnesota, Mississippi, Missouri, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Ohio, Oregon, South Dakota, Utah, Washington, Wisconsin, and Wyoming.

<u>The twenty metes and bounds states which were not surveyed under the PLSS are</u>: Maine, Vermont, Connecticut, Delaware, Georgia, Hawaii, Kentucky, Maine, Maryland, Massachusetts, New Hampshire, New Jersey, New York, North Carolina, Pennsylvania, Rhode Island, South Carolina, Tennessee, Texas, Vermont, Virginia, and West Virginia.

Day 1

The Northwest Ordinance of 1787:

It wasn't sufficient to pass a law for the surveying and sale of land without providing for government in the territory being settled, so the Northwest Ordinance of 1787 was codified. In it were six (6) Articles that dealt with religious freedom, individual and property rights, public schools, navigable waters, number of states, and the outlaw of slavery.

Although the Ordinance itself did not contain any instructions on surveying, it provided for policies over vast tracts of land that encouraged rapid settlement. This in turn created the need for surveys and Government Land Offices. In the years to come, surveyors would be very busy men indeed.

http://en.wikipedia.org/wiki/File:Statecessions.png

Day 1

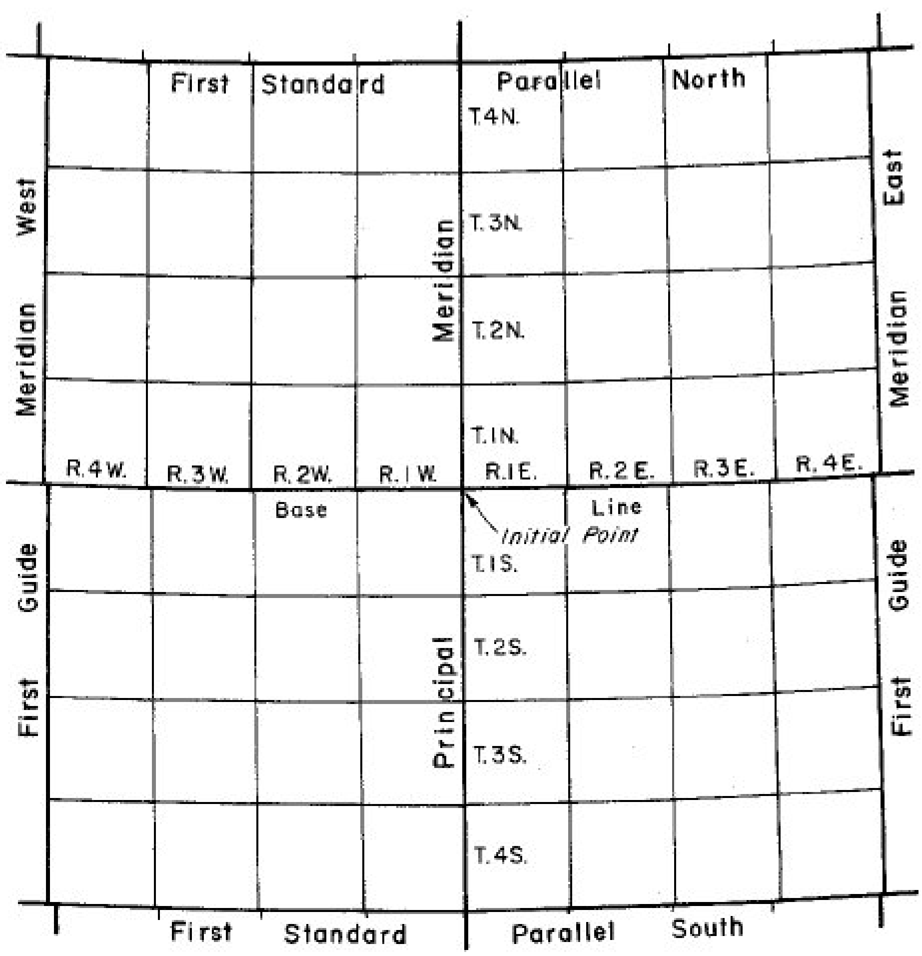
How the Public Land Survey System Works

PLSS Datum

The rectangular survey is based on a reference system by which measurements can be reported. This system can be referred to as the PLSS Datum. The PLSS datum includes a frame of reference for distances and a frame of reference for directions. For distances, the frame of reference is "horizontal measure in chains based on the U.S. Survey foot at actual ground elevation." For directions, the frame of reference is called "mean true bearings referenced to the true meridian." (Wahl and Hintz). Further details about the PLSS Datum can be found in Chapters 1 and 2 of the 1973 Manual of Surveying Instructions.

The Township

Shown below - sixty-four Townships, with Base Line, and Meridians:



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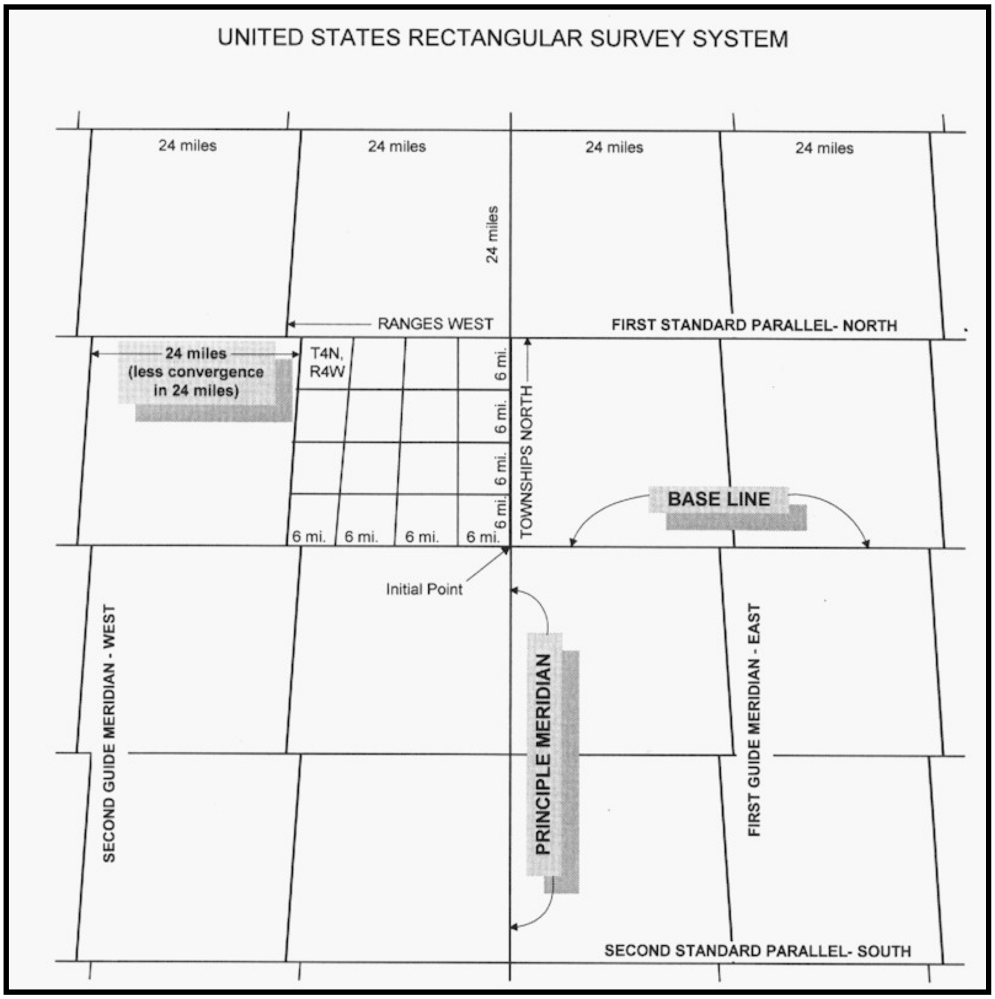

No township or section is mathematically perfect for various reasons, including the fact that the earth's surface is not flat.

Each extension of the PLSS begins at an Initial Point established as a control point for the survey. A north-south line through the Initial Point is called the Principal Meridian, and an east-west line through the Initial Point is the Base Line. There are thirty-three Initial Points with principal meridians and base lines in the contiguous U.S., and five in Alaska.

Meridians and Base Lines act as the reference axis for the rest of the survey. Township lines are township boundaries running east and west and are intended to be true parallels of latitude, and are numbered North-South. Range lines are township boundaries running north and south and are intended to be true meridians of longitude, and are numbered East-West

Because of the curvature of the earth, the convergence of township lines increases the farther north they extend. So the PLSS establishes standard parallels typically every 24 miles north and south, i.e. every four townships. Working along principal meridians and base lines surveyors set corners every ½ mile, and establish township corners at six mile intervals.

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Morning Review Questions

1. What does PLSS stand for?

2. The first PLSS surveys were performed in what state?

3. Standard Parallels are typically how many townships apart?

4. What normally is placed at a Section Corner?

5. The East - West line that runs through the initial point is called?

6. The North – South line that runs through the initial point is called?

7. What does BLM stand for?

8. Which Ordinance provided for the systematic survey and monumentation of public domain lands.

9. The PLSS is based upon how many principles in land administration; Can you name them?

10. How many states were not surveyed under the PLSS?

11. The length of a chain is ___ feet long, made up of _____ links,

12. Ranges are numbered in which direction, North-South, or East-West?

Day 1

Rectangular Survey System of Public Lands

As discussed previously, in the Eastern United States, Texas, and Hawaii, land is surveyed in the indiscriminate metes and bounds system, not the Public Land Survey System. The metes and bounds survey system typically can use natural land features, such as trees and streams, as well as neighboring land owners, along with bearings and distances to describe plots of land.

The Public Land Survey System (PLSS) is a rectangular survey system. It is called a rectangular system because wherever practicable the units are in rectangular form. The rectangular survey system divides land into townships and ranges. A regular township is six miles on a side bounded on the North and South by township lines, and the East and West by range lines, and is the basic unit under the Land Ordinance Act of 1785. The township is subdivided into thirty-six sections, each one mile on a side, comprising about 640 acres.

One of the biggest differences between land in the public land states and metes and bounds states is that public land was surveyed prior to being made available for purchase or homesteading, using a *rectangular-survey system*, as described in the Land Ordinance of 1785. When a survey was done on new public land, two lines were run at right angles to each other through the territory - a *base line* running east and west and a *meridian line* running north and south. The land was then divided into sections from the point of this intersection as follows:

- **Township & Range** - Townships, a major subdivision of public lands under the rectangular survey system, measure approximately six miles on a side (thirty-six square miles). Townships are then numbered from the base line north and south and then from the meridian line east and west. The east/west identification is known as the Range. A Township is identified by this relationship to a base line and a principal meridian.

  Example: *Township 3 North, Range 9 West, 5th Principal Meridian* identifies a specific township that is 3 tiers north from the base line and 9 tiers west (Range) of the 5th Principal Meridian.

- **Section Number** - Townships were then further broken down into thirty-six sections of 640 acres each (one square mile) called sections, which were numbered with reference to the base line and meridian line.

- **Aliquot Parts** - Sections were then further subdivided into smaller pieces, such as halves and quarters, while still (generally) keeping the land in a square. Aliquot Parts were used to represent the exact subdivision of each such section of land. Halves of a Section (or subdivision thereof) are represented as N, S, E, and W (such as *the north half of section 5*). Quarters of a Section (or subdivision thereof) are represented as NW, SW, NE, and SE (such as *the northwest quarter of section 5*). Sometimes, several Aliquot

Day 1

Parts are required to accurately describe a parcel of land. Example: *E ½ of SW ¼* denotes the east half of the southwest quarter of a section, containing 80 acres.

In general:

- a township contains 23,040 acres
- a section contains 640 acres,
- a half section contains 320 acres,
- a quarter section contains 160 acres,
- a half of a quarter contains 80 acres,
- a quarter of a quarter contains 40 acres.
- One acre contains 43,560 square feet.

A legal land description for the public land states might, for instance, be written as: *The west half of the northwest quarter, Section 8, Township 38 N, Range 24 E, containing 80 acres*, usually abbreviated as *W½ of NW¼ 08-38-24, containing 80 acres*.

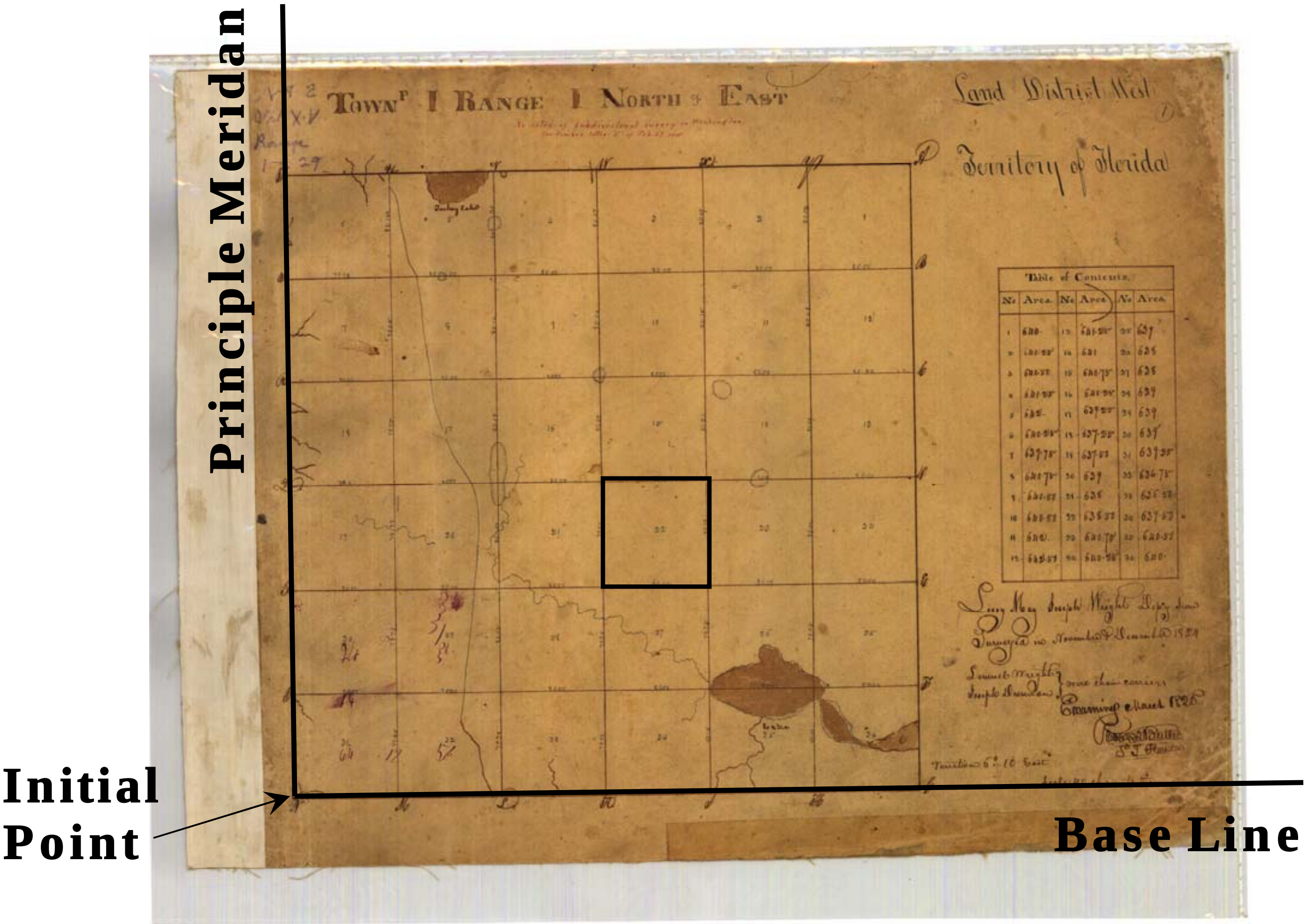
Township and Range: The United States Public Lands Survey

Following the Louisiana Purchase and the exploration of the western United States "frontier," the federal government decided to sell as much of the land as possible to the public. In order to make the distribution as equitable as possible among a generally uncharted and very diverse two and a quarter million square miles, they decided to divide up land west of the colonies with squares.

The General Land Office (developing later into the Bureau of Land Management) started surveying west from Ohio. They established 34 sets of survey meridians and base lines which were the starting points for each region of townships. Thirty-one sets are in the western and southern contiguous United States and three pairs are in Alaska. Originally surveyors named the earliest pairs by number (the first through sixth principal meridians); the rest are named for geographic features. Names include the Boise Meridian, Gila and Salt River Meridian, and the Mount Diablo Meridian.

A township is both a square six miles long on each side as well as the method to locate the north-south (horizontal) row from the base line where the township lies. Ranges are columns of townships east or west of the meridian (vertical). In the graphic below, the township is located at Township 1 North because it is in the first row north of the base line, and is located at Range 1 East because it is in the first column to the east of the principal meridian.

Day 1



Each 36 square mile township is divided up into 36 single-square-mile "sections." These sections are numbered sequentially from the northeast corner to the southeast corner (see graphic). The 640 acre sections can be divided even further. For instance, if someone purchased the northeast corner (160 acres) of section 22 as shown in the township above, the property would be identified as the "Northeast quarter of Section 22, Township 1 North, Range 1 East of the Tallahassee Meridian"

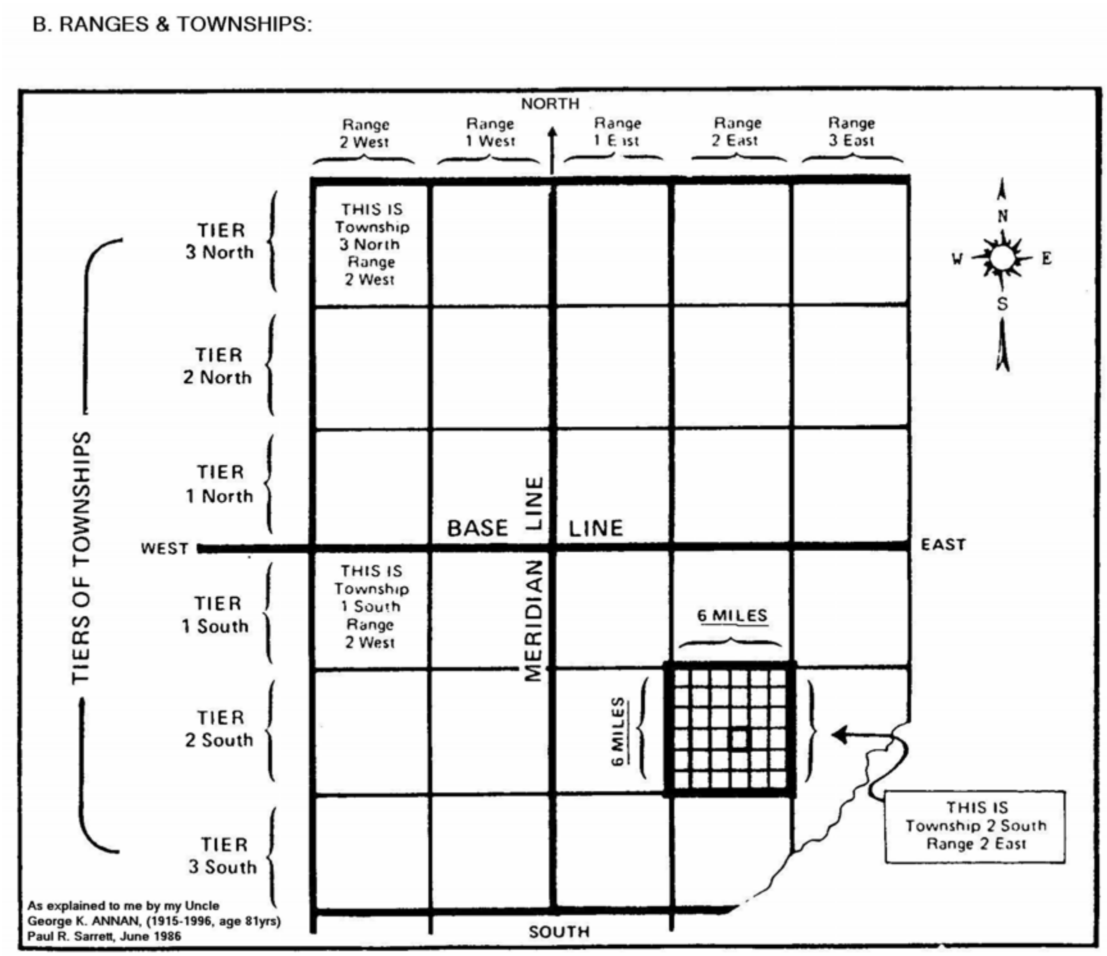
When there are even smaller portions of a section it becomes a bit more complicated. An example: "The Southeast quarter of the Northwest quarter of Section 22…" this quarter of a quarter section is a 40 acre parcel. Furthermore, one could identify a ten-acre parcel by adding another quarter to the description (a quarter of a quarter of a quarter of a section).

Not all townships are exactly square. Due to the curvature of the earth, every few rows of townships there is a slight "jog" in the meridians to compensate. There are also portions of the Public Land Survey System where land was previously titled and surveyed by different methods. Florida, New Mexico, Arizona, Colorado, and California's Spanish land grants are a notable example of interruptions in the grid.

Day 1

Graphical Display of the Federal Township and Range System

The largest grouping is the township which is named in reference to a Principal Meridian (P.M.) and a Baseline. T2N, R1E refers to Township 2 North (of the Baseline), Range 1 East (of the Principal Meridian).



A specific township is identified as being north or south of a particular baseline and east or west of a particular principal meridian. For example, T3N, R1E of the 3rd Principle Meridian is the third township north of the baseline in the first range east of the Third Principle Meridian. This particular 36 square-mile area is located in southern Illinois as the name of the Meridian is unique, and is found only in one location in the United States.

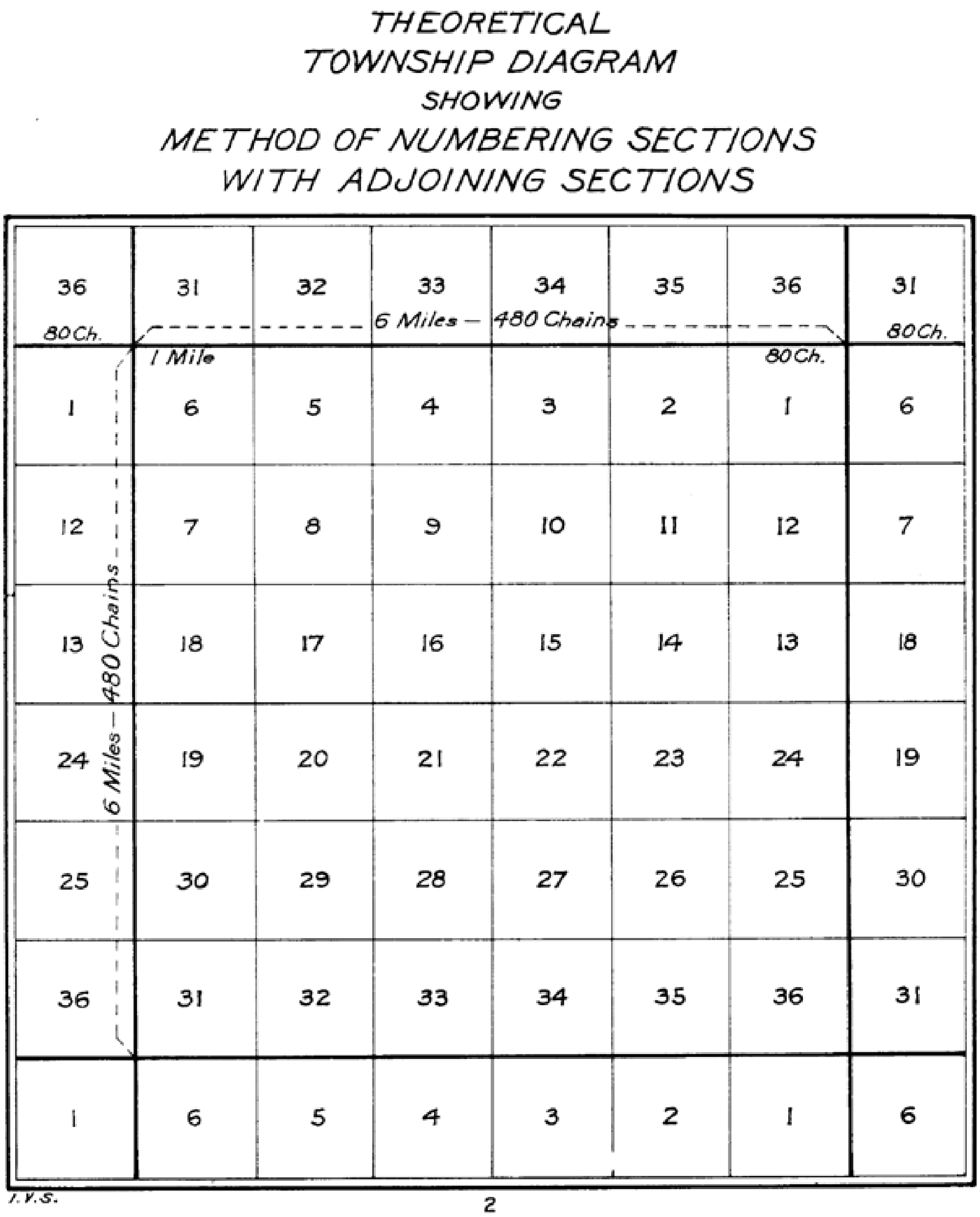
Day 1

PLSS Subdivision of Township

Various Acts of Congress during the years subsequent to the passage of the Land Ordinance added a myriad of changes and refinements.

Most notably are the appointment of a Survey General - with authorization for deputy surveyors, the term 'section' - used for the 1 mile square subdivision of the township, and the numbering 'path' of sections being changed to: *"beginning with number one in the northeast corner of the township, and proceeding west and east alternately"*.

Each township is divided into thirty-six one mile square sections, as shown below.



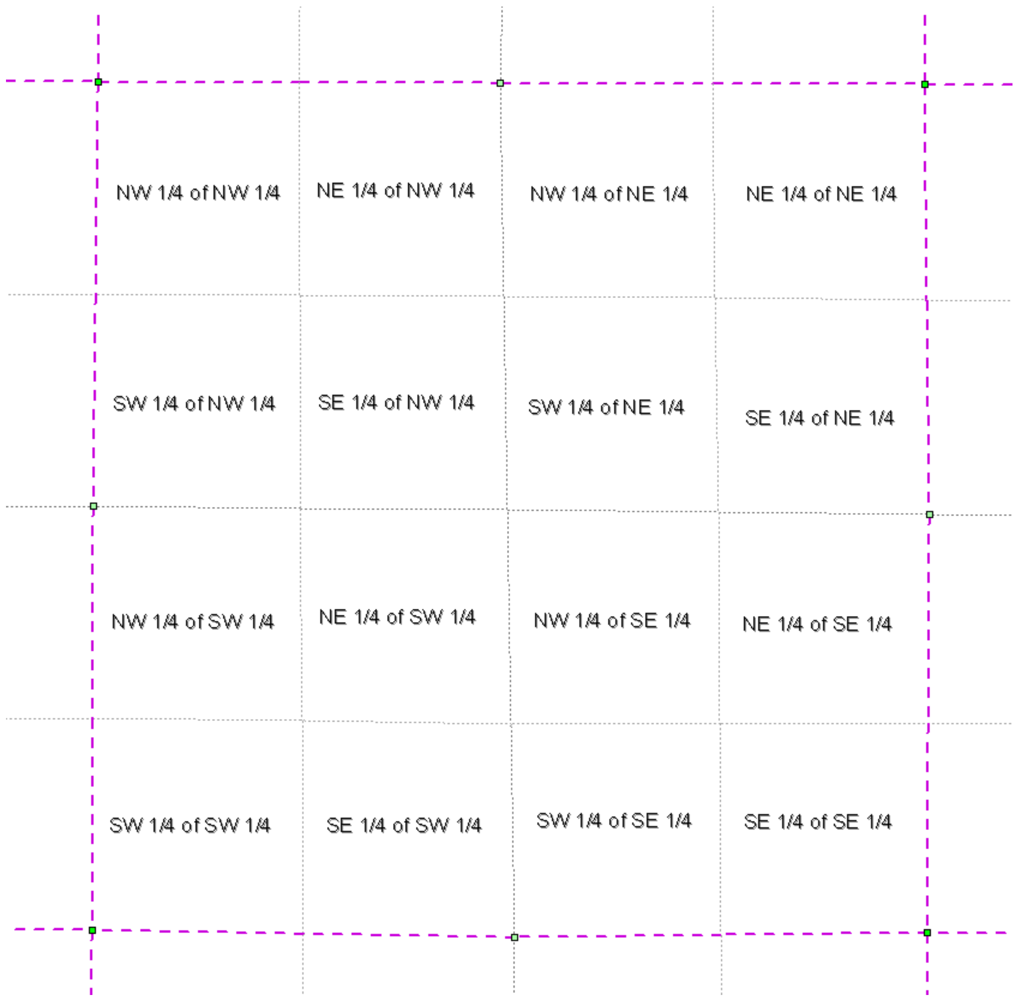
Day 1

Aliquot Parts of a Section

Within each section, the land is referred to as half and quarter sections. A one-sixteenth division is called a quarter of a quarter, as in the NW1/4 of the NW1/4. The descriptions are read from the smallest division to the largest, meaning they are read from right to left (or backwards).

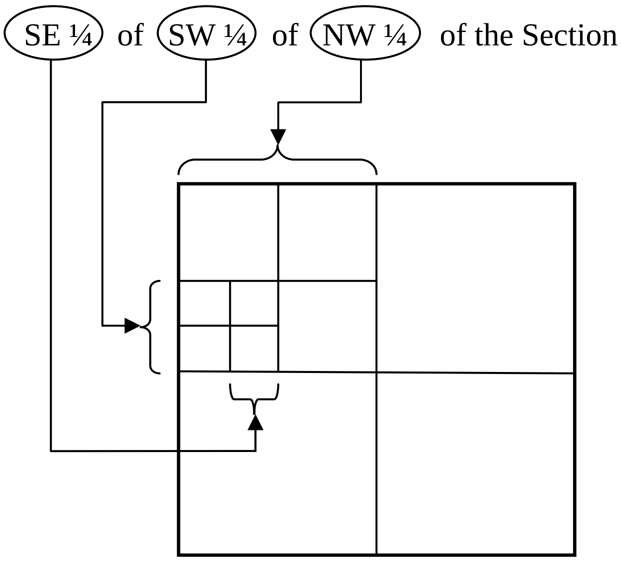
The land description generally starts with the smallest part of the description and proceeds to the largest definition. For example, SE1/4 of NW1/4 of Section 3, T3N, R1E, and 3rd PM would be the southeast quarter of the northwest quarter of section 3 in townships 3 north, range 2 east of the 3rd Principle Meridian.

Sections can be further subdivided, into quarter sections, quarter-quarter sections, and smaller. Aliquot parts of a section are equal subdivisions based upon an even division by distance along the edge, and not necessarily equal area . "Aliquot" means "contained in something else an exact number of times." Government Lots do not then by definition qualify as an aliquot part.



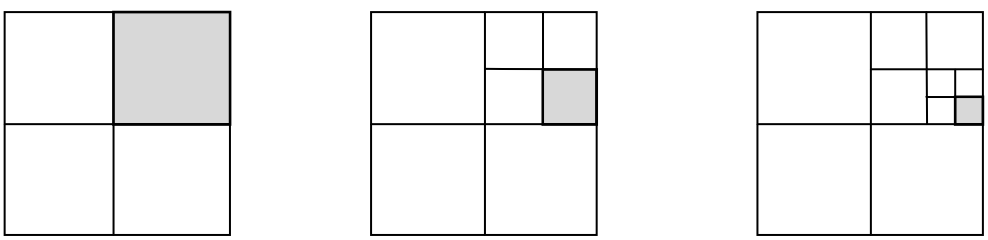
Day 1

Examples of aliquot breakdown of a Section:



For example, a square representing the lower right quarter (SE ¼) of the lower left quarter (SW ¼) of the upper left quarter (NW ¼) of a section is referred to as the SE ¼ of the SW ¼ of the NW ¼.

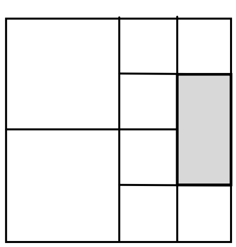
Sections can be further divided into smaller and smaller units until the particular parcel is described.



1 **2** **3**

Diagram 1 is the NE ¼ ; Diagram 2 is the SE ¼ of the NE ¼ ; Diagram 3 is the SE ¼ of the SE ¼ of the NE ¼

The example below represents the NE ¼ of the SE ¼ AND the SE ¼ of the NE ¼ of a section:



Although the parcel to the left maybe be treated as one 80 acre parcel for tax purposes, it can best be described as two separate parcels in the description

An easy way to calculate the acreage of aliquot parts is to multiply all of the fractions times the total acreage of one section (640 Acres)

How many acres in the first Example? SE ¼ of the SW 1/4 of the NW ¼ _______________

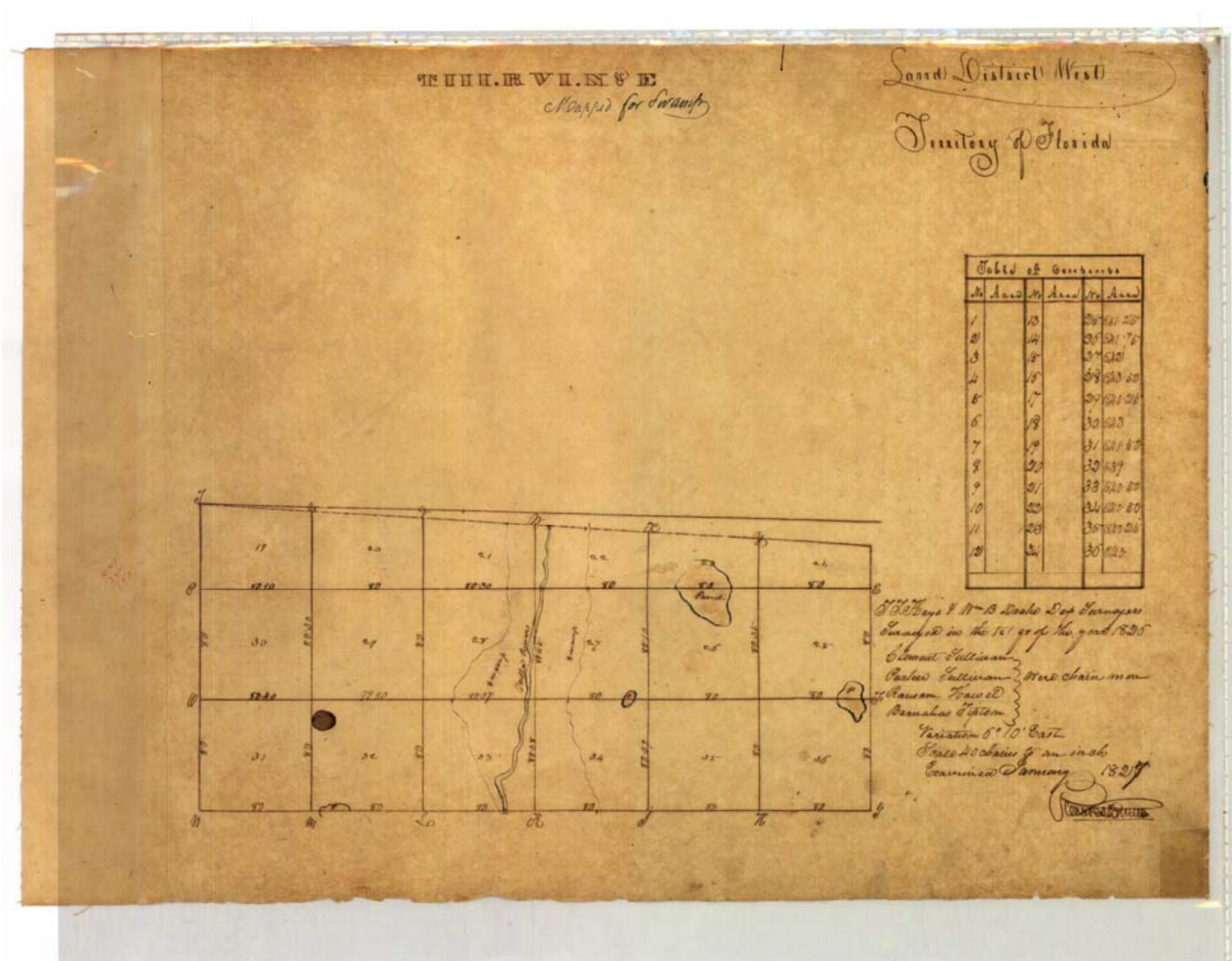
How many acres in the second Example? SE ¼ of the SE ¼ of the NE ¼ ________________

Day 1

Odds & Ends

Non Standard and Fractional Townships

The regular procedures described for subdividing full townships cannot always be adopted. A township invaded by a large meanderable body of water, impassable objects, or a State, reservation, or grant boundary may lack a full linear north, south, west, or east boundary. It has been found advisable to run section lines as offsets to the township exteriors, the fractional sections lines south and east of these controlling lines are projected opposite to the usual directions. The fractional measurements and the resulting fractional lots are placed against the irregular boundary. If only the north or west part of a fractional township is involved, no departure from the regular order of subdivision is necessary, since fractional measurements on the exterior and subdivisional lines, and the resulting fractional lots, will be placed to the north and west against the irregular boundary.



Day 1

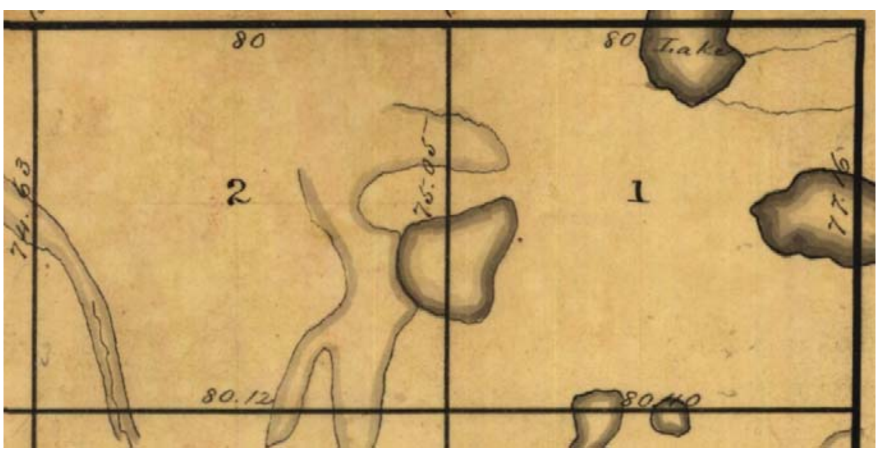
Township 3 North, Range 6 East, Tallahassee Meridian

Where no part of the south boundary of a township can be regularly established, the subdivision may proceed from north to south and from east to west, throwing fractional measurements and areas against the west boundary and the meanderable stream or other boundary limiting the township on the south. If the east boundary is without regular section corners and the north boundary has been run at regular intervals of 80 chains, the subdivision of the township may be made from west to east. In that case the fractional measurements and areas are thrown against the irregular east boundary. On the other hand, if the north boundary of section 6 is fractional, a sectional guide meridian, initiated at the easternmost regular section corner on the north boundary, is projected to the south to take the place of a governing east boundary. The subdivisional survey is then projected from north to south and from east to west, with fractional measurements and resulting fractional lots on the east, south and west boundaries of the township.

In the case of fractional townships the sections bear the same numbers they would have had if the townships were complete. That is, the section numbers are those relating to the governing boundaries.

Government & Fractional Lots

The lines closing on the north and west boundaries of a regular township the quarter section corners were established originally at 40 chains to the north or west of the last interior section corners. Any excess or deficiency in measurement of a standard section was thrown into the half mile next to township or range line, as the case may be.

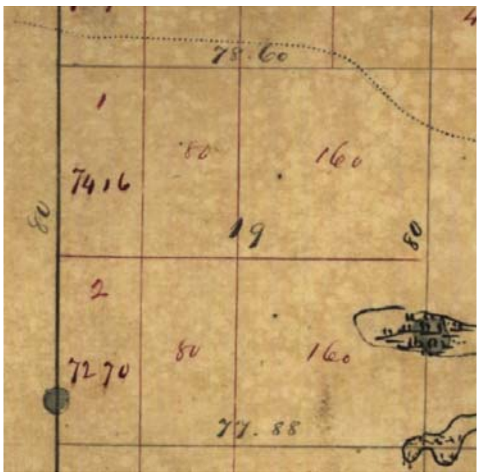


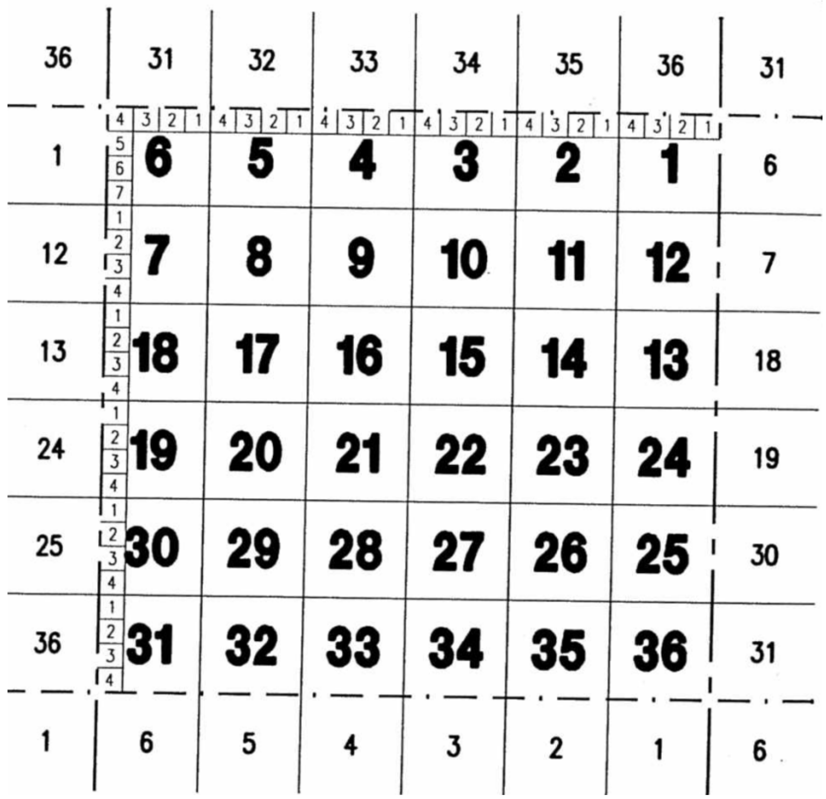
Ideally, twenty-five of the thirty-six sections in a township each contain 640 acres. The ten sections along the north and west boundaries (numbers 1-5, 7,18, 19,30,31 each contain 480 acres in regular subdivisions plus four fractional lots, each containing forty acres plus or minus adjustments.

Section 6 should contain 360 acres in regular subdivisions plus seven fractional lots. The fractional lots (also called fractional forties or government lots) are numbered beginning with one in the northeast corner and numbering alternately east to west and north to south.

Day 1

The process of numbering these lots began sometime in the late 1830's, showing up officially in the 1855 Instructions of the Surveyor General of Public Lands.





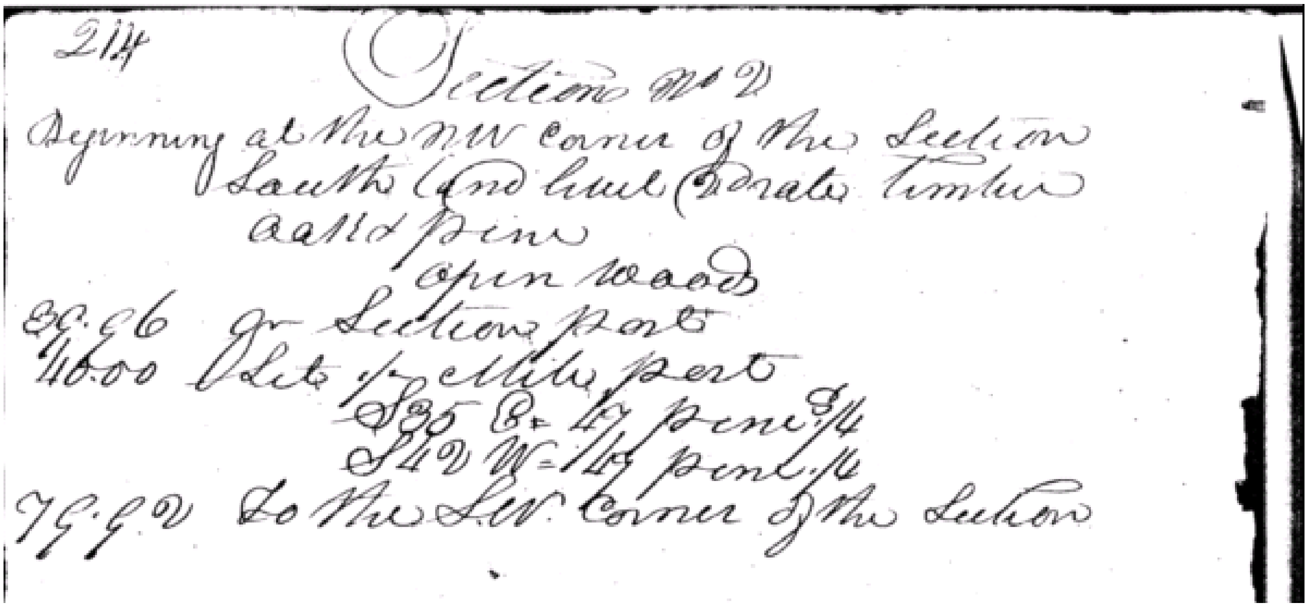
"Illustration of a Typical Township with correction along the North & West Boundaries"

In 1800 during the early development stages of the PLSS, the GLO was instructed by Congress to survey and sell ½ sections (north ½ or south ½). The lines surveyed during this time were the section lines running east-west and the instructions called for *"Section Corners are be set at 1 mile intervals and ½ mile corners were to be fixed on east-west lines only"*. This, many believe, is the origin of the term "½ mile post".

Later, as Congress allowed for the sale of ¼ sections and finally, the smallest legally describable part to be sold by the government: the ¼, ¼ section (40 ac.). Corners were to be set at all section corners and ¼ corners. In the early practice in parts of Alabama and Florida, so-called "half-mile posts" were established at distanced of 40 chains from the starting section corner. The term "½ mile post" was still being used interchangeably in the notes with what is the legal ¼ corner.

The "½ mile post" (monument) is set at 40 Chains, where the ¼ corner (legal) is exactly the midpoint between two section corners. So if the "½ mile post" is set at 40 chains and the section corner is set at 80 chains, the "½ mile post" and the ¼ corner are one and the same. Review and discuss the following field notes.

Day 1


214
Section No 2
Beginning at the NW corner of the Section
South (2nd line) Moderate timber
Oak & Pine
open woods
39.96 Qr Section post
40.00 Set 1/2 mile post
S35 E 14 pine 14
S42 W 16 pine 16
79.92 To the SW corner of the Section

What was set in the ground?

CLOSING CORNERS

Several types of closing lines have been discussed earlier. Guide meridians are closed against standard parallels as a way to avoid the extreme effect of convergency on the width of sections. Township and section lines are closed on standard parallels as a part of the same plan. Both township and section lines may be made closing lines to maintain rectangularity. A different type of closing line occurs where the lines of the rectangular system of survey cross or close on the boundaries of reservations or grants, State boundaries, or the lines of various kinds of claims.

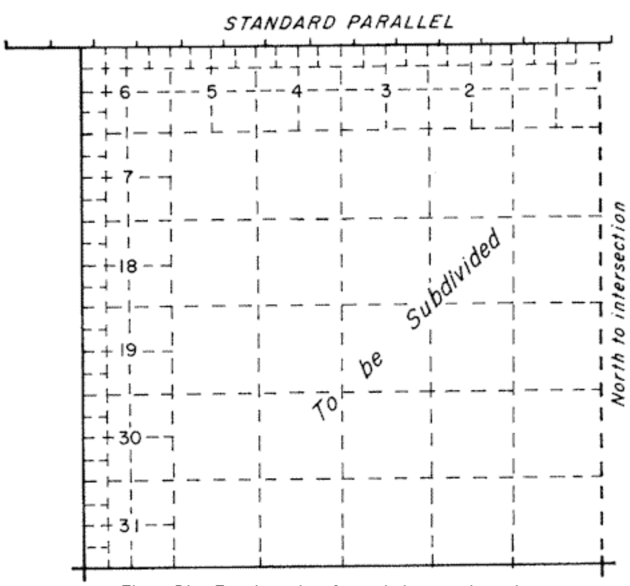


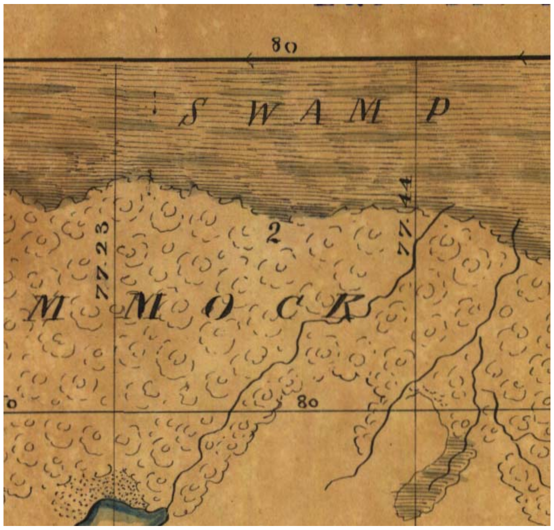
Figure 21. - Regular order of completing exteriors where north boundary (standard parallel), south boundary, and west boundary previously surveyed.

3-73. Closing corners are intended to be established where a closing line intersects a boundary already fixed in position. While the closing corner thereafter controls the direction of the closing line, a failure to place it at the true point of intersection does not alter the position of the line closed upon but may cause interested parties to rely on the faulty position. The line closed upon should always be retraced between the first corners to the right and left. Determination of the point of intersection by calculation is not permissible.

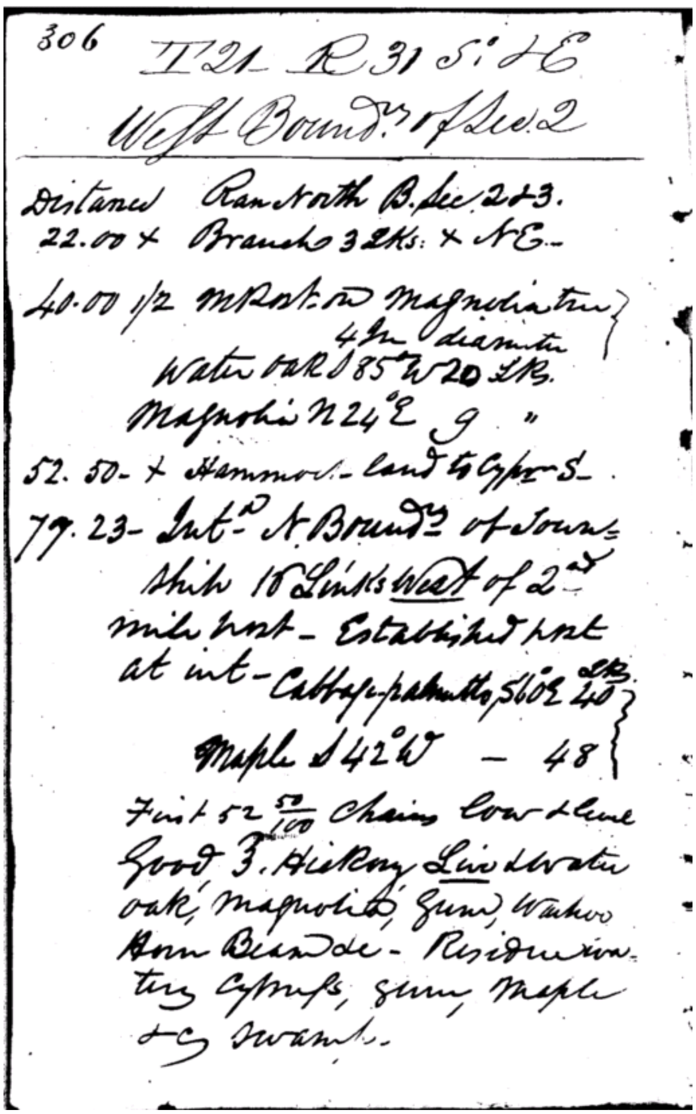
http://www.blm.gov/cadastral/Manual/73man/

Day 1

Closing Section Lines Example:



The following example gives a good illustration for understanding Closing Corners within a typical Township. This example falls along the West line Section 2, Township 21 South, Range 31 East. The original Township and Sections were surveyed by Henry Washington on 1843 with additional Private Claims being surveyed by A.M. Randolph in 1850.



306 T 21 R 31 S. & E
West Boundy of Sec 2
Distance Ran North B. Sec 2 & 3.
22.00 x Branch 3 lks. x NE.
40.00 1/2 m Post: m Magnolia tree 4 in diameter
Water oak S85 W 20 lks.
Magnolia N24E 9 "
52.50 x Hammock land to Cyps S.
77.23 Intd N Boundy of Township 16 Links West of 2d mile post - Established post at int - Cabbage palmetto S60E 40 lks
Maple S42W - 48
First 52 50/100 chains low & level Good 3. Hickory Live & Water oak, magnolia, Gum, Wahoo ... Residue ... Cypress, gum, maple & Cy swamp.

As we have discussed already, the typical surveying or subdivision of sections would run north along the West boundary of Section 2, from the Southwest corner. Here are the original notes from the survey. Mr. Washington notes the following:

Distance Ran North B[etween] Sec 2&3.

22.00(chains) x[crossed] Branch 3 l[in]ks x NE

40.00(chains) 1/2 M[ile] Post". m[ade of] Magnolia tree 4 in[ch] diameter – Water Oak S85W 20 l[in]ks – Magnolia N24E 9 [links]

52.50(chains) x[crossed] Hammock-land to Cypress S[wamp]

77.23(chains) Int[ersected]d N. Bound'y of Township, 16 links <u>West</u> of the 2nd mile post – Established post at int[ersection] – Cabbage palmetto S60E 40 l[in]ks – Maple S42W 48[links]

First 52.50 chains low & level – Good [?] Hickory, Live & Water Oak, Magnolia, Gum,…Cypress, Gum, Maple, & Cy[press] swamp

Day 1

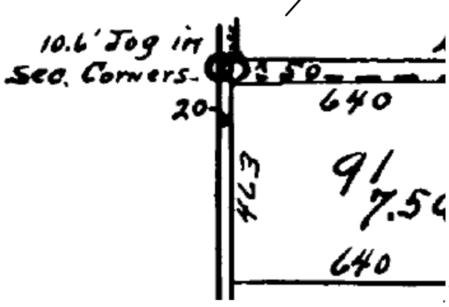
So from the original notes above, we know that there are two corners (posts) established here. One for the Southwest Corner of Sec 35-20-31 and one for the Northwest Corner of 2-21-31.

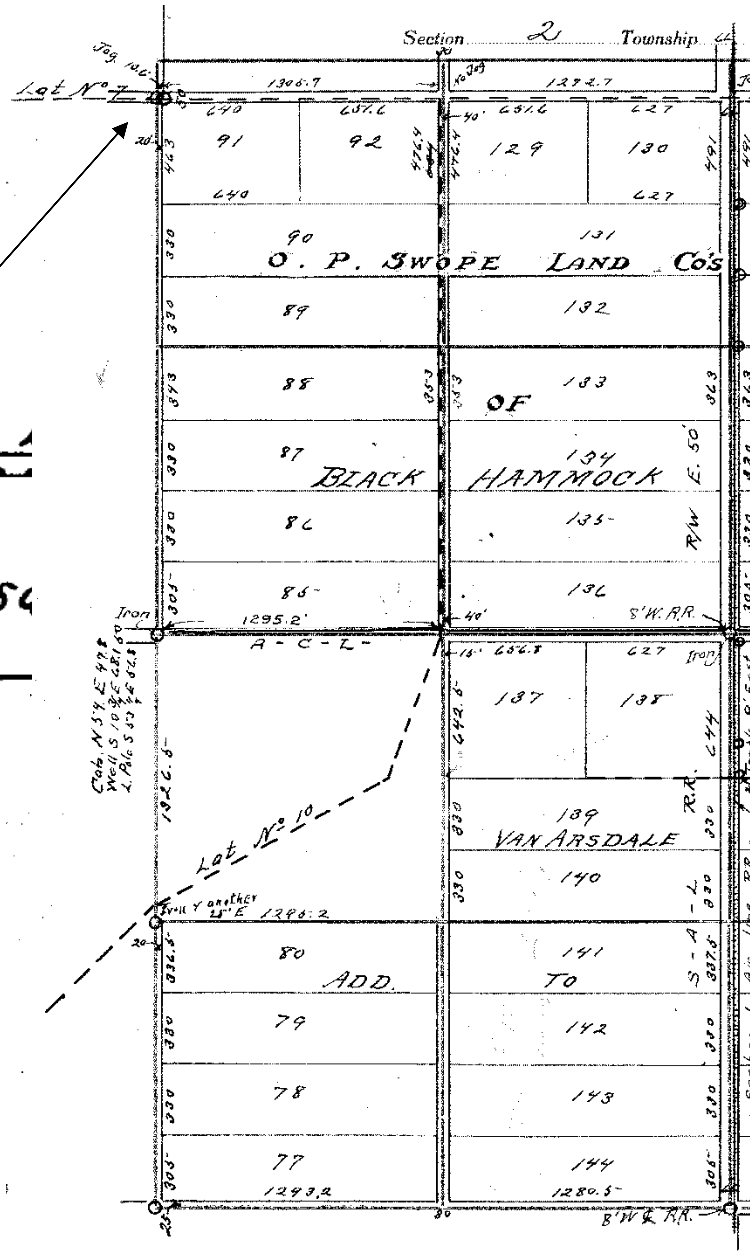
How far apart are they in Feet? _______

Also, what is the distance, in feet, of the West line of the Northwest ¼ of Section 2-21-31? _______

Survey records from Fred Williams, County Surveyors Office dating from about 1930. Helps corroborate this distance.

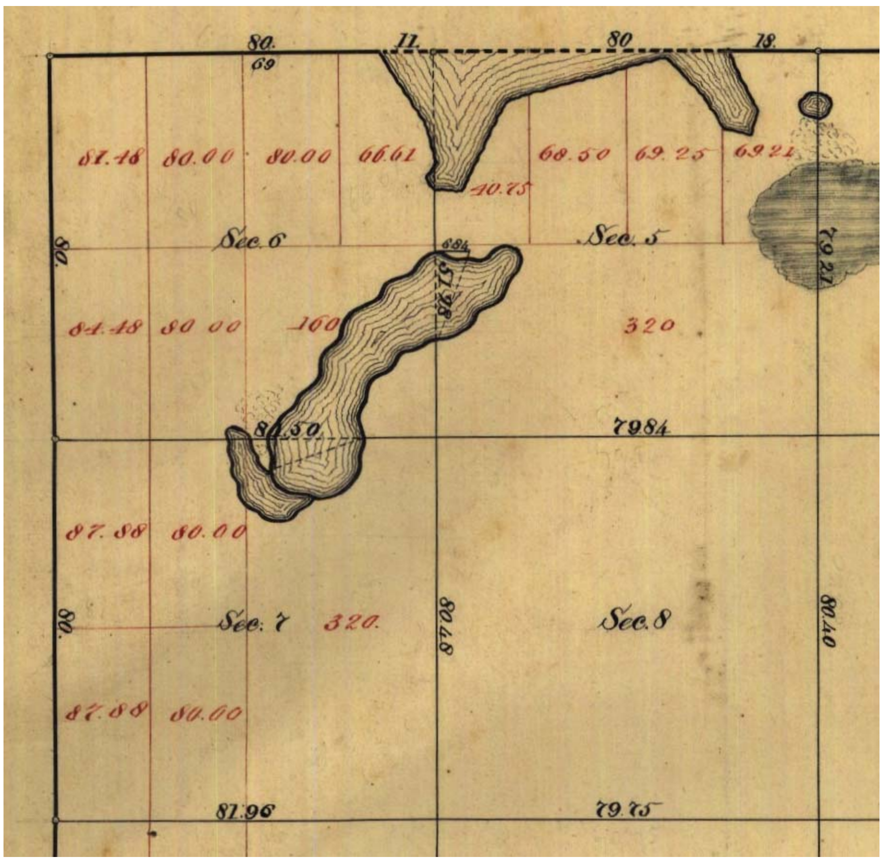
Mr. Williams notes a “Jog of 10.6[feet]” at the Northwest Corner of Section 2-21-31.





Subdivision of Fractional Sections

The law provides that where opposite corresponding quarter-section corners have not been or cannot be fixed, the subdivision of section lines shall be ascertained by running from the established corners north, south, east or west, as the case may be, to the water course, reservation line, or other boundary of such fractional section, as represented upon the official plat on an averaged bearing line. In this, the law presumes that the section lines are due north and south, or east and west lines, but usually this is not the case. When running the center lines through fractional sections it may be necessary to adopt mean courses where the section lines are not on due cardinal, or to run parallel to the east, south, west, or north boundary of the section, as conditions may require, where there is no opposite section line.

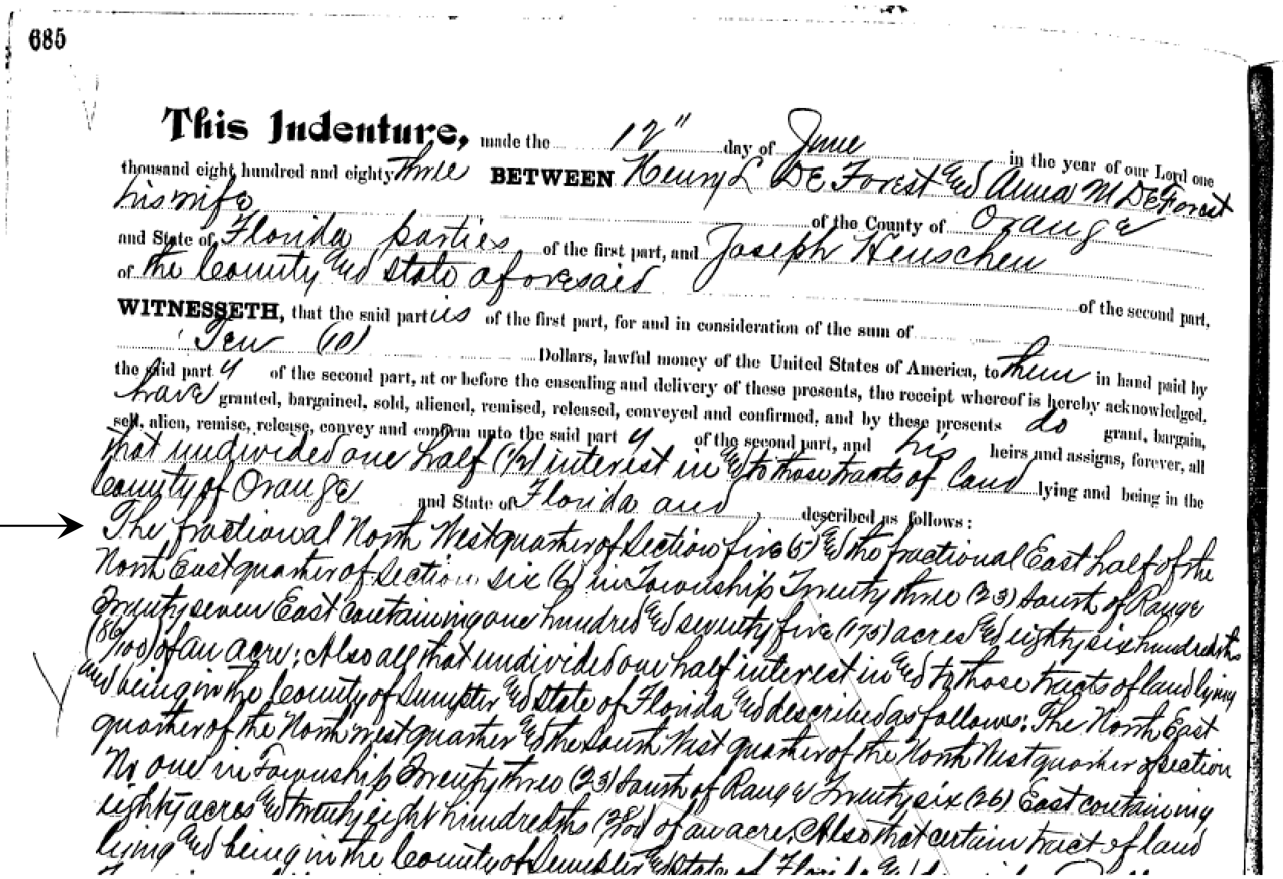


Sections 5 and 6 above can be considered fractional as the N ¼ of each section is interrupted by a meandered water body. Note that in this case the less that 80 acre fractional aliquot parts were not labeled as government lots, but were termed as fractional, i.e. “the fractional NW ¼ of Section 5 and the fractional East ½ of the NE ¼ of Section 6 containing 175.86 Acres”

[Quickly checking the area of the W½ of the SW ½ of Sec 7 above using the Gunter’s chain formula (page 1-10) reveals that 40 chains x 21.96 chains / 10 = 87.84 acres. Note the 0.04 acre difference; this is due to the section not being entirely square.]

Day 1

And the corresponding deed describing the fractional part:



685

This Indenture, made the 12" day of June in the year of our Lord one thousand eight hundred and eighty three BETWEEN Henry L De Forest and Anna M De Forest his wife of the County of Orange and State of Florida parties of the first part, and Joseph Heuschen of the County and State aforesaid of the second part,

WITNESSETH, that the said parties of the first part, for and in consideration of the sum of Ten (10) Dollars, lawful money of the United States of America, to them in hand paid by the said party of the second part, at or before the ensealing and delivery of these presents, the receipt whereof is hereby acknowledged, have granted, bargained, sold, aliened, remised, released, conveyed and confirmed, and by these presents do grant, bargain, sell, alien, remise, release, convey and confirm unto the said party of the second part, and his heirs and assigns, forever, all that undivided one half (1/2) interest in and to those tracts of land lying and being in the County of Orange and State of Florida and described as follows:

The fractional North West quarter of Section five (5) and the fractional East half of the North East quarter of Section six (6) in Township Twenty three (23) South of Range Twenty seven East containing one hundred and seventy five (175) acres and eighty six hundredths (86/100) of an acre; Also all that undivided one half interest in and to those tracts of land lying and being in the County of Sumter and State of Florida and described as follows: The North East quarter of the North West quarter and the South West quarter of the North West quarter of Section No one in Township Twenty three (23) South of Range Twenty six (26) East containing eighty acres and twenty eight hundredths (28/100) of an acre, Also that certain tract of land lying and being in the County of Sumter and State of Florida

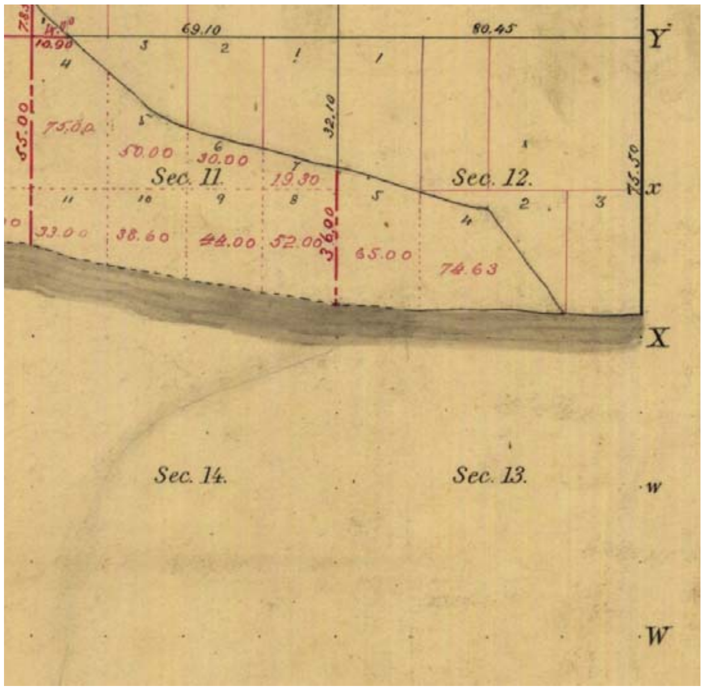
Another example of sections interrupted by a meander line:

Fractional Sections 11 and 12 originally surveyed in 1849.

Day 1

Unsurveyed Lands

Unsurveyed lands simply means land not surveyed by the Government Land Office. Fractional section surveys, for example, leave unsurveyed land within a section. The land is known to exist, but the survey has either not yet been authorized or, for whatever reason, has not yet been completed. Let's look at the same example from the previous discussion:



A later government survey from 1883 shows how additional lands can become available that were possibly not adequately surveyed initially.

This particular area of Sections 13 & 14 was most likely due to the construction of a canal, and a permanent lowering of the waters of the adjoining lake.

Un-surveyed part of Section 12

Entire section un-surveyed for Sections 14 & 13

Day 1

Meandering in the PLSS

The traverse of the margin of a permanent natural body of water is termed a meander line. All navigable bodies of water and other important rivers and lakes are segregated from the public lands at mean high-water elevation. In original surveys, meander lines are run for the purpose of ascertaining the quantity of land remaining after segregation of the water area.

The running of meander lines has always been authorized in the survey of public lands fronting on large streams and other bodies of water. But the mere fact that an irregular or sinuous line must be run, as in the case of a reservation boundary, does not entitle it to be called a meander line except where it closely follows the bank of a stream or lake. The legal riparian rights connected with meander lines do not apply in the case of other irregular lines, as the latter are strict boundaries.

The low-water mark is the point to which a river or other body of water recedes, under ordinary conditions, at its lowest stage. The high-water mark is the line which the water impresses on the soil by covering it for sufficient periods to deprive it of vegetation. The shore is the space between the margin of the water at its lowest stage and the banks at high-water mark. [Alabama v. Georgia, 64 U.S. 505 (1859)].

Numerous decisions in the United States Supreme Court assert the principle that meander lines a not boundaries defining the area of ownership of lands adjacent to the water. The general rule is th meander lines are run not as boundaries, but to define the sinuosities of the banks of the stream other body of water, and as a means of ascertaining the quantity of land embraced in the survey. Th stream or other body of water, and not the meander line as actually run on the ground, is th boundary. When by action of water the bed of the body of water changes, high-water mark change and the ownership of adjoining land progresses with it. [Lane v. United States, 274 Fed. 290 (1921)]

Meander lines will not be established at the segregation line between upland and swamp or overflowed land, but at the ordinary high-water mark/line (OHWL) of the actual margin of the river or lake on which such swamp or overflowed lands border.

Practically all inland bodies of water pass through an annual cycle of changes, between the extremes of which will be found mean high water. In regions of broken topography, especially when bodies of water are bounded by sharply sloping lands, the horizontal distance between the margins of the various water elevations is comparatively slight, and the surveyor does not experience much difficulty in determining the horizontal position of mean high-water level with approximate accuracy. Where the meanderable bodies of water are bordered by relatively flat lands, the horizontal distance between the successive levels is relatively great. The most reliable indication of mean high-water elevation is the evidence made by the water's action at its various stages, which are generally well marked in the soil. In timbered localities a very certain indication of the locus of the various important water levels is found in the belting of the native forest species.

Day 1

Mean high-water elevation is found at the margin of the area occupied by the water for the margin of the area occupied by the water for the greater portion of each average year. At this level a definite escarpment in the soil is generally traceable, at the top of which is the true position for the meander line. A pronounced escarpment, the result of the action of storm and flood waters is often found above the principal water level, and separated from the latter by the storm or flood beach. Another, less evident, escarpment is often found at the average low-water level, especially of lakes, the lower escarpment being separated from the principal escarpment by the normal beach or shore. While these questions properly belong to the realm of geology, they should not be overlooked in the survey of a meander line.

Where native forest trees are found in abundance bordering bodies of water, those trees showing evidence of having grown under favorable site conditions will be found belted along contour lines. Certain mixed varieties common to a particular region are found only on the lands seldom if ever overflowed. Another group are found on the lands which are inundated only a small portion of the growing season each year, and indicate the area which should be included in the classification of the uplands. Other varieties of native forest trees are found only within the zone of swamp and overflowed lands. All timber growth normally ceases at the margin of permanent water.
A meander corner is established at every point where a standard, township, or section line intersects the bank of a navigable stream or other meanderable body of water. No monument should be placed in a position exposed to the beating of waves and the action of ice in severe weather. In such cases a witness corner should be established on the line at a secure point near the true point for the meander corner. The distance across a body of water is ascertained by triangulation or direct measurement, and the full particulars are given in the field tablets.

In as much as it is not practicable in public-land surveys to meander in such a way as to follow and reproduce all the minute windings of the high-water line, the United States Supreme Court has given the principles governing the use and purpose of meandering shores in its decision in a noted case as follows:

Meander lines are run in surveying fractional portions of the public lands bordering on navigable rivers, not as boundaries of the tract, but for the purpose of defining the sinuosities of the banks of the stream, and as the means of ascertaining the quantity of land in the fraction subject to sale, which is to be paid for by the purchaser. In preparing the official plat from the field notes, the meander line is represented as the border line of the stream, and shows to a demonstration that the watercourse, and not the meander line as actually run on the land, is the boundary.

The surveyor commences at one of the meander corners, follows the bank or shore line, and determines the length and true bearing of each course, from the beginning to the next meander corner. All meander courses refer to the true meridian and are determined with precision. "Transit angles" showing only the amount of the deviation from the preceding course are not acceptable in field notes of meanders. Where it is impossible to survey the meander line along mean high-water mark, the notes would state the distance there from and the obstacles which justify the deviation. A table of latitudes and departures of the meander courses would be computed before leaving the vicinity, and if any mis-closure was found, indicating error in measurement or in reading courses, the survey lines would be rerun.

Day 1

The following items would be noted along the meander line: (1) all streams flowing into a river, lake, or meanderable bayou, with the width at their mouths; (2) the position, size, and depth of springs, and whether the water is pure or mineral; (3) the heads and mouths of all bayous; (4) all rapids and bars, with intersections to the upper and lower ends; (5) the elevation of the banks of lakes and streams, the height of falls and cascades, and the length and fall of rapids; and (6) artificial structures in both land and water areas.

The field notes of meanders show the corners from which the meanders commenced and upon which they closed, and exhibit the meanders of each factional section separately. Following, and composing a part of the notes, should be given a description of the adjoining land, soil and timber, and the estimated depth of inundation to which the bottom land is subject.

SYSTEM OF RECTANGULAR SURVEYS

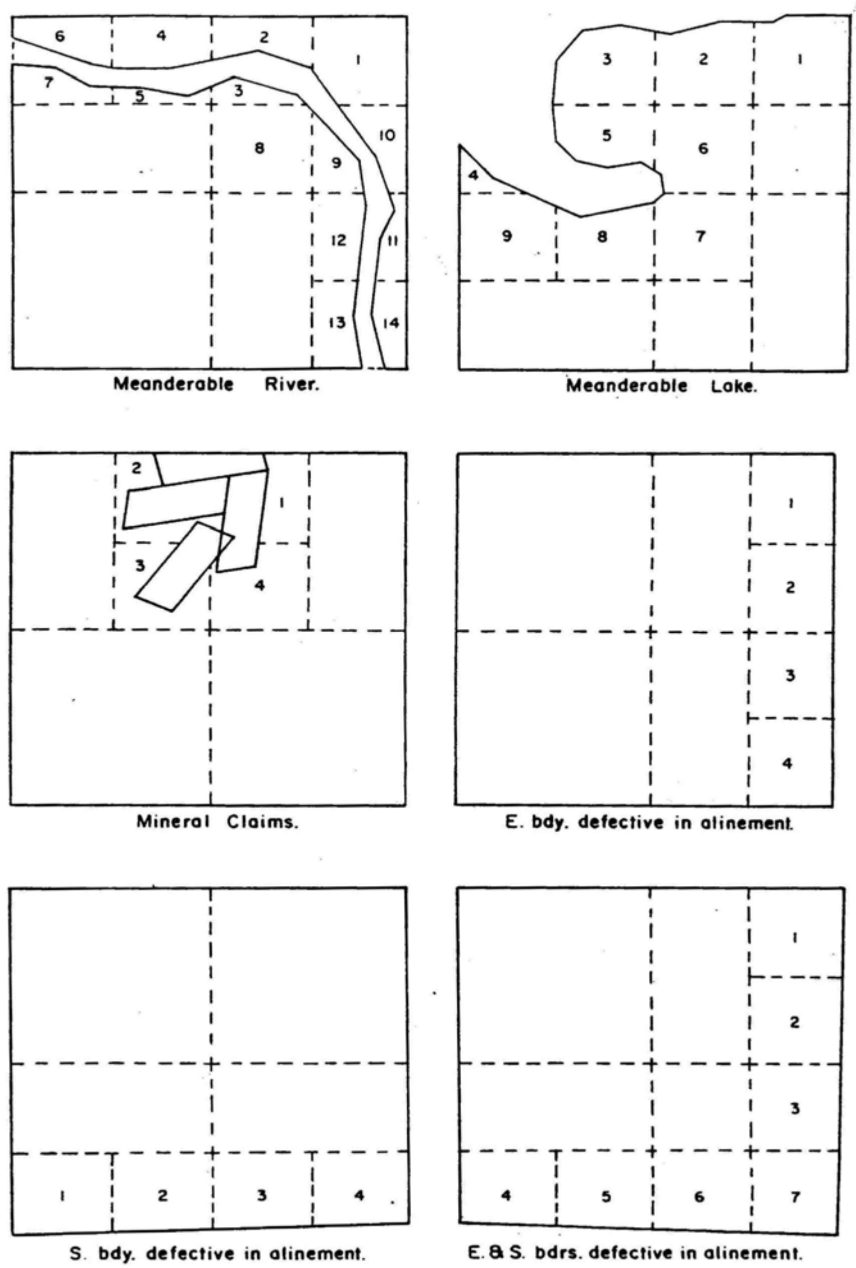
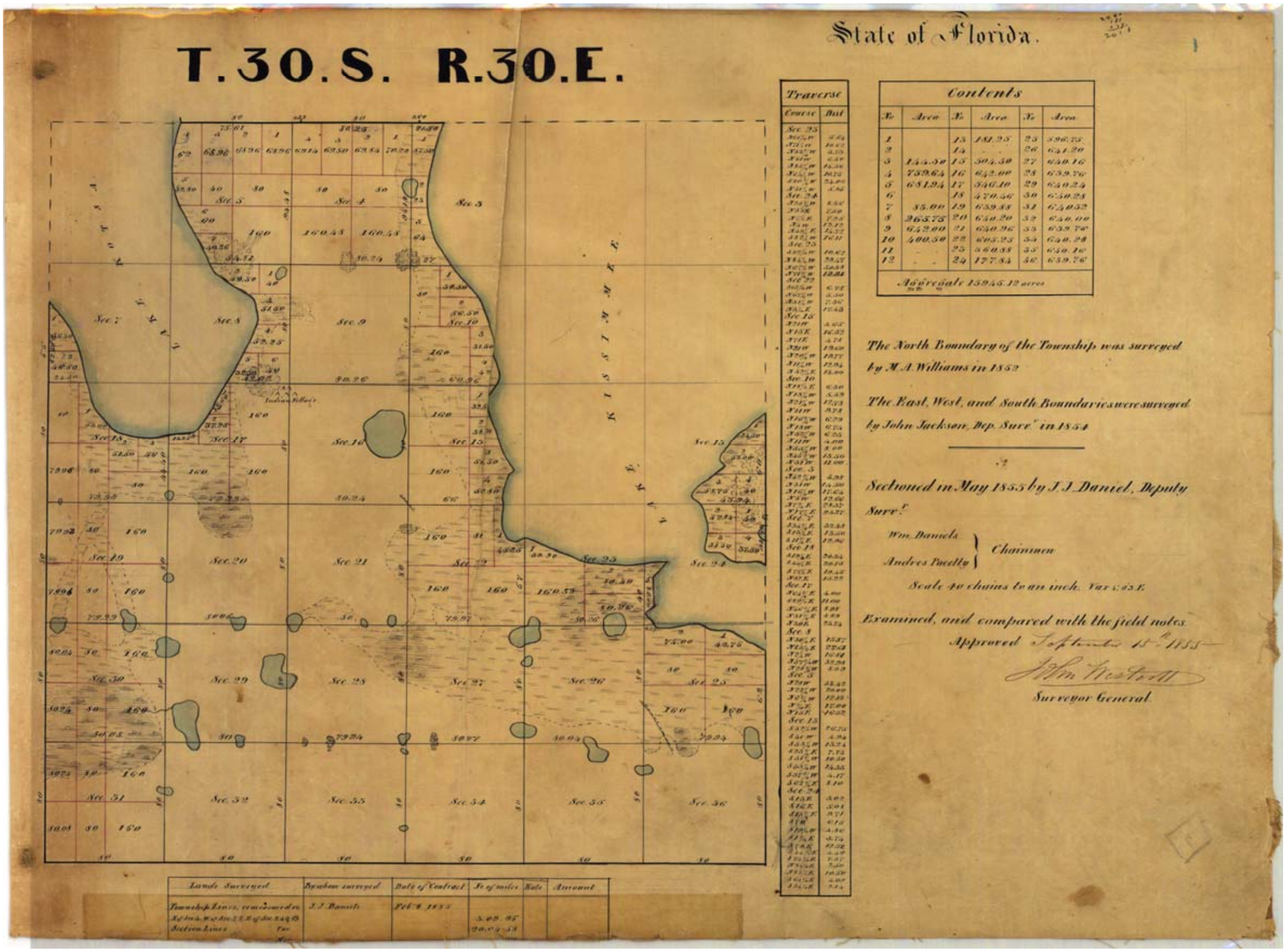


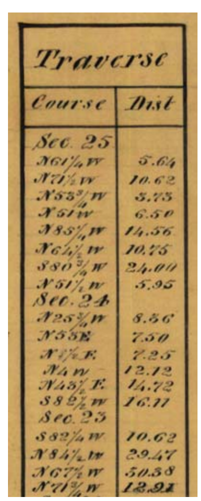
FIGURE 47.—Examples of subdivision of fractional sections.

Day 1

Township 30 South, Range 30 East, Tallahassee Meridan



The "Traverse" of calls shown to the right of the township subdivision indicates the Meander line along the body of water. This will correspond to the government survey notes, which can be much more detailed with information about the particular township being surveyed.



Course	Dist
Sec. 25	
N61¼W	5.64
N71½W	10.62
N53¾W	5.75
N51W	6.50
N85¾W	14.56
N64¼W	10.75
S80¾W	24.00
N51¼W	5.95
Sec. 24	
N25¾W	8.56
N55E	7.50
N1¼E	7.25
N4W	12.12
N45¼E	14.72
S82¼W	16.11
Sec. 23	
S82¼W	10.62
N84½W	29.47
N67¾W	30.58
N71¾W	12.91

Day 1

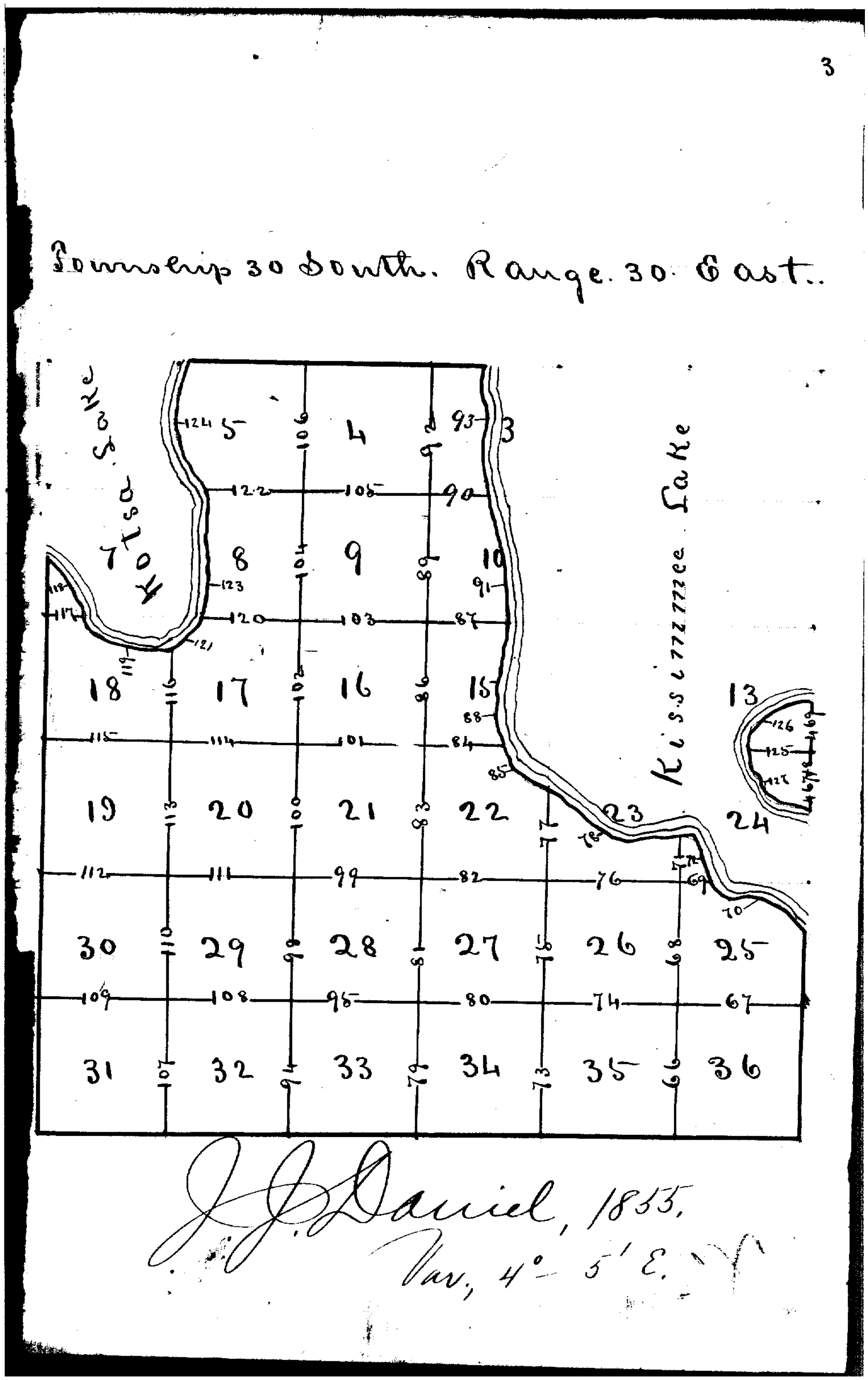


Diagram for Township 30 South, Range 30 East. Numbers refer to survey notes page.

Day 1

70

Township 30 South. Range 30 East.

On traverse of Section 25

Variation 4°03' East.

beginning at traverse post

set on the margin of

Mix Co Lake Kissimmee N 6 2.07 chains

North of a post, on Range line

between ranges 30 & 31 East,

& corner to Sections 25, 36

30 & 31.

No.	Cos.	Dis.	N	S	E	W
1	N 61 W	5.64	2.71			4.94
2	N 71½ W	10.12	3.37			10.07
3	N 53¾ W	3.73	2.23			2.99
4	N 51 W	6.50	4.09			5.15
5	N 85¼ W	14.56	1.21			14.51
6	N 64½ W	10.75	4.63			9.71
7	S 80¾ W	24.00		3.86		23.69
8	N 51½ W	5.95	3.71			4.65
			21.94	3.86		75.61
			3.86			4.29
			18.08			79.90
			62.00			
			80.08			

Course no. 8 closes on traverse post set between fractional Sections 24 & 25.

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Day 1

Rivers

Facing downstream, the bank on the left hand is termed the left bank and that on the right hand the right bank. These terms will be universally used to distinguish the two banks of a river or stream.

Navigable rivers and bayous, as well as all rivers not navigable, the right-angle width of which is 3 chains and upwards, are meandered on both banks, at the ordinary mean high-water mark, by taking the general courses and distances of their sinuosities. Rivers not classed as navigable are not meandered above the point where the average right-angle width is less than 3 chains, except when duly authorized.

Shallow streams and intermittent streams without well defined channel or banks are not meandered, even when more than 3 chains wide. Tidewater streams are meandered at ordinary mean high tide as far as navigable, even when less than 3 chains wide. Tidewater inlets and bayous are recorded, and are meandered is more than 3 chains in width, but when nonnavigable are not meandered when less than 3 chains wide.

Lakes

All lakes of the area of 50 acres and upwards, are meandered.

In the case of lakes which are located entirely within the boundaries of a section, a quarter-section line, if one crosses the lake, is run from one of the quarter-section corners, on a theoretical course to connect with the opposite quarter-section corner, to the margin of the lake, and the distance is measured. At the point thus determined a "special meander corner" is established.

Where one or both of the opposite quarter-section corners cannot be established, and in all cases where the distance across a lake exceeds 40 chains or the physical crossing in difficult, a temporary special meander corner is established at the computed intersection with the center line of the section when surveying the meander line. The temporary point is later corrected to the true center line position for monumentation, at midpoint in departure (or latitude), or at proportionate distance in a fractional section.

If a meanderable lake is found to be located entirely within a quarter section, an "auxiliary meander corner" is established at some suitable point on its margin, and a connecting line is run from the monument to a regular corner on the section boundary. A connecting traverse line is recorded, if run, but it is also reduced to the equivalent direct connecting course and distance, all of which is stated in the field notes. Only the course and length of the direct connecting lines are shown on the plat of the survey.

The meander line of a lake tying within a section is initiated at the established special or auxiliary meander corner, as the case may be, and continued around the margin of the normal lake at its mean high-water level, to a closing at the point of beginning. All proceedings are fully entered in the field notes.

Artificial lakes and reservoirs are not segregated from the public lands, unless specially provided in the instructions, but the true position and extent of such bodies of water are determined in the field and shown on the plat.

Other exceptions to the general rule are shallow or poorly defined "lakes" which are actually pools that collect because of permafrost and lack of drainage or which are ephemeral desert playas formed seasonally or in wet years. These "lakes" should not be meandered even when larger than 50 acres.

Islands

Every island above the mean high-water elevation of any meanderable body of water, except islands formed in navigable bodies of water after the date of the admission of a State into the Union, is located by triangulation or direct measurement or other suitable process, and is meandered and shown upon the official plat.

Even though the United States has parted with its title to the adjoining mainland, an island in a meandered body of water, navigable or nonnavigable, in continuous existence since the date of the admission of the State into the Union, and omitted from the original survey, remains public land of the United States. As such the island is subject to survey. This is because such islands were not a part of the bed of the stream at the date of Statehood, and therefore their title remained in the United States, subject to survey and disposal when identified. The riparian right that attaches to the lottings along the meander line of the mainland pertains only to the bed of the stream, and to such islands as may form within the bed subsequent to the disposal of the title. The proof of the time of the formation of islands is often difficult. It is the practice to make a careful examination of the history of an island in relation to the question of its legal ownership.

Islands that have been given well-known proper names are so identified, both in the field notes and on the plat. Sometimes there are a number of islands in the same section without proper names. Some may have been surveyed, others omitted. Of the latter, some may rightfully belong to the State, some to a riparian proprietor, so that any system of numbering may be uncertain, and if used may still be confused with a lot number, if and when surveyed. For these reasons their identification may be uncertain unless the following rule is applied:

Where there are several unnamed islands within the same section, these will be referred to in the field notes (when surveyed) according to the lot number (Island designated as lot No. ___) that is assigned on the plat, excepting that islands which are crossed by section line boundaries, or by a center line of the section, are readily identified by location.

Any township boundary or section line which will intersect an island is extended as nearly in accordance with the plan of regular surveys as conditions permit, and the usual township, section, quarter-section, and meander corners are established on the island. If an island falls in two sections only, the line between the sections should be established in its proper theoretical position based upon suitable sights and calculations. If an island falls entirely in one section, and is large enough to be subdivided (over 50 acres in area), a suitable sight or calculation is made to locate on the margin of the island an intersection with the theoretical position of any suitable subdivision-of-section line.

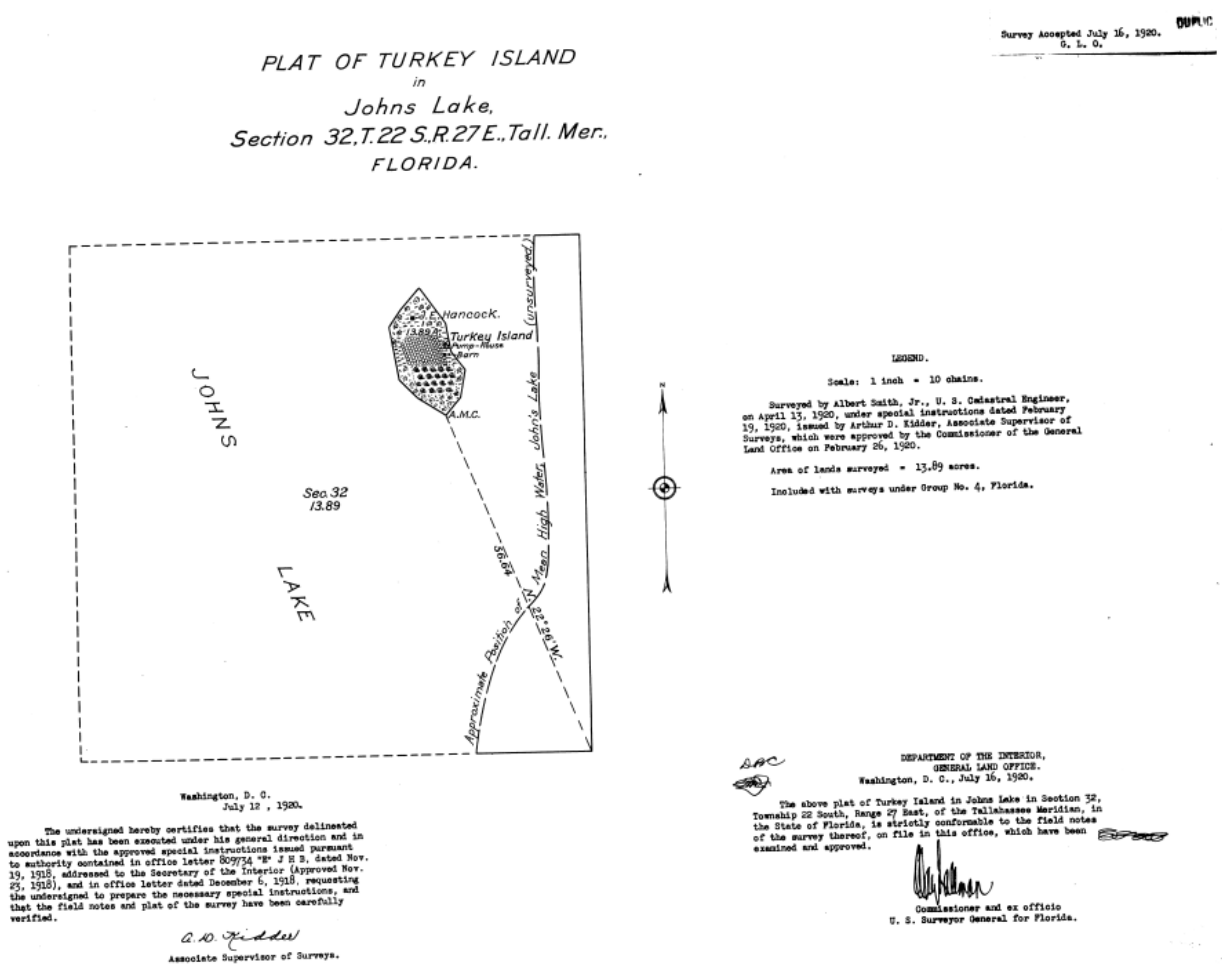
Day 1

At the point thus determined a "special meander corner" is established. In the case of an island falling entirely in one section and too small to be subdivided, an "auxiliary meander corner" is established at any suitable point on its margin, which is connected with any regular corner on the mainland. The direct course and length of the connecting line is given in the field notes and shown on the plat.

The meander line of an island is surveyed in harmony with principles and rules heretofore stated. All township and section lines crossing the island are shown on the plat. if the island is large enough to be subdivided, the subdivision is accomplished by the protraction of suitable subdivision-of-section lines in their correct theoretical position.

Under special circumstances where administration or disposal requires no subdivision, an island is given a tract number within a township. In such cases, the section lines need not be extended to the island.

Agricultural upland within the limits of swamp and overflowed lands should be so classified and shown upon the plat accordingly, but such land is not meandered as an island.



Plat of Turkey Island in Johns Lake, Section 32, Township 22 South, Range 27 East

Day 1

Afternoon Review Questions

1. How many acres are in the NW quarter of the SW quarter of a section? ___________
2. What is the name of the Meridian used in Florida? ____________________________
3. True/False – Townships are subdivided into 24 one mile-square Sections.
4. The closing sides on a Township are typically on which sides? __________________
5. Subdivided parts of a Section that do not meet the standard 40 acres are called ______
6. Lands that have not yet been surveyed by the U.S. government are called __________
7. True/False – When a Meander Line traverses along a permanent natural body of water, it is officially the legal boundary between private ownership, and submerged sovereign land.
8. Government Lot 3 of Section 12 is 37.75 chains long by 20 chains wide. How many acres does it contain? _________
9. What way would you read a legal description from the rectangular survey system? ____
10. You are looking for the Section, Township & Range directly to the west of Section 6 Township 3 South Range 28 East. What is it? ____
11. True/False - The PLSS typically divides land into six mile-square Townships.
12. True/False – A Government Lot is considered an Aliquot part.
13. One acre of land contains how many square feet? ________________
14. Sketch out the following description: The N ½ of the NE ¼ of the SW ¼ and the E ½ of the S ¼ of the SE ¼ of the NW ¼. How many acres?

Day 1

PRACTICE SECTIONAL DESCRIPTIONS

- THE SOUTHEAST ¼ OF THE SOUTHEAST QUARTER OF SECTION 17 AND THE NORTHEAST ¼ OF THE NORTHEAST ¼ OF SECTION 20

- THE SOUTHEAST ¼ OF THE SOUTHWEST OF SECTION 17…LESS THE NORTH ½ OF THE SOUTH ½

- THE NORTHWEST ¼ …LESS THE SOUTHWEST ¼ OF THE SOUTHEAST ¼ AND ALSO LESS THE NORTHWEST ¼ OF THE SOUTHEAST ¼ ALL OF SECTION 6

- THE SOUTHEAST ¼ OF THE SOUTHEAST ¼ OF THE NORTHWEST ¼ AND THE WEST ½ OF THE SOUTHWEST ¼ OF THE NORTHEAST ¼ AND THE EAST ½ OF THE NORTHEAST ¼ OF THE SOUTHWEST ¼ AND THE SOUTHWEST ¼ OF THE NORTHWEST ¼ OF THE SOUTHEAST ¼ OF SECTION 17

- THE WEST ½ OF THE SOUTHWEST ¼ AND THE NORTHEAST ¼ OF THE SOUTHWEST ¼ OF SECTION 15, TOGETHERWITH THE NORTHEAST ¼ OF THE SOUTHEAST ¼ OF SECTION 16, AND ALSO A TRACT OF LAND LYING IN SECTION 16, BEING DESCRIBED AS FOLLOWS:

  BEGINNING AT THE SOUTHWEST CORNER OF SAID SECTION 15, THENCE RUN SOUTH 2640 FEET; THENCE RUN EAST 1320; THENCE RUN NORTH 2640 FEET; THENCE RUN 1320 FEET TO THE POINT OF BEGINNING.

Day 1

PRACTICE ACREAGE DESCRIPTIONS

- THE WEST 60 ACRES OF THE NORTH ½ OF THE NORTHWEST ¼
- THE SOUTH 10 ACRES OF THE SOUTHWEST ¼ OF THE NORTHWEST ¼
- THE NORTH 40 ACRES OF THE SOUTHEAST ¼
- THE EAST 10 ACRES OF THE NORTHWEST ¼ OF THE SOUTHWEST ¼

PRACTICE LINEAR DESCRIPTIONS

- THE NORTH 7.5 CHAINS OF THE SOUTHEAST ¼ OF THE SOUTHWEST 1/4
- THE WEST 15 CHAINS OF THE NORTHWEST ¼ OF THE NORTHEAST 1/4
- THE NORTH 10 CHAINS OF THE SOUTHWEST ¼ OF THE SOUTHEAST 1/4
- THE EAST 2 CHAINS OF THE WEST 5 CHAINS OF THE OF THE NORTHEAST ¼ OF THE SOUTHWEST ¼ OF THE SOUTHWEST 1/4

Day 1

Begin Case Study:

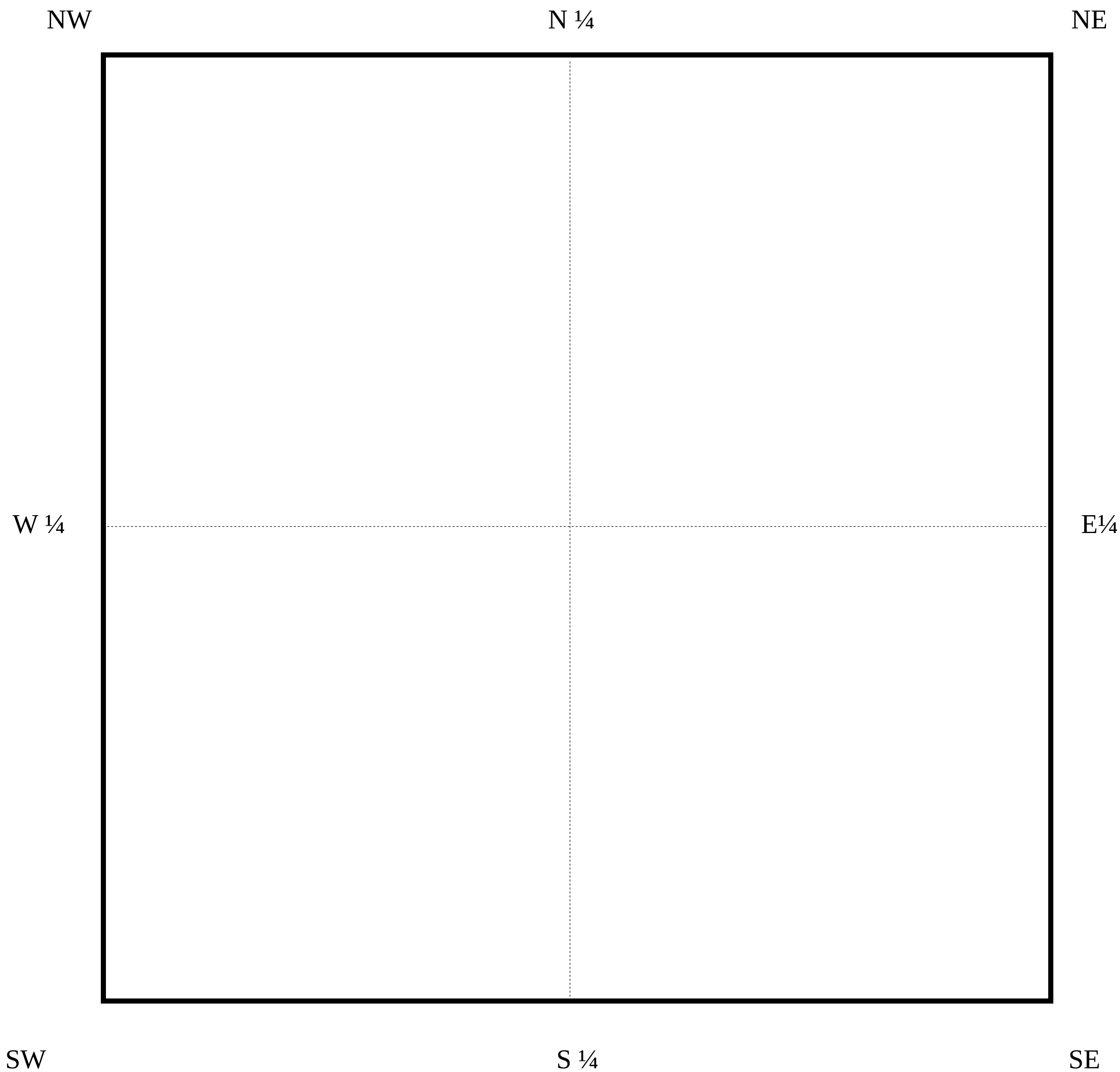
Section 9, Township 22 South, Range 30 East

Use the sample section on the next page, and breakdown the Section using the following descriptions, numbering each tract:

1.) The SW ¼ of the NW ¼
2.) The SE ¼ of the SW ¼ LESS the NE ¼ thereof
3.) The SE ¼ of the SE ¼ LESS the North 330 feet
4.) The NE ¼ LESS the West 15 chains of the North 20 chains thereof, and LESS The SW ¼ of the SW ¼ of the NE ¼.
5.) The SW ¼ of the SW ¼ of the NE ¼ and the S ½ of the E ¼ of the SE ¼ of the NW ¼

Day 1

Case Study Worksheet:



Day 2

The Public Land Survey System in Florida

The Public Land Survey System for the Cadastral Mapper

Day 2

Intro and Overview of the PLSS in Florida

Florida's official system of describing land is the rectangular survey system or now more commonly referred to as the PLSS. The surveys that were required to put this system into practical usage had directions that were set forth in various sets of instructions from the Surveyor General to the various Deputy Surveyors in the public lands. These instructions were based on the laws passed by Congress. The first issue of these instructions was in 1815; the Instructions for Deputy Surveyors by Edward Tiffin, Surveyor General of the United States under which the surveys within Florida started. As of 2009, the latest is the “Manual of Surveying Instructions, 1973” which obviously was issued long after Florida became a "Closed State". A closed state simply means that as far as the federal government is concerned the surveys of the public lands within the state were completed and the records were transferred to the state for safe keeping.

Under the Swamp and Overflowed Lands Act, large portions of Public lands in Florida were transferred to the state by the federal government for disposing of as the state saw fit. In the federal governments rush to declare the state closed, large parcels were not yet surveyed and were left for Florida to survey under her own instructions. Florida was issued only one set of General instructions to deputy Surveyors by the Federal Surveyor General and that was in 1842.

Under these instructions the state was surveyed into the grid of townships as (somewhat) previously described. The surveys were determined from the initial point set near Tallahassee. The north-south line running through this “initial point” is called the Tallahassee Meridian. Working along the principal meridian and base line, the township corners were set at six mile intervals, and then the townships were marked off into a grid. Any specific township can then be located according to its relationship to the Tallahassee Meridian and the Base Line.

The original surveys of Florida subdivided the lands into 6 mile square townships. Each township was further divided into 36 one mile square sections. Florida Territory was given a ¼ Section to serve as its seat of government. These surveys are all based on the Tallahassee Base and Guide Meridian Marker, sometimes referred to as The Initial Point or the 0 (zero) Marker. The marker can be found just south of Gaines Street and just west of Bloxham Street in Tallahassee. That location is at:

North Latitude: 30º 26’ 03’’
West Longitude: 84º 16’ 38’’

(Approximately ¼ mile south and east of the “Old Capitol” building.)

But we are getting ahead of ourselves. Florida has a long and rich history prior to the PLSS that without a cursory understanding, the student would be ill served. Let’s look at a few events prior to Florida becoming a Territory of the United States on March 30, 1822.

Day 2

Spanish Rule and Territorial History (1513-1824)

Spanish Discovery

Ponce de Leon set out from Puerto Rico on March 4, 1513 on a venture to the Northwest in search of rumored island and lands. His contract from Ferdinand allowed him exclusive rights to discovery, provided that de Leon finance all costs for the voyage. In exchange for financing, de Leon would be appointed governor for life of any lands discovered. Records show no indication that his adventure was associated with finding a "Fountain of Youth"; it wasn't until after his death that such stories were attached to him.

By March 27, 1513 (Easter Sunday) de Leon's fleet of three ships had past the northern Bahamas. On April 2, 1513 (Pascua Florida, or Festival of Flowers), de Leon had sighted land, naming it Florida in honor of the Holiday.

Spain would continue to hold Florida as a colony, establishing Pensacola in 1559 and St. Augustine in 1565. Pensacola was later abandoned in 1561 after being hit with a severe hurricane, leaving St. Augustine as the longest continuous settlement in what is now the United States. Pensacola re-founded in 1696 as the territorial seat for West Florida, which extended from the Mississippi River to the Apalachicola River. East Florida was governed from St. Augustine.

Tabula Novarum insularum, quas diversis respectibus Occidentales & Indianas vocant
[Map of the New Islands Named by Various Sources the West and the Indies]
(Sebastian Münster, 1550)

Day 2

British rule

During the Seven Years War (also referred to as the French and Indian War) Spain allied herself with France against Great Britain and the colonies. With the loss by the French, Spain had to relinquish her hold on Florida ceding the colony over to Great Britain in 1763. The British established a novel concept in the territory by creating a representative "assembly", thus introducing democracy to Florida.

Second Spanish rule

Spain returned to govern Florida in 1783 under terms of the Treaty of Paris, ending the American Revolution with Great Britain. It was during this time that many of Florida's Land Grants were assigned. However, due to poor record keeping both by the Spanish and later by the Americans, many grants came under dispute, later to be decided upon by the U.S. Supreme Court.

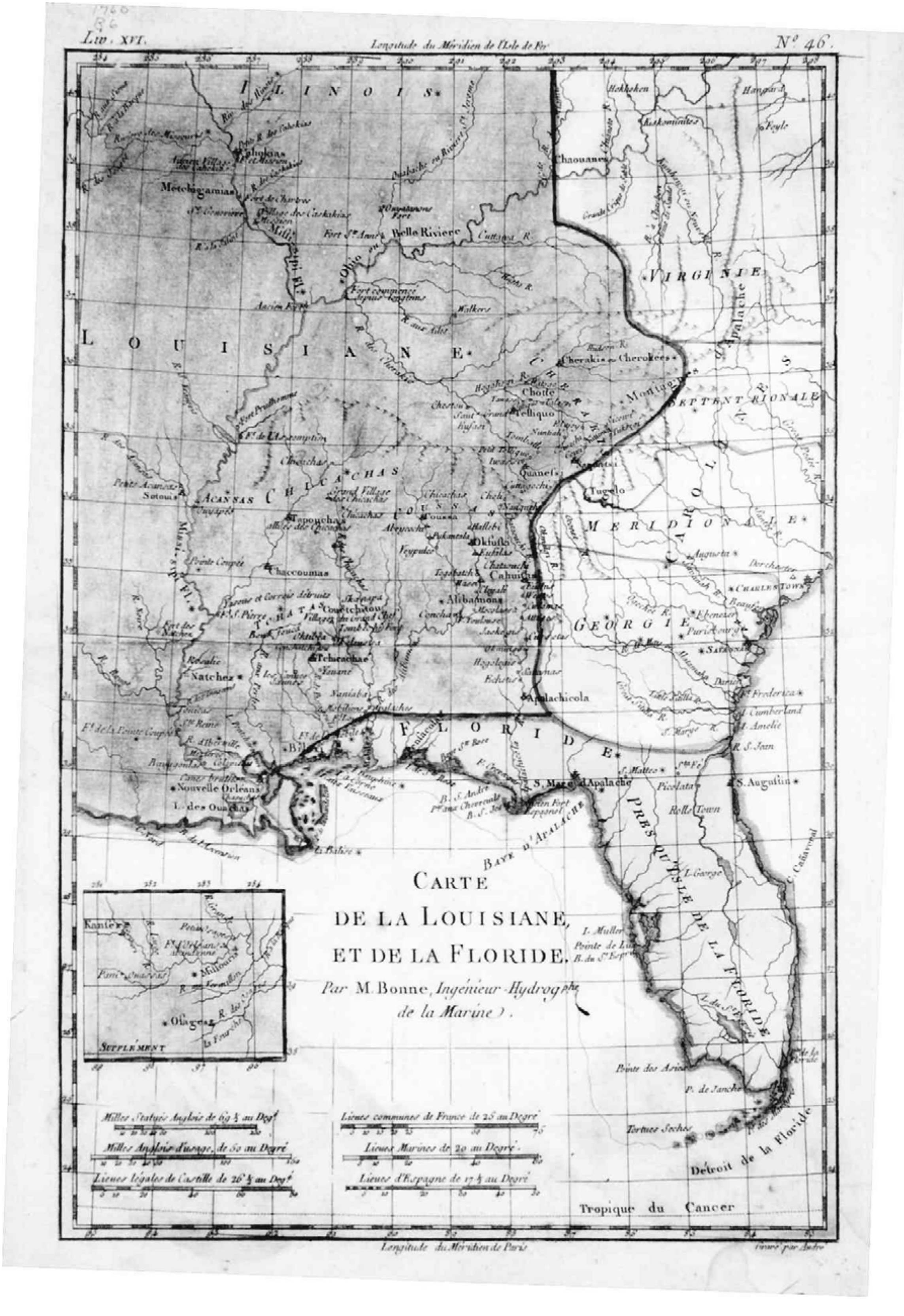
Adams-Onis Treaty

By the late 1700's and early 1800's Continental power was quickly declining in the Americas. With the several Treaties of San Ildefonso, France and Spain traded back and forth large amounts of land west of the Mississippi. By the Third Treaty, signed in 1800, France had one again regained its control of the territory Louisiane, only to sell it to Thomas Jefferson in 1803. At issue were the boundaries of these lands. With the various transfers, many boundary lines had shifted depending on who was in control, leaving several disputed areas.

The Adams and Onis Treaty was negotiated by John Quincy Adams, Secretary of State of the Untied States and Don Luis de Onis, Spanish Minister to the United Stated and signed between the two countries to clear up some of these disputed areas, one of which was the north boundary of Florida. Ultimately, the issue was settled with a payment for the entire territories of East and West Florida for the sum of $5,000,000, in addition to the United States relinquishing some of its claims to the west, bordering the disputed areas along the Louisiana Purchase.

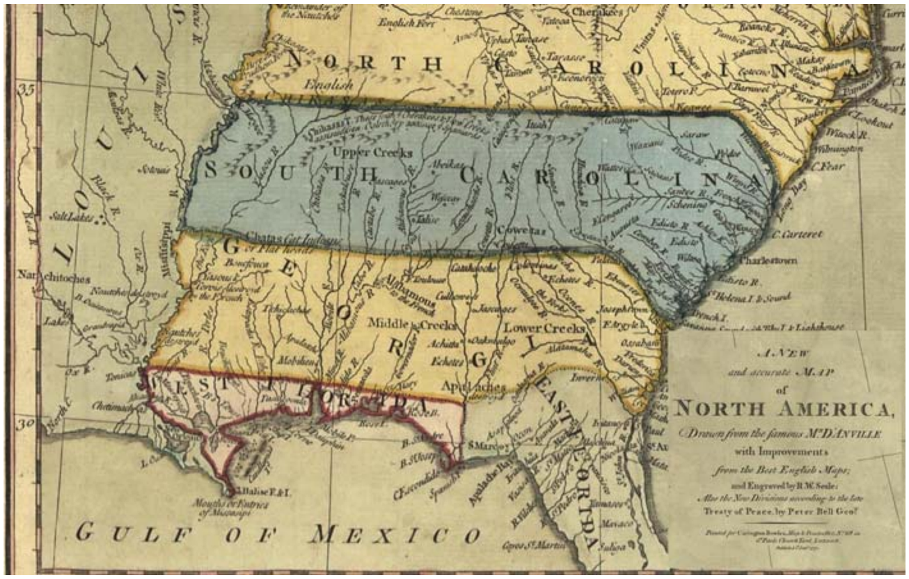
With the signing of the Adams-Onis Treaty concluding on February 22, 1819, and final ratification on July 10, 1821, Florida became a Territory of the United States. Formal control was the handed over to Andrew Jackson by the local Spanish authorities on July 17 at Pensacola.

Day 2

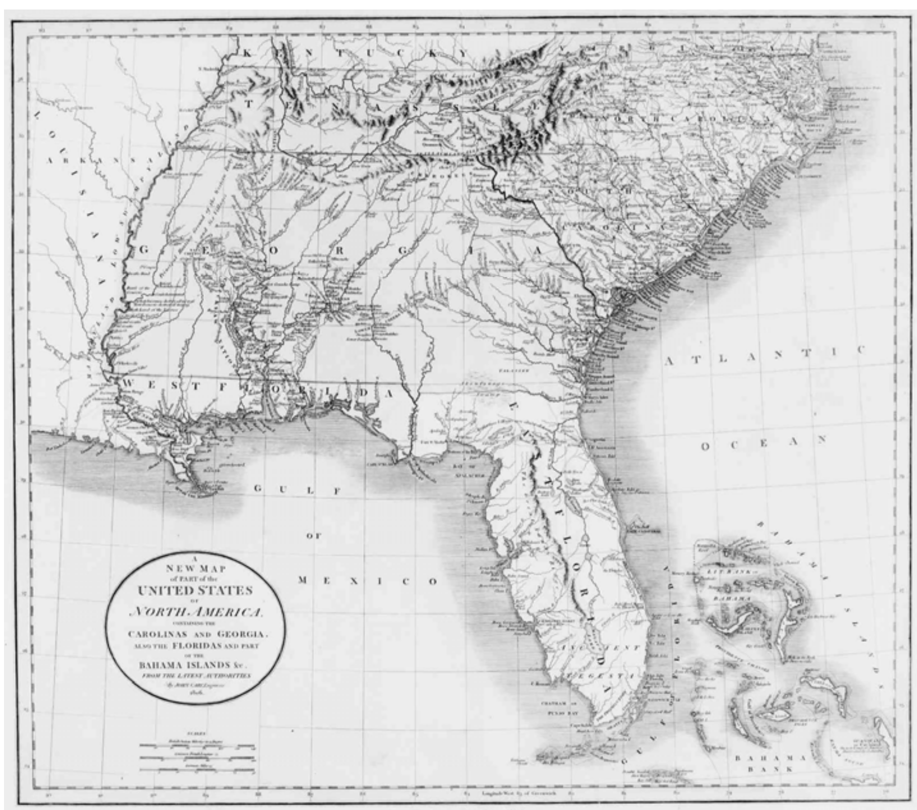


Carte de la Louisiane et del Floride (Bonne 1760)

Day 2



"A New and Accurate Map of North America" (d'Anville 1771)



A new map of part of the United States of North America, containing the Carolinas and Georgia (Cary, 1806)

Day 2

Colonel Butler & Tallahassee

Colonel Butler was commissioned Surveyor of the Public Lands of Florida on July 9, 1824, by George Graham, Commissioner of the General Land Office in Washington. William P. Duval, Florida Territorial Governor was notified of his appointment on July 10, 1824. The appointment was made by President James Monroe at the request of General Andrew Jackson. With his appointment as Surveyor of the Public Lands of Florida (later referred to as the Surveyor General of Florida), the actual work of surveying the state by the PLSS began.

Colonel Butler arrived in Tallahassee and assumed his duties as Surveyor General. The selection of the Tallahassee Base and Guide Meridian Marker was one of his immediate tasks. The site of the territorial capital had previously been selected "halfway between the two major towns of St. Augustine and Pensacola.   Lt. Governor Walton, in the absence of Governor Duval, requested Colonel Butler to select the Initial Point so that the Capitol Building would be approximately in the center of the first quarter section to the northwest. This quarter section had been granted to the Territory by the U.S. Government as the seat of government.

The initial point, one-quarter mile south and one-quarter mile east of the capital site, fell in a low area near the junction of two meandering streams and was referenced to four nearby trees. There is a small park at the intersection of Meridian Street and Park Avenue with a concrete pyramid shaped marker with bronze plates signifying the point.

From this initial point, the Principal Meridian was surveyed north and south and a Base Line was run east and west. The field work on the rectangular survey system in Florida began on or shortly after November 16, 1824 when the first contract was issued to a Deputy Surveyor to mark off the Principal Meridian and a portion of the Base Parallel. Colonel Butler was instructed to appoint one of his most skillful surveyors to run the Tallahassee Base Line west to the Perdido River. Benjamin Clements and James Exum completed this task. The field notes indicate that Deputy Surveyor Benjamin Clements' first day in the field was sometime in late November or December, 1824. Instructions were received to survey 20 Townships in the vicinity of Tallahassee as soon as possible, as settlers were arriving and clearing land even before the survey could be made. Colonel Butler appointed Deputy Surveyors as required and expedited the subdivision of the Public Lands of Florida into Townships and Sections. The Florida portion of the Public Land Survey System was to proceed with all due speed.

Day 2

The name "Tallahassee" is a Muskogean Indian word often translated as "old fields." This likely stems from the Creek (later called Seminole) Indians who migrated from Georgia and Alabama to this region in the late 18th and early 19th centuries. Upon arrival, they found large areas of cleared land previously occupied by the Apalachee tribe. Earlier, the Mississippian Indians built mounds near Lake Jackson around AD 1200, which survive today in the Lake Jackson Archaeological State Park.

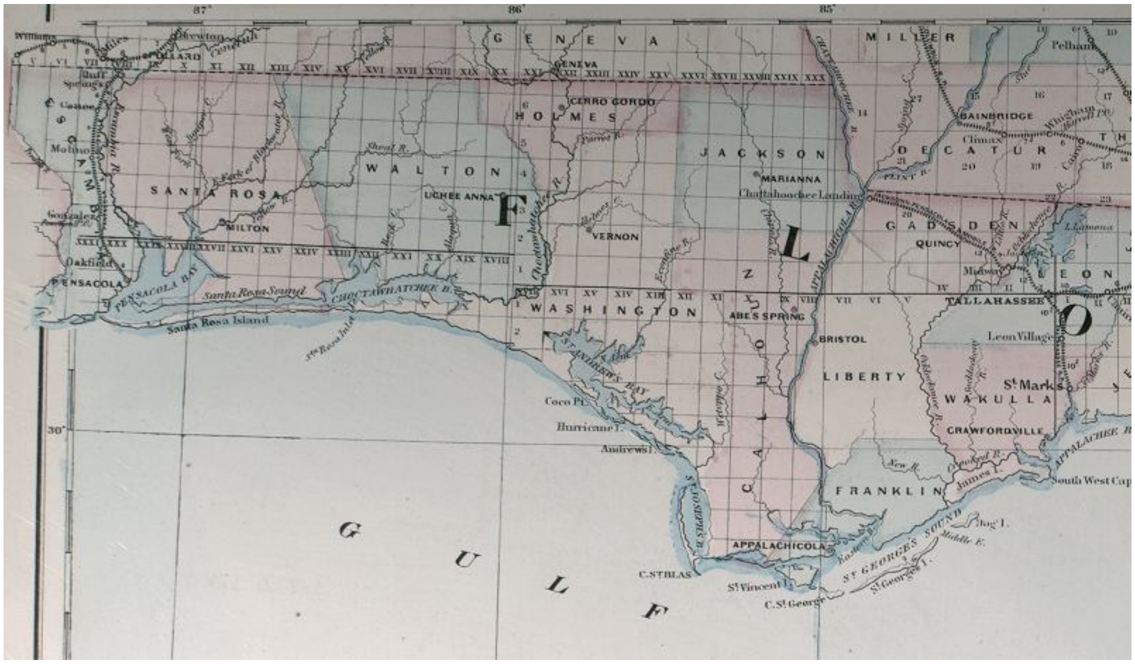
The expedition of Panfilo de Narvaez encountered the Apalachees, although it did not reach the site of Tallahassee. Hernando de Soto and his expedition occupied the Apalachee town of Anhaica in what is now Tallahassee in the winter of 1538–1539. Based on archaeological excavations, this site is now known to be located about 0.5 miles (800 m) east of the present Florida State Capitol. The DeSoto encampment is believed to be the first place Christmas was celebrated in the continental United States. During the 17th century, several Spanish missions were established in the territory of the Apalachee to procure food and labor for the colony at St. Augustine. The largest of these, Mission San Luis de Apalachee, has been partially reconstructed by the state of Florida.

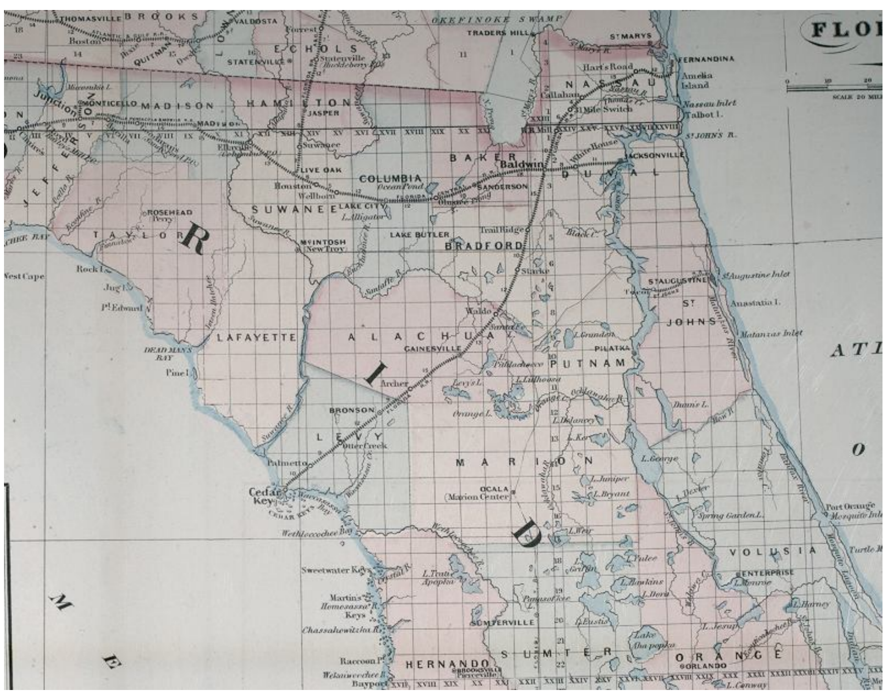
Tallahassee was created as the capital of Florida during the second legislative session. It was chosen as it was roughly equidistant from St. Augustine and Pensacola, which had been the capitals of the Spanish and British colonies of East Florida and West Florida, respectively. The first session of Florida's Legislative Council - as a territory of the United States - met on July 22, 1822 at Pensacola and members from St. Augustine traveled fifty-nine days by water to attend. The second session was in St. Augustine and required western delegates to travel perilously around the peninsula on a twenty-eight day trek. During this session, it was decided that future meetings should be held at a half-way point to reduce the distance. Two appointed commissioners selected Tallahassee, at that point an abandoned Apalachee settlement, as a halfway point. In 1824, the third legislative session met there in a crude log capitol.

Photos of the Initial Point Tallahassee Meridan

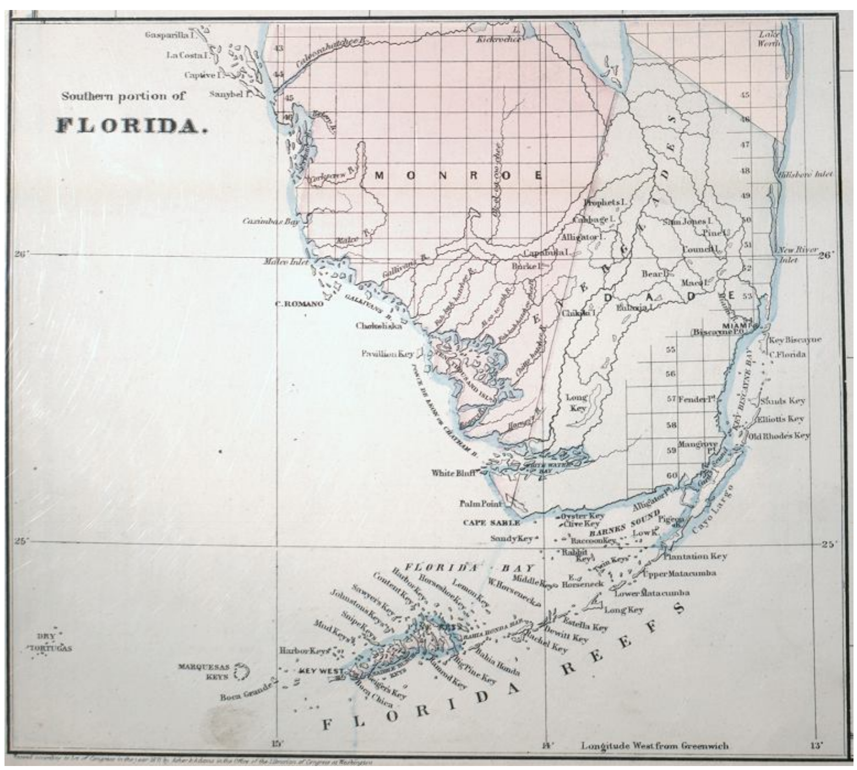
Day 2

1877 Historical Map of Florida
(showing Base Line, and standard parallels):





Day 2



Map of Florida that was, "Entered according to Act of Congress in the year 1877 by Asher and Adams..."
Map Credit: Courtesy of the Special Collections Department, University of South Florida. Digitization provided by the USF Libraries Digitization Center.

Day 2

Interruptions in the Grid

Spanish Land Grants

Florida was governed by Spain prior to its United States territorial status in two periods of time: the first from 1513 to 1763; the second from 1783 until 1821. From 1763 until 1783, Florida was governed by Great Britain.

During the second period (1783-1821), allotments of land were officially granted to settlers in one of two ways.

Under a Royal Order dated October 29, 1790, acreage was granted to settlers who petitioned (also called a memorial) the Spanish governor of Florida. In this memorial, the petitioner specified the amount of acreage desired, according to the family size and number of slaves, and the location desired. The governor responded in one of two ways. He would give the petitioner title of absolute property or a concession, which allowed possession but not title, until certain requirements were fulfilled. In most cases, the petitioner had to cultivate the property for a specified time.

Grants of land were made while Spain was negotiating the transfer of Florida to the United States, between February 1819 and July 1821. After Florida passed out of Spain's control, the United States began a process of verifying these land grants through the Land-Grant Act. Commissioners were appointed for East and West Florida to investigate land claims. East Florida Commissioners were located in St. Augustine; Pensacola was the site for the West Florida Commissioners. There was in the Territory of Florida a large number of settlers who had no titles to show for the lands they occupied—renters, squatters, or purchases of lands with doubtful titles. The majority of these were probably citizens of the United States. To retain and do justice to these settlers Congress enacted the “Donation Act” of May 26, 1824. These are commonly referred to as **Donation Act** grants.

Under the formal inquiry, the testimony of family members and friends were recorded and a decision was made to either award the land or not, in which case the claim was unconfirmed. These records became known collectively as the Spanish Land Grants.

In the 1940s, these valuable records were preserved through the Works Projects Administration. The Spanish and English records of the Land Grant Commissions were translated, collated, typed and made into a several volume reference work. Divided into Confirmed and Unconfirmed Claims, these typewritten records provide family names and relationships, early place names (some of which have since disappeared), dates, brief personal and military data, excerpts of estate inventories in short, a treasure trove for the genealogist with Florida roots and the historian of early Florida.

Day 2

THE CASE OF GEORGE J. F. CLARKE

By Dr. Joe Knetch

The problems of surveying the Spanish land grants in Florida are almost continuous with the total history of the State. From the very first attempts until the final disposition of the grants by their private owners, the land grants have been a source of disagreement, court battles and fraud. The Land Commissions of East and West Florida, set up to settle some of the smaller grants in 1822-23, found the records disjointed, obliterated, non-existent or removed to Spanish territory elsewhere. It appears that from the moment that Spain undertook to negotiate with the United States the transfer of the Territory of Florida, there was an attempt to defraud. Richard Keith Call, representing the United States in Federal Court on many occasions, noted: "In the case of Clark, 8 Peters, we find the following remark: `It is stated that the practice of making large concessions commenced with the intention of ceding the Florida's, and these grants have been treated as frauds on the United States.' `The increased motives for making them have been stated in argument, and their influence cannot be denied.'" [House Report No. 1348. 24th Cong., 1st Session. December 16, 1835. 252.] Call states that the Supreme Court recognized this attempt to defraud, but refused to disclaim responsibility and accepted many claims as valid, despite the lack of bonafide evidence. Claims were accepted that had never been surveyed or marked on the ground, which meant that the U. S. Deputy surveyors would have to "create" these grants without the benefit of physical evidence and take the word of the grant holder or some other witness as to the land desired by the claimant. This lack of information, the questionable character of some of the witnesses, the non-existence of physical evidence, etc. place tremendous pressures upon the shoulders of those responsible for separating the private grants from the public lands in Florida.

How did such a state of affairs come about in Florida? The primary answers are the decisions of the United States Supreme Court in declaring many of the grants valid, the lack of a usable source of Spanish land laws [not until Joseph M. White's work, in 1828, did any court or Land Commission have the benefit of this information], the political pressures applied by some of the grant holders [original grantees or purchasers], and the very liberal interpretations of the Spanish Surveyor General of East Florida, George J. F. Clarke regarding his powers. In West Florida, the problems were not with Surveyor General Pintado's surveys, as with the lack of cooperation by the local inhabitants and the "loss" of many of the records, many of which were removed to Cuba, contrary to the treaty of cession. It is in the assumptions of power by George J. F. Clarke that many of the more well-known problems in East Florida begin. Because of the lack of reliable authority (ies) for Spanish land law, questionable witnesses, and Clarke's own statements regarding his powers, those hearing cases involving the grants were at a distinct disadvantage in attempting to judge what was valid and what was not. Little wonder that historians George C. Whatley and Sylvia Cook entitled their article, "The East Florida Land Commission: A Study in Frustration." [Florida Historical Quarterly. 50(1971).] It is an apt title.

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The Supreme Court came under question by Richard K. Call when he argued, as noted above, that the Court was operating with the knowledge that some of the grants, especially those after 1815, were done with intent to defraud the United States. Call also pointed out that some of the grants that were confirmed were done so with only copies admitted as evidence, a clear contradiction of the rules of evidence of that day. (Copies could be admitted only if the original were clearly not available and the copies were certified as to their authenticity.) He further questioned the authority under which many grants were made, especially those made under Governors Coppinger and Kindelan. Call believed that the power to make large grants rested with the Intendant, stationed in Havana, and not with the provincial governor. He observed that the Court considered the powers of the governor to equal to that of the King of Spain, because they derived their office from him and allegedly reported to him all of their actions. This assumption, Call declared, was absurd and that the governors reported to Havana and other officers, but not directly to the King. As he put it: "In 9 Peters, 735, the court decided, that `by the laws of Spain is to be understood the will of the King, expressed in his orders, or by his authority, evidenced by *the acts themselves*, or by such usages and customs in the province as may be presumed to have emanated from the King, or to have been sanctioned by him, as existing authorized law.' Thus, the *`acts themselves'* of the Spanish officers, in making grants, is evidence of the law conferring the granting power." [House Report No. 1348. 24th Cong., 1st Session, December 16, 1835. 258.] This became the standard of action for the court, and not Call's, much to his chagrin.

The Court also decided, first in the case of the Clarke Mill Grant of 16,000 acres, that this type of grant also gave title to the land. Call, argued against this concept most forcefully. He clearly state his case in his discussion of the Eusebio Bushnell and Seth Stubblefield grants: "It does not appear, in any part of the preceding case, the first of the mill grants, that the soil is asked for, or that any definite number of acres is granted on which the applicants may cut their logs. They may build a saw-mill at Moultrie, and may cut logs in the woods. This is all that is granted. ... no title to the soil was intended to be given." [Ibid. 267.] Again, Call lost his pleading in front of the Court. Mill grants, including many of the grants along the Indian River, were recognized as transferring title to the land also. Mill grants, because they were intended to be use grants, as Call recognized, were seldom surveyed out with any degree of accuracy, if at all. The result was confusion and headaches for those surveyors who attempted to find and lay out these grants.

The political pressures to have the grants surveyed during the Territorial Period [1821-1845] were great. Some of the most important citizens of the territory were holders, of these lands, mostly through purchase, and wanted to sell or develop them quickly. Moses Levy, Peter Mitchel, Benjamin Chaires, General Joseph Hernandez, and many other notables had all either been granted lands or purchased grants from the heirs or their agents. All of these men were powerful individuals whose word carried much weight in the councils of the Territorial government. The pressures on Deputy Surveyor, Henry Washington, when attempting to find the starting point of the Great Arredondo Grant, in modern Alachua, Marion and Levy Counties, demonstrates their attempts to shape the form and area of that survey. In this particular case, the Deputy Surveyor had the complete backing of the Surveyor

General, Robert Butler. However, this did not prevent the pressure from showing in all of the correspondence between the grant's owners, Levy and Mitchel, and the Surveyor General, the General Land Office and various members of Congress. [See Knetsch: "The Big Arredondo Grant: A Study in Confusion." Micanopy Historical Society, Micanopy, Florida, 1991.]

The assumption of unusually liberal powers by the Surveyor General for East Florida, George J. F. Clarke, led to some interesting forms of surveys and even more confusion in attempting to locate them. When asked who maintained the documents related to surveys, Secretary of the Colony, Antonio Alvarez, under oath, stated that the office of the escribano, not the clerk, kept most of the surveys. This was contrary to what was presumed to be the practice as indicated by other Spanish authorities. Additionally, Alvarez testified that Clarke had, on "more than one instance" changed the location of the grants, "without the decree of the governor." This was clearly beyond the powers of the Surveyor General, as only the governor (if one accepts the arguments noted above) had the power to confer grants. [See House Report No. 1348. 24th Cong., 1st Session. December 16, 1835. 280-81.] It was also the Surveyor General's duty to accurately report if the conditions of the grants had been met, in cases requiring such to be met, as in the case of mill grants or cattle ranching. This, again, was often done from the seat in an office and not by actual observation by the Surveyor General. Under oath, Clarke testified that: "In many instances he changed the location after actual possession, without special authority from the governor; where the claimant lived on his survey, the witness was not bound to respect the metes or bounds, but might give others. The plat and concession do not agree: ..." [House Report No. 412. 18th Congress, 1st Session. May 20, 1824. Reprinted in American State Papers. 634.] Grants changed, locations altered, no inspection of the claim by the Surveyor General, signing off on surveys not actually run by the signee, and these were just some of the confusions caused by Clarke's administration as Surveyor General.

Clarke's office also did not keep accurate or complete records of the surveying done in the colony. When asked if the Spanish Government of East Florida kept any memorandum of where lands were located, Clarke replied: "No regular record. The surveys were generally handed into the Government office." When asked, further, "Was there ever a regular field book kept of the surveys in this country?" the Survey General answered, "There was not." When questioned as to the method used in laying out land grants on water courses or roads, Clarke testified, "I followed no rule, but governed myself by the localities." [Ibid. 635] This, of course, in direct violation of the long standing rule of Marrot's instructions and others, that along such water bodies or public roads the grant is to be surveyed in a rectangular shape with one-third frontage and two-thirds in depth, with some minor adjustments to fill in spaces between grants. With few reliable records, whimsical changes in location, improper division of grants into numerous sections and no regular rules of surveying followed, George J. F. Clarke's tenure in office added greatly to the confusion found in Spanish land grant locations throughout East Florida.

Spanish grants were given on the ancient principle of "head-rights", i.e., the amount of land granted depended on the number of persons brought into the colony by the grantee. The amount of land varied also upon the age, sex and status of the person immigrating into the colony [Under Spanish rules enforced rigidly by Governor Enrique White, the male head of the family received 100 acres, the wife fifty, the children over 14 fifty, under 14 twenty-five acres. Male slaves over 14 brought fifty acres, all others only twenty-five acres. White changed these numbers to lower figures with approval from the Intendant.]. Under the law of 1815, allegedly to encourage development, the Spanish government gave permission for the colony to grant larger acreages for "service to the crown." It was these service grants that caused the concern and the charges of defrauding the United States. F. M. Arredondo, Sr., for example, received numerous grants throughout the colony for his services as Indian agent, negotiator with the rebels and the Americans, provisioner of the colony, etc. One grant to Arredondo covered most of today's Alachua County, totaling 289,645 and 5/7 acres. A 32,000 acre grant was conferred to him in today's Columbia County along with others. These grants were contested in the courts and finally confirmed by the Supreme Court of the United States, in spite of the arguments from Call and William Wirt, then Attorney General of the United States. Grants given under the size of 3,500 acres were to be decided by the East Florida Land Commission or local courts if applicable, this would include most granted under the ancient head-right system. [See: Spanish Land Grants in Florida. Volume 1-5, Introductions. Work Projects Administration. State Library Board, Tallahassee, Florida. 1941.]

Aside from testifying that he was not bound by the rules given him in 1811, or those of Marrot earlier (See readings), Clarke's administration also suffered from the actual want of physical surveys. Clarke admitted that he never re-ran the surveys of his deputies in the field and was, therefore, in no position to judge whether or not they had done what they attested to. Evidence from many of the letters of the United States Deputy Surveyors, points to the near total lack of monumentation in the field where grants were allegedly surveyed. Clarke, in defiance of today's standard of disinterestedness, actually let his brother, and others, survey their own grants and report same to him. The testimony of Andrew Burgevin, a deputy under Clarke, is very revealing as to Clarke's administration. When asked if he was ordered to follow the instructions provided the Surveyor General, the deputy answered, "I was not." Queried as to whom he gave his returns, Burgevin stated, "To the owners of the lands." "Did you not," Commissioner Alexander Hamilton asked, "consider yourself bound, when you were called on to survey, to give one-third front, and two-thirds depth?" [Required along navigable waters or public highways] To which the surveyor replied, "I never received any instructions on the subject." Questioned as to his making the actual surveys in every case where he had given certificates, Clarke's deputy stated, "I went upon the land, but was sometimes prevented from making the survey, for fear of being murdered by the Indians." Asked specifically about the Alachua grants, Burgevin noted, "I did go to Alachua, but did not go round the land. I have not been in the Hammock." Finally, when questioned as to whether or not Clarke had instructed him that it was "unnecessary to make actual surveys," the deputy announced, "Yes, provided the survey could not be made." [House Report 412. 18th Cong., 1st. Session. May 20, 1824. Reprinted in American State Papers: Public Lands. 641.] such damning evidence of the lack of professional standards and documentation of work demonstrates why Clarke's tenure in office caused so much confusion for the United States Deputy Surveyors when they were required to retrace Spanish land lines, most of which did not exist.

In one of the more important questions regarding land grants in Florida, a recent decision by the Florida Supreme Court upheld the State's title in lands covered with navigable waters inside of such grants. [See. Webb v. Board of Trustees.] This case, involving the waters of Orange Lake in Alachua and Marion Counties, brought to light many documents, including and 1851 decision [See. Levy v. Smith] which indicated that all of the grant's owners, of which Levy was one, were familiar with the law noting that they were not entitled to the lands under the navigable waters. On October 24, 1825, Peter Mitchel, who held the largest share of the land in the Arredondo Grant, stated that he understood that the grant, "consists of four leagues of land exclusive of land covered by water." (See readings) In their protests against the survey made by Henry Washington, the heirs of many of the owners, led by Horatio G. Prall, filed in the Superior Court of East Florida, clearly stated that, "... Henry Washington should also have excluded from each survey all lakes, navigable waters and all lands covered with water so that the same were unfit for use ..." [Peter Mitchel vs. Nehemiah Brush, Partition of Arredondo Grant, 1832-1843. St. Augustine Historical Society Archives, St. Augustine, Florida.] And, when questioned, "What was the rule where the land called for was discovered to be covered by water, or was not good?", George J. F. Clarke responded, "To locate elsewhere, upon application to the governor." [House Report No. 412. 18th Cong., 1st Session, May 20, 1824. Reprinted in American State Papers: Public Lands. 640.] Clearly, the lands under the navigable waters, by the historical record, were never intended to be included in any grant by the Spanish government in Florida and this was well understood by those who received and applied for grants of land.

Clark, who was appointed Surveyor General by Acting Governor Estrada in 1811, had already had some experience in this office when John Purcell left office and never returned. It is speculated that he had some service as a deputy surveyor prior to his appointment, however, documentary evidence of this is lacking at this time. [L. B. Hill. "George J. F. Clarke, 1774-1836." Florida Historical Quarterly. 21(Jan. 1943.): 213.] His early life had been spent, after the age of twelve, in the offices of the Panton Leslie & Company as an apprentice, which gave him some experience in travel, trade and land issues. By 1802, he had begun purchasing property of his own, aside from slaves, in St. Augustine, first a "marsh lot" and then a town lot which appears to have come with buildings. This lot was located strategically on Marine Street, between the barracks and the old powder magazine. This convenience to things military fitted into his role as a member of the Urban Militia. For whatever reason, he soon left St. Augustine for the confines of Fernandina, where the census of 1814 shows him with a wife and four sons. [Ibid. 212-13.] The famed Clarke Mill Grant was located there and shows clearly on the official map of the town surveyed and drawn by George J. F. Clarke, in 1811-12. Clarke was instructed to make this map because of the unsanitary condition of the old town and its general unsightliness. According to the instructions of Governor Enrique White, Clarke was to lay down a regular plan of the city which would put the streets in proper alignment and all of the lots somewhat uniform. These same instructions also note that an individual who conformed to the new plan could freely move his house to the new lot and receive clear title, with the ability to sell the old lot (or remains thereof) as vassels of the King. Clarke was required to give certificates of proof before they could receive clear title. These lots, those now occupied, were reserved only for residents current to Clarke's survey, not newcomers. Numerous grants were made within the new plan, especially to Charles W. Clarke, Flora Clarke, William Garvin, Felicia "a free woman of color", Elizabeth Wiggins, a free mulatto and Anna Wiggins, all related to George J. F. Clarke, although not by marriage, as Clarke admitted that he had never married in his will. [Ibid. 199-200.]

Each of the above named individuals was related to Clarke as brother, children, concubine or married to one of these, as in the case of Garvin. It is interesting to note that these people received numerous grants of land from the Spanish authorities throughout Clarke's life. Garvin, as many know, received a grant mostly situated in Township 20 South, Ranges 34 and 35 East, just south of the Volusia and Brevard County line. The well-known Volusia County grant, the Clarke-Atkinson grant on Haw Creek, set some precedents when the Supreme Court ruled that:

> *The grant of Atkinson was for the land he mentioned in his petition, or for any other lands that were vacant. Three surveys were made of lands within the quantity granted, not at the place specifically mentioned in the grant, but at other places. Held that these surveys were valid, notwithstanding that they were made at different places. [Peters 16. "The United States v. The Heirs of Clarke and Atkinson." 228-33.]*

The grant was for a total of fifteen thousand acres, but because the Governor, in the words of the grant, stated: "Consequently the surveyor-general will run them in the places he mentions; or in others that are vacant and of equal convenience to the party." The U. S. Attorney General, Lagare' argued, in vain, that this description was too vague to be valid and that there was no interest in them held by the Clarke family and that there was no authority to survey four different tracts to make up the total acreage. These points held little weight with the Supreme Court, which held, in the last named objection, that as the grant was for any vacant land, there was no restriction on the surveyor-general in deciding where, in the interests of the Crown, he was to situate the final portions of the grant. [Ibid. 231.] Clarke, and his extended family connections, benefited from such liberal rulings by the Supreme Court. As Louise B. Hill noted in her biographical sketch of Clarke, "Indeed, so numerous were their grants, together with those confirmed to Honoria Clarke at an earlier date, that they fill four pages in *American State Papers/Public Lands*." [Hill. 217.]

It would be unfair to record only the land grabbing by Clarke and others during those confusing years without noting that the Surveyor General did accomplish a great deal on behalf of the Spanish Crown. Aside from his serving as Surveyor General, Clarke also had an important hand in helping to reestablish what passed for order at the end of the rebellion that lasted, off and on, from 1812 to 1816. Clarke served as a commissioner to the rebel leaders and even proposed a plan for a workable peace on the frontier. The fact that part of this plan was earlier put forth by Governor Kindelan does not detract from the accomplishment Clarke helped to bring about, namely local peace on the St. Mary's River frontier. It was Clarke who proposed the idea in person and helped to make sure that it was carried out. For this feat, he was commissioned, “deputy governor of the northern and western divisions of Florida,” i.e. the upper and lower regions of the St. Mary’s River. He also led Spanish militia forces in the attempt to dislodge the rag-tag outfits of Macgregor and Aury. It has been noted by Hill, that, “he was without doubt the chief factor in holding his section to its Spanish allegiance.” [Hill. 226-231.] Other accomplishments of this rather remarkable man include the establishment of a postal route through St. Mary’s, Georgia, and into East Florida and his service as Spanish vice consul for the Carolinas and Georgia. For all of these services to the Crown, he received grants of land from a monarchy strapped for any form of hard cash.

George J. F. Clarke was an unusual man, given to taking opportunity and running with it. He established a large family, whose heirs held the land for many years after his demise. His legacy on the land is innumerable land grants, surveyed or not, throughout East Florida, which bear his stamp or name. Clarke’s approval of surveys which did not follow the rules laid down by Spanish authority has done much to add to the confusion of land titles in the State of Florida. Grants which were allegedly designed to not overlap, do in many places. Parcels which should have been surveyed in contiguous units were divided as “vacant” lands became available. Indeed, the landscape of Florida is literally dotted with repetitive names of grants, causing confusion for those looking to find a particular piece of property. And, finally, numerous court decisions added even more contention to the controversial nature of the man named George J. F. Clarke.

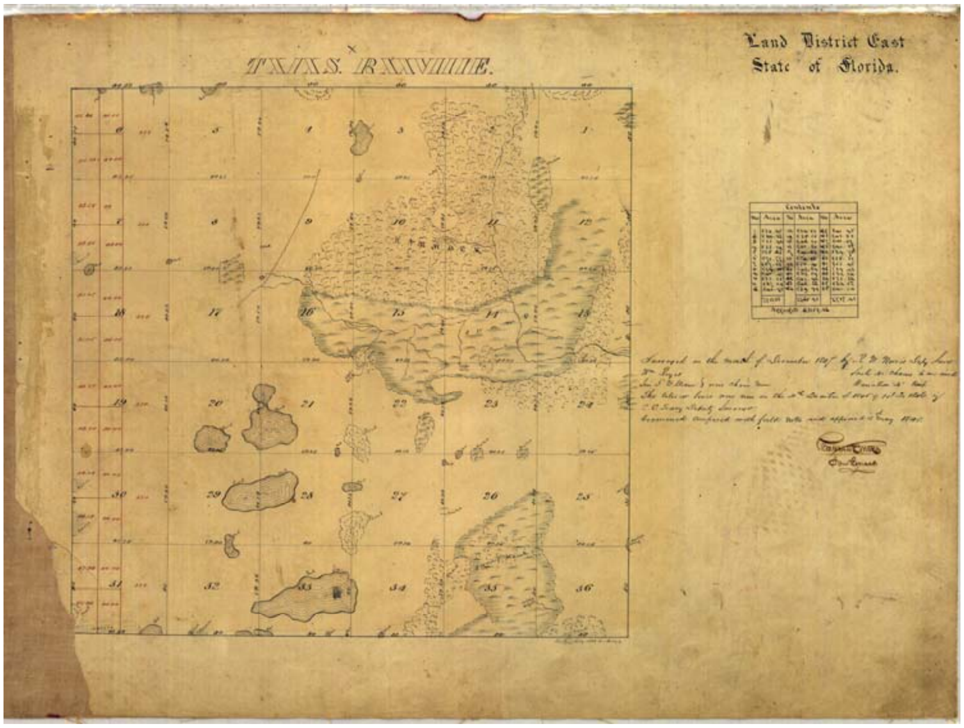
Although the above does not cover each and every problem created by the Spanish land grants, it does give an adequate overview of the major problems. Few areas of Florida surveying have caused as much trouble, confusion and acrimony as the surveying of the Spanish land grants. From lines never being run, to poor recording of the land plats, surveys and titles by the archivists of Colonial Florida, these grants have been the bane of Florida’s surveyors. In East Florida, the lax administration of George J. F. Clarke caused many of the problems by simply ignoring each and every rule ordered through the office of the governor. The land commissioners were handicapped, as were the courts, in attempting to handle the problems created by these grants. From all of the confusion, it is easy to see why Whatley and Cook, stated, “As far as the commission could discover, there was no comprehensive Spanish code of land laws which it could use to determine the ultimate validity of the grants.” [Whatley and Cook. 43.] Unfortunately for the United States Deputy Surveyors, it was their job to locate and accurately map the grants so loosely defined or questionably conveyed.

(http://www.dep.state.fl.us/lands/files/spanish_land_grants.pdf)

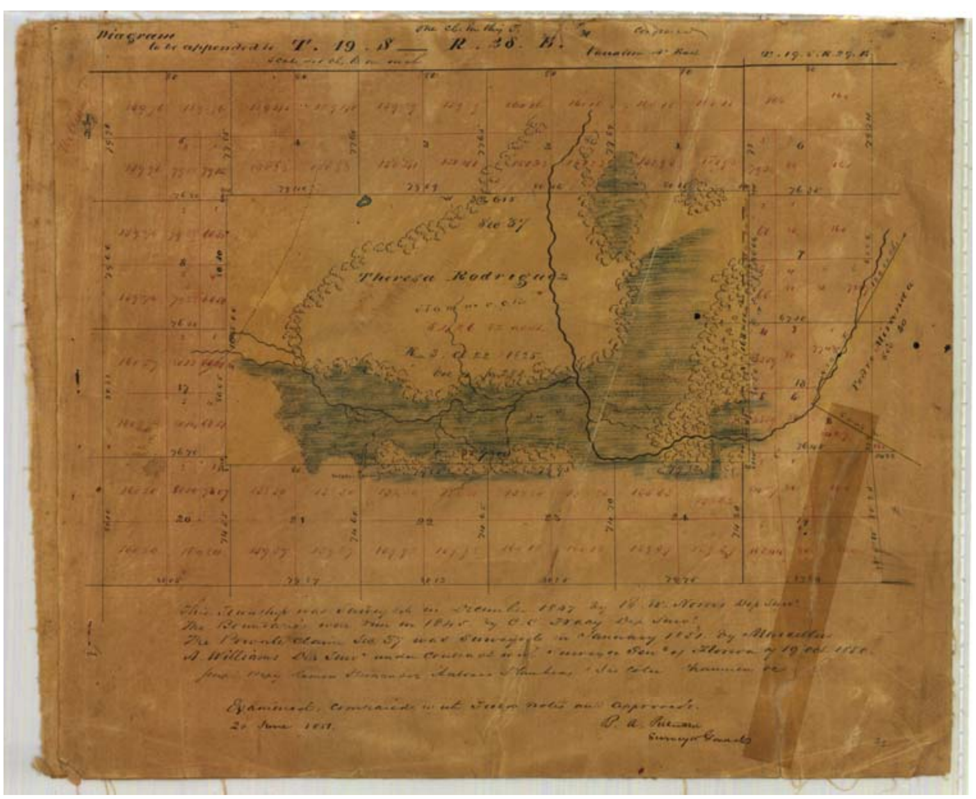
Day 2

Government Surveying in a Township with a Grant

Township 19 South, Range 28 East (Surveyed Dec 1847)



The above image shows the plat as filed prior to the incorporation of the Teresa Rodriguez Grant. Sections were run out and numbered according to the Instructions. Below shows the plat with the Grant (aka Section 37), resurveyed in 1851.



Day 2

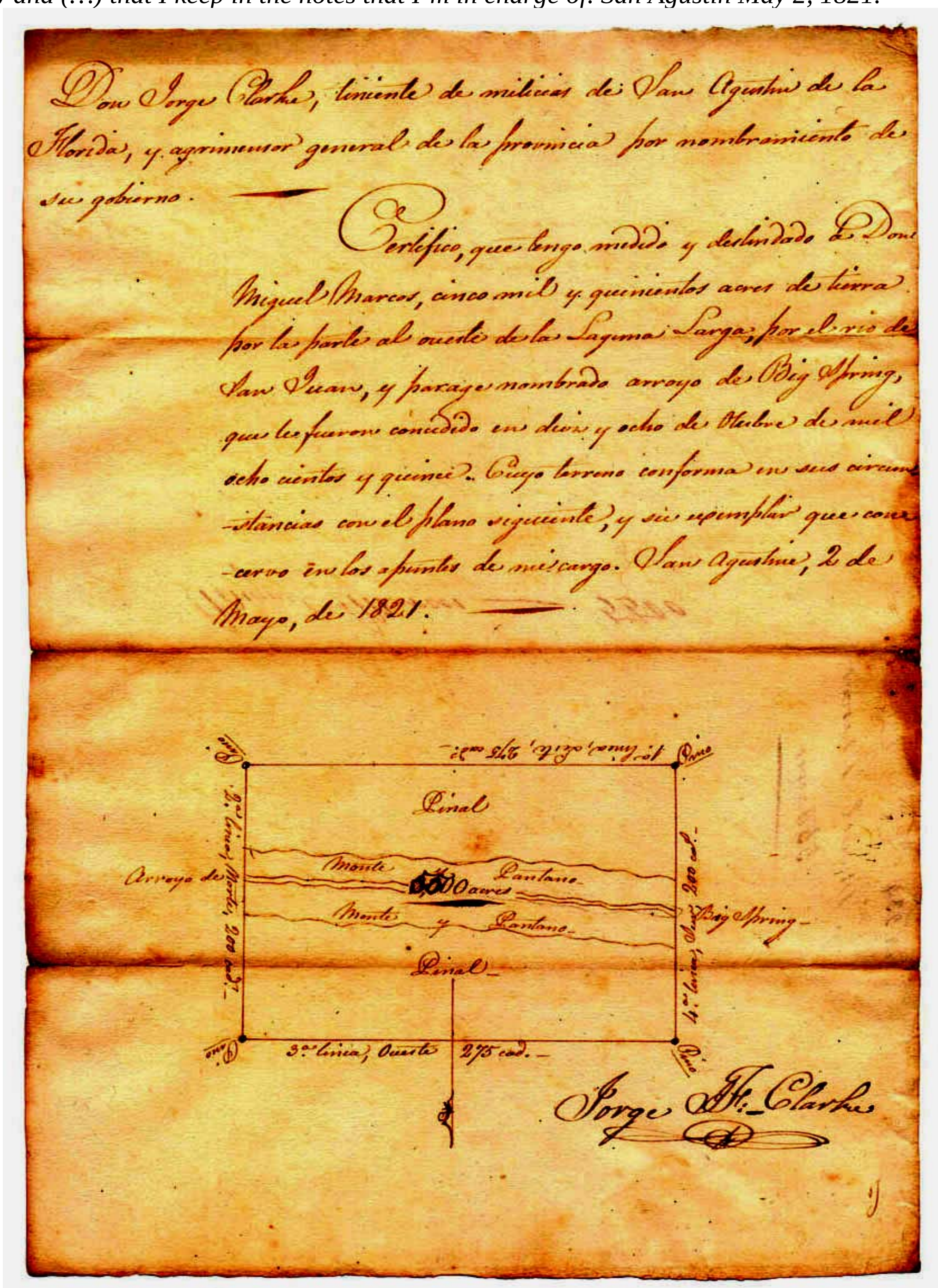
Aerial Image of Teresa Rodriguez Grant (aka Section 37)

Day 2

The Grant reads:

> *Don Jorge Clarke, lieutenant of army of San Agustin of Florida and surveyor general of the province by appointment of his government:*

I certify that I have measured and bounded to Don Miguel Marcos, five thousand five hundred acres of land by the side west of the Laguna Largo, by the river of San Juan, and the place named arroyo of Big Spring, that were given on the day 18 of October 1815. Such land is in the drawing below and (…) that I keep in the notes that I'm in charge of. San Agustin May 2, 1821.



Map of Teresa Rodriguez Grant (May 2, 1821)

Day 2

Meandering in Florida

Swamp and Overflowed Lands Act

The acts of Congress which granted to certain States the swamp and overflowed lands within their respective boundaries were listed in Chapter I of the Act. These lands are not conveyed without survey, selection, or patent. *Lee Wilson & Company* v. *United States*, 245 U.S. 24 (1923). They are surveyed as public lands and subject to classification at that time.

Swamp lands include marshes and intermittent ponds which do not have effective natural drainage, particularly where such conditions are long continued.

Overflowed lands include essentially the lower levels within a stream flood plain as distinguished from the higher levels, according to the characteristic effect of submergence where long continued.

Tidelands are coastal areas situated above mean low tide and below mean high tide, particularly as they are alternately uncovered and covered by the ebb and flow of the daily tides. As a part of the bed of navigable waters, such lands belong to the States. *Pollard's Lessee* v. *Hagan*, 44 U.S. 212 (1844). Tidelands are mentioned here to stress their distinction from swamp and overflowed lands. Coastal "salt marshes" that are covered by the daily tide are tidelands and not subject to survey. On the other hand, coastal marshes that are not covered by the daily tide are swamp and overflowed lands within the meaning of the grants and are subject to survey.

It has already been emphasized that meander lines will not be established between the upland and the swamp and overflowed lands. Riparian rights, which are applicable within the beds of lakes, streams, and tidal waters, are not enforceable over the swamp and overflowed lands granted to the States. The survey of meander lines at the margin of swamps in the past has been in important cause of the erroneous omission of lands from survey.

The following rules should be followed in making surveys or field examinations of swamp and overflowed lands:

(1) According to R.S. 2481 (43 U.S.C. 984), any legal subdivision the greater part of which is "wet and unfit for cultivation," shall be included in the category of swamp and overflowed lands. When the greater part of a subdivision is not of that character, the whole of it shall be excluded. The legal subdivision referred to is the quarter-quarter section or comparable lot.

(2) "Wet and unfit for cultivation" is interpreted to mean that the land must have been so swampy or subject to overflow during the planting, growing, or harvesting season, in the majority of years at or near the date of the grant, as to be unfit for cultivation in any staple crop of the region in which it is located, without the use of some artificial means of reclamation such as levee protection or drainage ditches.

(3) A subdivision which becomes swampy or overflowed at a season of the year when this condition does not interfere with the planting, cultivating, or harvesting of a crop at the proper time and by the ordinary methods is not "made unfit for cultivation" and does not qualify under the swamp land grant.

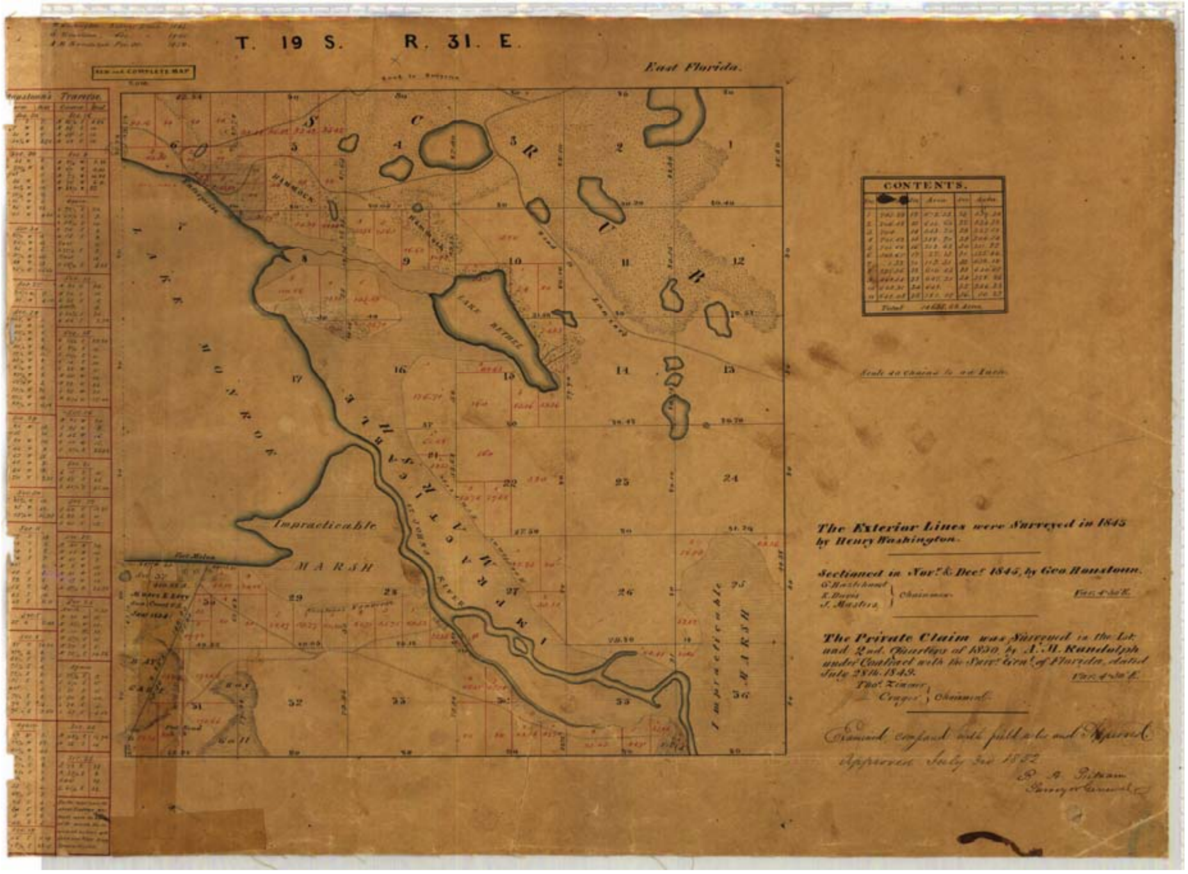
(4) Tame grass or hay, when produced by the ordinary methods of preparing the ground, is considered a staple crop, as well as the cereals, or cotton, or tobacco.

(5) In the administration of the swamp acts the States have been allowed optional methods of preparing the lists of subdivisions that are to be identified as swamp and overflowed within the meaning of the acts. But the surveyor must determine with accuracy the position and extent of the swamp and overflowed land within the area under survey regardless of the methods employed by the States in asserting claims.

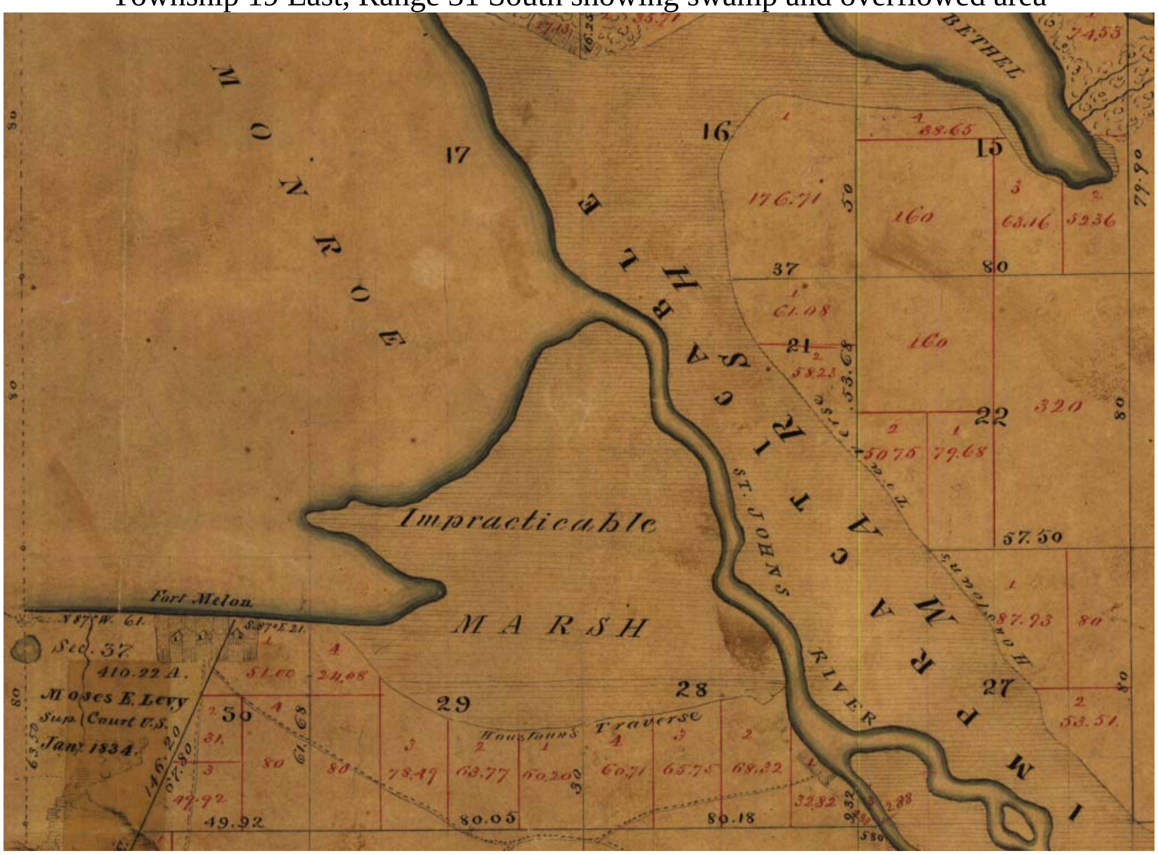
It is always important to note any marked changes in the water level and drainage conditions of the region, and to ascertain the situation as of the date of the granting act. It is desirable to secure the testimony of persons who have known the lands for long periods. The most convincing evidence of the land's character at the date of the granting act is the older native timber, as the varieties reflect their site conditions with great certainty.

This line of investigation requires an inquiry into the habitat of the forest species which are found, particularly as to whether the usual range of the tree is within low wet ground, as for example the cypress, tupelo, sweet gum, water ash, water locust, and red bay of the southern latitudes, and the tamarack, white cedar, black spruce, swamp spruce, and black ash of the northern latitudes of the United States. The presence of any of the species named indicates the possibility of swamp land, and while conclusive with some of them, others of the species named have a wider range and may be found associated with upland varieties. If upland varieties are present the plain inference will be that the site conditions are that of upland, even though a forest species may favor moist rich soil.

Day 2



Township 19 East, Range 31 South showing swamp and overflowed area



Day 2

Navigable Waters

Ordinary High Water Line

The OHWL has been defined as "the point up to which the presence and action of the water is so continuous as to destroy the value of the land for agricultural purposes by preventing the growth of vegetation, constituting what may be termed an ordinary agricultural crop." It is an ambulatory line, shifting in response to long term changes in the water level. The primary indicators of the OHWL have been vegetation, soil and geomorphology. In addition, corroborative evidence such as historical records, old surveys, hydrology, and eyewitnesses, have been used in establishing the OHWL. This definition has been based on several Court cases: Tilden v. Smith, Martin v. Busch, and State v. Florida National Properties Inc.

It is also the boundary between the navigable waters (owner by the general public & administered by the state) and the adjoining privately owned uplands. Typically is the average reach of water during the high water season, excluding floods and/or other unusual extreme water events such as hurricanes, etc.

Day 2

Pre 1975 Filled Lands Information

All of the state's right, title, and interest to all tidally influenced land or tidally influenced islands bordering or being on sovereignty land, which have been permanently extended, filled, added to existing lands, or created before July 1, 1975, by fill, and might be owned by the state, is hereby granted to the landowner having record or other title to all or a portion thereof or to the lands immediately upland thereof and its successors in interest.

Thereafter, such lands shall be considered private property, and the state, its political subdivisions, agencies, and all persons claiming by, through, or under any of them, shall be barred from asserting that any such lands are publicly owned sovereignty lands. The foregoing provisions shall act to transfer title only to so much of such extended or added land as was permanently exposed, extended, or added to before July 1, 1975. A showing of dates by which certain lands were filled or added to may be made by aerial photograph or other reasonable method. Upon request of the landowner and submission of a proposed legal description and aerial photographs or other evidence accompanied by a fee set by the board reflecting the actual administrative cost of processing, the board shall provide an appropriate legal description of the water ward boundary line as of July 1, 1975, in a recordable document.

The Legislature specifically finds and declares these grants to be in the public interest. The boundary between state-owned sovereignty lands and privately owned uplands is ambulatory and will move as a result of nonavulsive changes. This subsection shall not grant or vest title to any filled, formerly submerged state-owned lands in any person who, as of January 1, 1993, is the record titleholder of the filled or adjacent upland property and who filled or caused to be filled the state-owned lands.

Day 2

Accretion

The term "accretion" is applied both to the gradual and imperceptible deposition of material along the bank of a body of water and the lands formed by this process.

A meander line is not surveyed as a boundary. When the Government conveys title to a fractional lot fronting on a navigable body of water, the intention, in all ordinary cases, is that the lot extends to the water's edge.

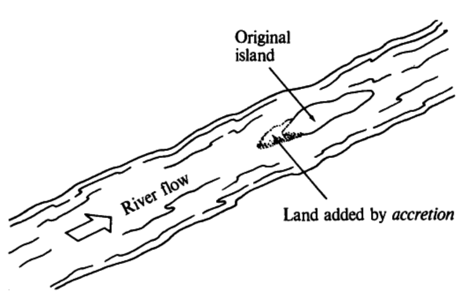
The title and rights of riparian owners in areas below the line of mean high water of navigable bodies of water are governed by State law rather than Federal law. Whether Federal or State law controls the ownership of land accreted to a riparian holding has been answered in a series of cases:

It is therefore settled that wherever it retains title to the original subdivisions along a body of water, either navigable or nonnavigable, the Government may subdivide the lands formed by accretion or by recession of the water, since these, too, are public lands.

Occasionally, subsequent to survey, but before entry, a *large* body of land has formed by accretion between the meander line and the high water line. If such land had formed *after entry*, it would merely attach to the riparian holdings. If the land had been in place before the survey and at all subsequent times, it would fall in the class of omitted land, to be treated as hereafter described under that subject. But, in this special case, the meander line is treated as the boundary line of the grants, and patent is construed to convey only the lands within the meander line. *Madison* v. *Basart*, 59 I.D. 415 (1947).

The lands accreted after survey but before entry are not usually surveyed as would be ordinary accreted lands. Instead, the regular rectangular survey is extended to the body of water. The same procedure would be followed in surveying regular accreted lands only if none of the riparian lots had been patented and it was desired to extend the survey.

In determining what constitutes a "substantial" accretion, to which the rule in *Madison* v. *Basart* is applicable, the area of accretion should be compared quantitatively with the riparian lots to which it attached. Some consideration should also be given to the total area accreted. Accretion to a small lot might be large in proportion but negligible in absolute size. From the standpoint of *size* and *relative size*, the area in question can be weighed as in the case of omitted lands.



Sketch showing Accretion courtesy of Answers.com

Day 2

Erosion

"Erosion" is the process by which the earth's surfaces are worn or carried away by waves, ice, rainfall, wind, or running water. In this context, erosion is the opposite of accretion.

Avulsion

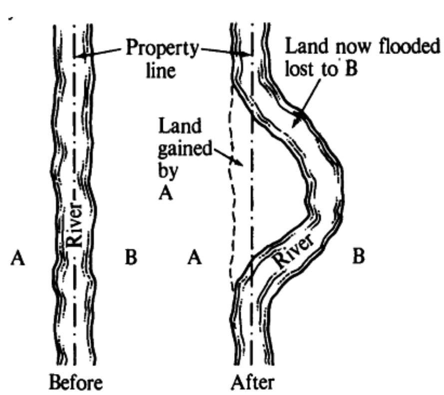
"Avulsion" is the sudden and rapid change of channel of a boundary stream, or a comparable change in some other body of water forming a boundary, by which an area of land is cut off. An island may result or the avulsed land may become attached to the opposite shore.

An avulsive change cannot be assumed to have occurred without positive evidence. When no such showing can be made, it must be presumed that the changes have been caused by gradual erosion and accretion.

The change in course of a stream is clearly avulsive when the land between the old and new channels remains substantially as it was. The unaltered condition of the land may be indisputably shown by the continued existence of improvements in place or of timber, undergrowth, and other vegetation. A study of historic documents, especially maps and aerial photographs, will often help in determining what process has taken place. As a general rule the abandoned channel is easily identifiable where an avulsive action has occurred.

The bed of a new channel resulting from avulsion continues to belong to the owner of the land encroached upon. The bed of the former channel continues to belong to the riparian owners if the stream is non-navigable. Ownership of the abandoned bed of a navigable stream is governed by State law.

When the change in a water course is avulsive, and the boundaries remain unchanged, any subsequent movement of the avulsive channel, whether caused by accretion or by another avulsive action, does not change properly lines.



Sketch on Left showing Avulsion (courtesy of Answers.com) Image on right showing Mississippi River & State line after 1812 earthquake.

Day 2

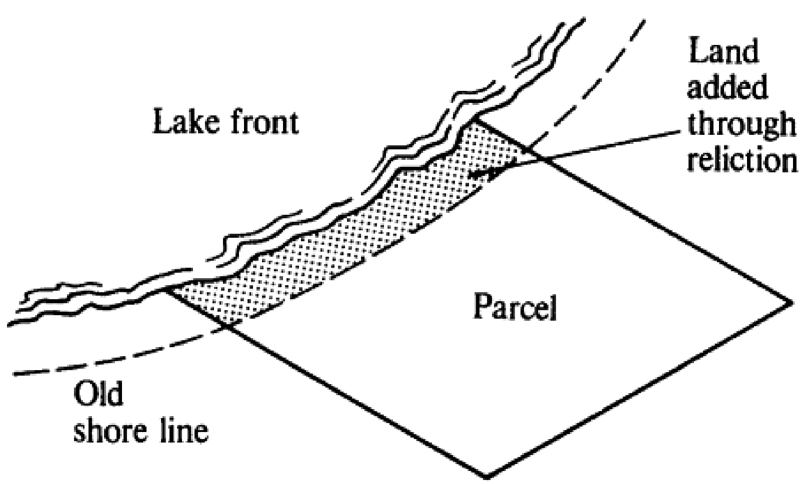
Reliction

"Reliction" is the physical process whereby land that was once covered with water becomes exposed or uncovered by the imperceptible recession of the water, usually when the water level is lowered.

Generally, the process of accretion, reliction, and erosion carry the boundary of the landowner along with the change, a rule accepted in virtually every state and sometimes called the "doctrine of accretion." Similarly, land that is gradually submerged by a rising navigable lake reverts to ownership of the state. Also, a riparian owner may acquire land through accretion or reliction, even if brought about by an artificial obstruction caused by a third person where the riparian owner had no part in erecting the obstruction. The opposite legal consequence generally follows an avulsion. The common law rule is that avulsive changes, such as a river breaking through the narrow neck of an ox bow, do not affect the boundaries of riparian lands.

Land title adjacent to a navigable waterway is transitory, and generally unaffected by language in a deed, though dependent upon determining the ordinary high watermark of the navigable waterway. A similar result follows for determining land title as between two private property owners along a non-navigable waterway, where ownership is typically described as being to the center or thread of the waterway, although contrary deed language may control. Where the waterway border changes as a result of an avulsion, however, the title boundary typically is not altered.

The usual remedies for the protection and enforcement of rights in respect of real property are available to the loss of land through erosion. A landowner who suffers a loss as a result of the wrongful activities of another may successfully maintain a civil action for damages. Access to these remedies may be lost if they are not timely enforced. If a change is made to a natural waterway through the construction of an artificial structure, and a riparian owner fails to protest the change, the acquiescence will later preclude restoration of the water to its prior condition.



Sketch showing Reliction courtesy of Answers.com

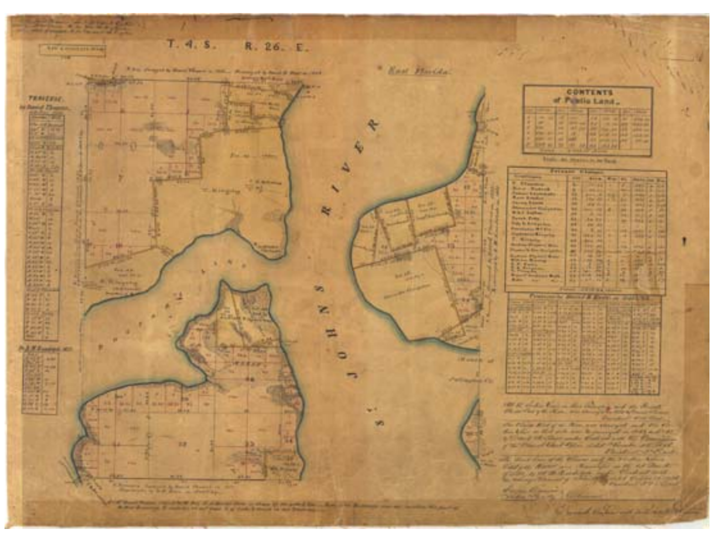
Day 2

Putting the Pieces Together

Florida Department of Environmental Protection (DEP)

In 1946, the responsibility for the surveying of the public lands was turned over to the Department of the Interior, Bureau of Land Management (BLM), Cadastral Survey Department, who today surveys public lands. When a state's public land survey is completed, the records are turned over to the state for management and that state is described as closed. In open states, the BLM continues to perform surveys and maintain the records. Florida is a closed state and the survey records are maintained by the Department of Environmental Protection, Division of State Lands. The federal government still has copies of almost every field book and map. An index to the actual patents to individuals is available on CD-ROM from them or available on line through the internet. Copies of most of the older patents are also available from the Bureau of Land Management, but there is a fee for research and copying.

The Florida Department of Environmental Protection, Bureau of Survey and Mapping provides a website: www.LABINS.org for distributing survey related data to the general surveying and mapping community. LABINS (Land Boundary Information System) is an online survey information and map site that contains useful information for the Cadastral Mappers such as Certified Corner Records (CCR's), Government Land Office Early Records including downloadable Government Survey Township maps, Township Survey notes, and links to the Board of Trustee's Land Database Systems (BTLDS), and the DEP/Division of State Lands interactive map, an IMS portal to access state owned interests and conveyances.

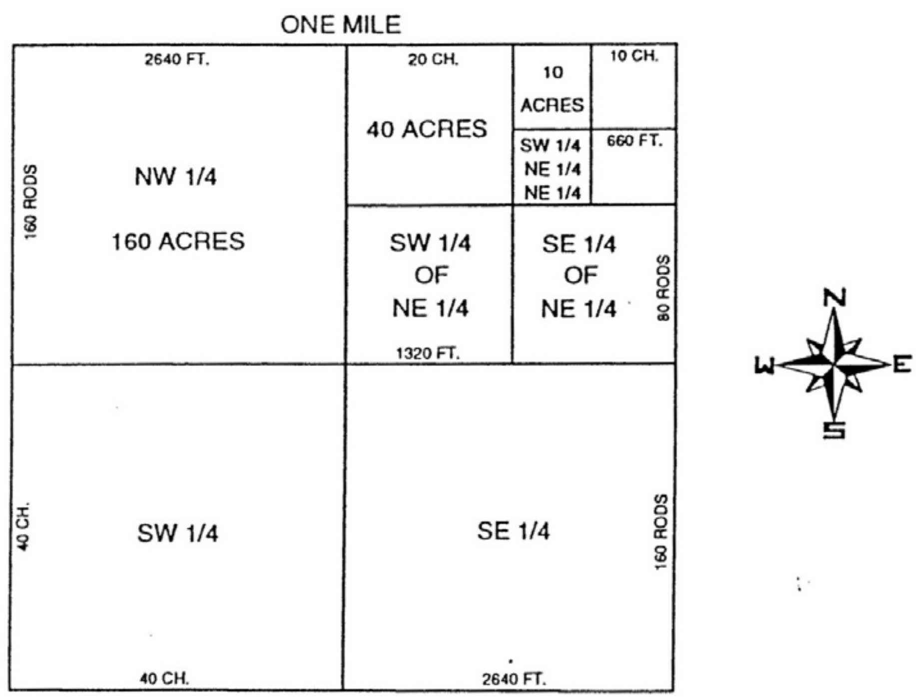


Township 4 South, Range 26 East
(showing Land Grants, Government Lots, and Fractional Sections)

Day 2

Section Breakdown Review

To subdivide a section into quarter sections, run straight lines from the established quarter-section corners to the opposite quarter-section corners (one horizontal and one vertical). The point of intersection of the lines thus run will be the corner common to the several quarter sections, or the legal center of the section. Each quarter section represents one-fourth (1/4) of a section. Each quarter section is referred to by its direction from the center of the section.



As you can see a quarter section is nominally 2640 feet by 2640 feet, or half a mile square and contains 160 Acres. The distance of 2640 feet can also be converted from different measurements, such as 40 chains, or 160 rods. Some older deeds use these terms. Be sure to become familiar with the conversion terms: 1 chain = 66 feet, 4 rods, or 100 links; 1 link = 7.92 inches; 1 rod = 16.5 feet, ¼ chain, or 25 links; 1 mile = 5,280 feet, 320 rods, or 80 chains. Measurements in Government Surveys are typically indicated by chains and links.

Remember, sectional descriptions must be read from right to left, working from the largest described portion to the last (smallest) described portion. Think of it like reading an address backwards: State, City, Street and Name.

Day 2

Review Questions

1. Where is the initial point located in Florida?
 ____

2. What Florida agency is responsible for overseeing public lands, including warehousing the original Government Land Office documents?
 ____

3. How should sectional descriptions be read?
 ____

4. When Florida was governed by Spain, tracts of land were officially granted to various individuals for service to the Crown. These tracts are called….?____

5. True/False – Meander Lines are the legal boundary between navigable waters and the adjoining uplands.

6. The term ______________ is the physical process whereby land that was once covered with water becomes exposed by the imperceptible recession of water.

7. The term ______________ is applied both to the gradual and imperceptible deposition of material along the bank of a body of water and the lands formed by this process.

8. ________________ is the sudden and rapid change of a channel of a boundary stream, or a comparable change in some other body of water forming a boundary, by which an area of land is cut off. An island may result or the avulsed land may become attached to the opposite shore.

9. One rod = how many feet? ____

10. One square mile typically contains how many acres? ____________________

Day 2

Case Study

[Section 9, Township 22 South, Range 30 East]

Ex

The United States of America,

TO ALL TO WHOM THESE PRESENTS SHALL COME, GREETING:

Homestead Certificate No. 1251
Application 5437

Whereas, *there has been deposited in the* GENERAL LAND OFFICE *of the United States a* CERTIFICATE *of the Register of the Land Office at* Gainesville Florida *, whereby it appears that, pursuant to the Act of Congress approved 20th May, 1862, "To secure Homesteads to actual settlers on the public domain," and the acts supplemental thereto, the claim of* Henry H. Berry Junior *has been established and duly consummated in conformity to law for the* South East quarter of the North East quarter and the North East quarter of the South East quarter of Section eight, and the South West quarter of the North West quarter and the North West quarter of the South West quarter of Section nine in Township twenty two South, of Range thirty East, in the District of Lands subject to sale at Gainesville Florida containing one hundred and sixty acres and forty eight hundredths of an acre

according to the Official Plat of the Survey of the said Land returned to the GENERAL LAND OFFICE *by the* SURVEYOR GENERAL.

Now know ye, *That there is therefore granted by the* UNITED STATES, *unto the said* Henry H. Berry Junior *the tract of Land above described:* TO HAVE AND TO HOLD *the said tract of Land, with the appurtenances thereof, unto the said* Henry H. Berry Junior *and to* his *heirs and assigns forever.*

In Testimony whereof, I, Rutherford B. Hayes , PRESIDENT OF THE UNITED STATES OF AMERICA, *have caused these letters to be made Patent, and the* SEAL OF THE GENERAL LAND OFFICE *to be hereunto affixed.*

Given *under my hand, at the* CITY OF WASHINGTON, *the* twenty fourth *day of* June *, in the year of Our Lord one thousand eight hundred and* seventy eight *, and of the Independence of the United States the* one hundred and second

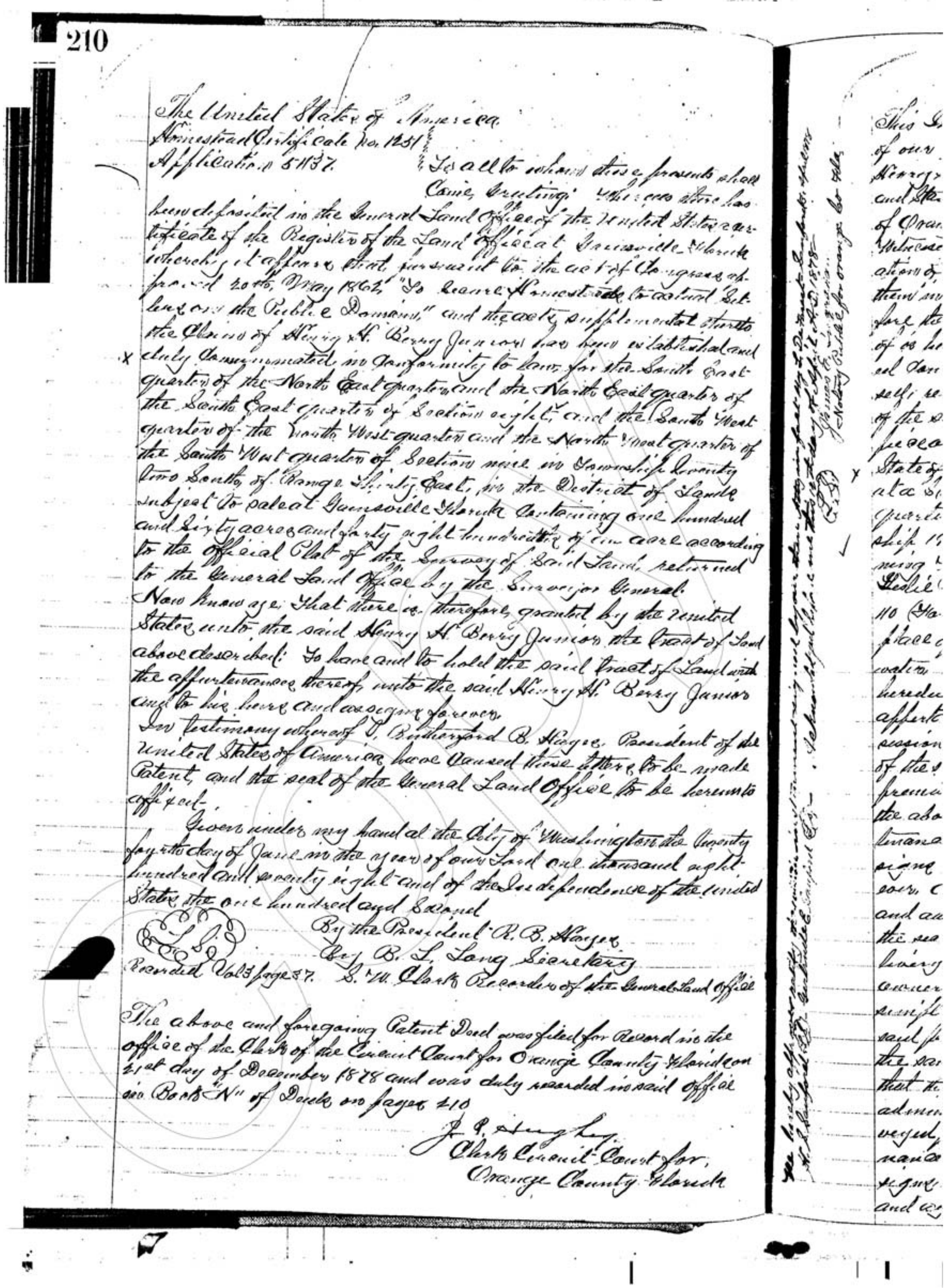
By the President: R. B. Hayes

By B. L. Lang , Sec'y.

S. W. Clark , Recorder of the General Land Office.

Day 2

The following page shows a sample of a transcribed Homestead Certificate #5437 to H. H. Berry Jr. for the SW ¼ of the NW ¼ and the NW ¼ of the SW ¼ of Section 9 as recorded in the County Records:


210

The United States of America
Homestead Certificate No. 1251
Application 5437.

To all to whom these presents shall Come, Greeting: Whereas there has been deposited in the General Land Office of the United States a certificate of the Register of the Land Office at Gainesville Florida whereby it appears that pursuant to the act of Congress approved 20th May 1862, "To secure Homesteads to actual Settlers on the Public Domain," and the acts supplemental thereto the Claim of Henry H. Berry Junior has been established and duly consummated in conformity to law, for the South East quarter of the North East quarter and the North East quarter of the South East quarter of Section eight, and the South West quarter of the North West quarter and the North West quarter of the South West quarter of Section nine in Township twenty two South of Range Thirty East, in the District of Lands subject to sale at Gainesville Florida Containing one hundred and Sixty acres and forty eight hundredths of an acre according to the Official Plat of the Survey of said Land, returned to the General Land Office by the Surveyor General.

Now know ye, That there is therefore granted by the United States unto the said Henry H. Berry Junior the tract of Land above described: To have and to hold the said tract of Land with the appurtenances thereof unto the said Henry H. Berry Junior and to his heirs and assigns forever.

In testimony whereof I, Rutherford B. Hayes, President of the United States of America, have caused these letters to be made Patent, and the seal of the General Land Office to be hereunto affixed.

Given under my hand at the City of Washington the twenty fourth day of June in the year of our Lord one thousand eight hundred and seventy eight and of the Independence of the United States the one hundred and Second

(L.S.) By the President R. B. Hayes
By B. L. Long Secretary
Recorded Vol 3 page 37. S. W. Clark Recorder of the General Land Office

The above and foregoing Patent Deed was filed for Record in the office of the Clerk of the Circuit Court for Orange County Florida on 21st day of December 1878 and was duly recorded in said office in Book "N" of Deeds on pages 410

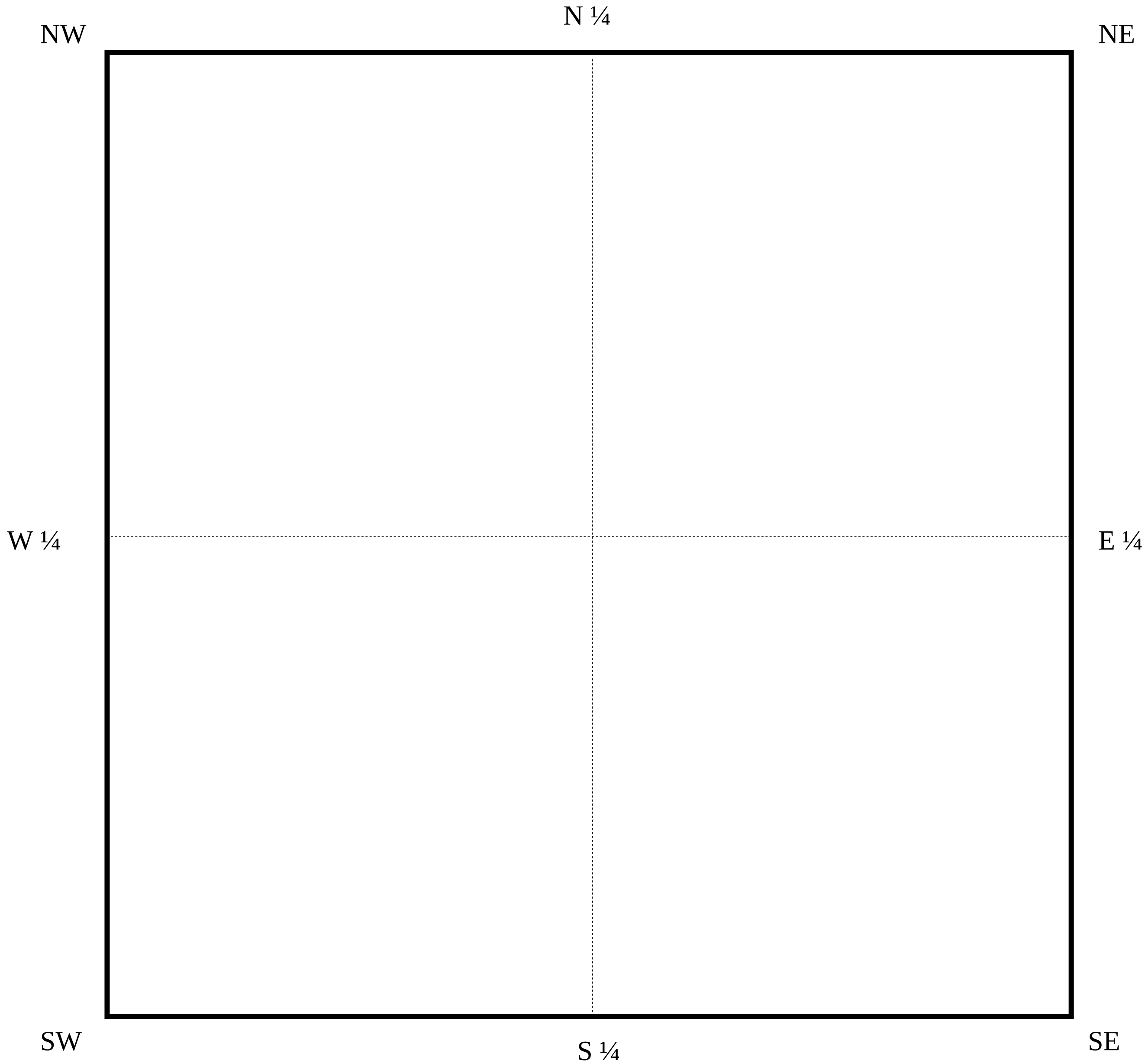
J. P. Hughey
Clerk Circuit Court for,
Orange County Florida

Day 2

IP No. 22 South RANGE No. 30 East — STATE OF FLORIDA

DY	DESCRIPTION OF THE TRACT: Part of Section	Sec.	T.	R.	Contents: Acres	Hdths.	Purchase Money: Dolls.	Cts.	NAME OF PURCHASER	DATE OF SALE	No. of Receipt, Certificate and Deed	TO WHOM DEEDED	DATE OF DEED	Re… Vol.
		9												
	NE¼										13476	Samuel S. Hill	Dec 11 1890	
	NE¼ of NW¼										7219	Edgar Richmond	April 10 1892	
	NW¼ of NW¼								Jas D. Kline	July 28 1875	1790			
	SE¼ of NW¼										5581	Edgar Richmond	June 30 1894	
	SW¼ of NW¼										5437	H. H. Berry Jr	June 24 1878	
	SE¼										13648	Henry Huntington	Dec 10 1885	
	NE¼ of SW¼										5581	Edgar Richmond	June 30 1894	
	NW¼ of SW¼										5437	H. H. Berry Jr.	June 24 1878	
	S½ of SW¼										5083	E. B. Livingston	June 20 1883	

Breakdown the Section with the above descriptions recorded in the Government Land Office.



Day 3

Coordinate Systems and Application

The Public Land Survey System for the Cadastral Mapper

Day 3

LABINS

The Land Boundary Information System (LABINS) was begun in 1984 by the state of Florida as a means for distributing survey and mapping related data. Today LABINS is available over the Internet (www.labins.org) providing a multitude of data sets of interest to a variety of sectors. Today's site includes digital mapping images and databases for viewing and downloading including DOQQs, DRGs, DLGs, and DEMs in various formats and projections. Survey-related data includes horizontal and vertical control, original land records, sectional land corner records, mean high water elevations, or methods used to determine mean high water datums on the states tidally affected water bodies. An ArcIMS mapping component was added to visually display data in geographical context. All data sets are available for download at no cost. Since the web site has been in place, Florida's Bureau of Survey and Mapping has experienced as much as a 75% reduction in data requests. Generally speaking, for Cadastral Mappers, this site is useful for obtaining:

1.) Certified Corner Record (CCR) information (especially if they have been filed with State Plane coordinates)

2.) Original Government Land Office Records (i.e. Township Plat Maps, Survey Notes for townships, and Surveyor Instructions)

3.) Original Patent & TIIF deeds (Board of Trustees Lands Database Systems (BTLDS)

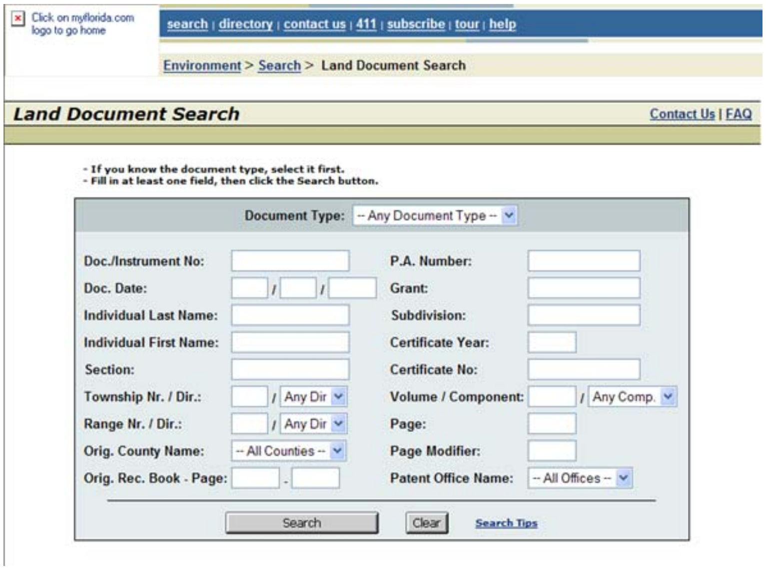
4.) Florida DEP/Division of State Lands - Interactive Map (GIS map showing TIIF deed & other interest locations)

5.) Water Boundary Data, especially coastal locations.

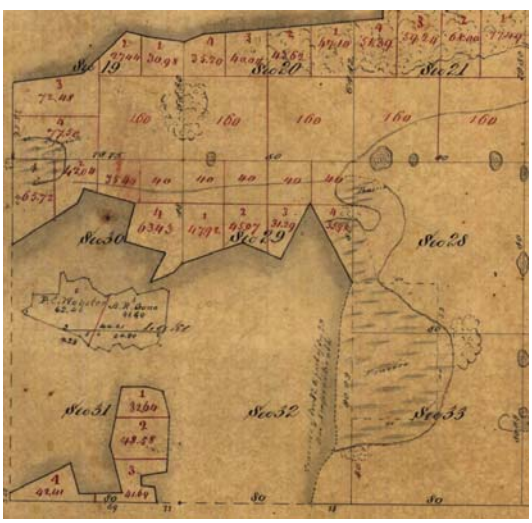
Day 3

Navigating LABINS for the Cadastral Mapper

For the Cadastral Mapper in the State of Florida, LABINS is a wealth of information relating to the PLSS, origin of title, and water boundary. It is from this information that the cadastral map should be started, and referenced to.



Your PLSS layer should closely resemble the original government maps for each particular township/range, with all aliquot parts and government lots noted.



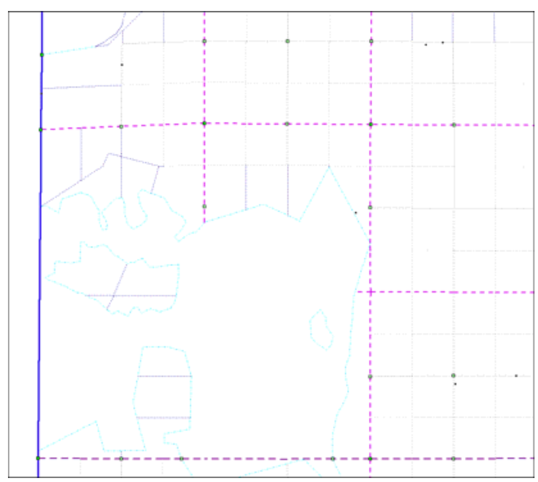


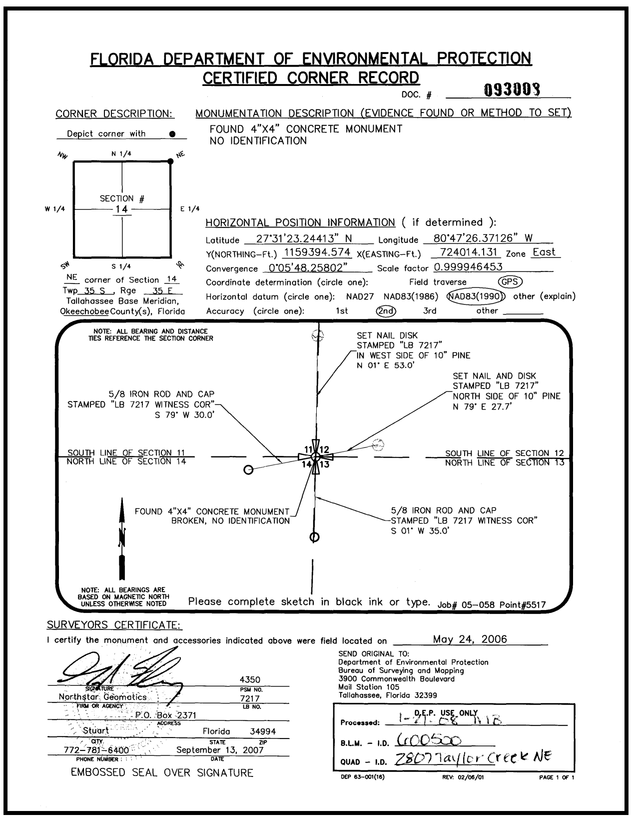
Image of sample Township above downloaded from the "General Land Office (GLO) Early Record (Township Plats, Survey Notes, & Survey Instructions) link at *http://data.labins.org/2003/SurveyData/LandRecords/landrecords.cfm*

Day 3

In addition, the Certified Corner Records, especially where they have State Plane coordinates, can help tie you map down spatially. CCR's usually are provided with a sketch, however not all are sufficiently detailed to the extent that they can adequately provide a definitive location without also providing coordinates that go along with the monument. What it can give you is a history of sorts for a particular monument. Is it the same object? Is it roughly the same measured distance from the "accessory" locations? If there are differences, then possibly what is purported to be the same corner location, may not be. Some investigation on the part of the mapper may be required.

This is where good contacts with your local surveying community can come in handy. Surveyors who have an extensive career in your local area can offer good, practical history of properties and boundaries.

Here are some examples of CCR's. The one on the left is recently filed (2007), and has State Plane Coordinates attached. The second is an older CCR (1982), without coordinates, but has a very useful sketch.



FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
CERTIFIED CORNER RECORD

DOC. # 093003

CORNER DESCRIPTION: Depict corner with ●

SECTION # 14

NE corner of Section 14
Twp 35 S, Rge 35 E
Tallahassee Base Meridian,
Okeechobee County(s), Florida

MONUMENTATION DESCRIPTION (EVIDENCE FOUND OR METHOD TO SET)
FOUND 4"X4" CONCRETE MONUMENT
NO IDENTIFICATION

HORIZONTAL POSITION INFORMATION (if determined):
Latitude 27°31'23.24413" N Longitude 80°47'26.37126" W
Y(NORTHING–Ft.) 1159394.574 X(EASTING–Ft.) 724014.131 Zone East
Convergence 0°05'48.25802" Scale factor 0.999946453
Coordinate determination (circle one): Field traverse GPS
Horizontal datum (circle one): NAD27 NAD83(1986) NAD83(1990) other (explain)
Accuracy (circle one): 1st 2nd 3rd other

Please complete sketch in black ink or type. Job# 05–058 Point#5517

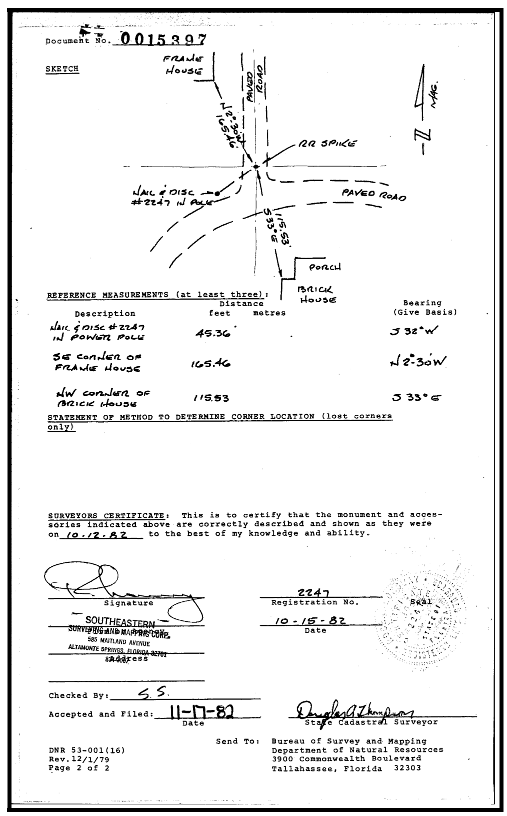
SURVEYORS CERTIFICATE:
I certify the monument and accessories indicated above were field located on May 24, 2006

SIGNATURE — PSM NO. 4350
Northstar Geomatics (FIRM OR AGENCY) — LB NO. 7217
P.O. Box 2371 (ADDRESS)
Stuart (CITY) Florida (STATE) 34994 (ZIP)
772–781–6400 (PHONE NUMBER) September 13, 2007 (DATE)
EMBOSSED SEAL OVER SIGNATURE

SEND ORIGINAL TO:
Department of Environmental Protection
Bureau of Surveying and Mapping
3900 Commonwealth Boulevard
Mail Station 105
Tallahassee, Florida 32399

D.E.P. USE ONLY
Processed: 1-21-08 MB
B.L.M. – I.D. 600500
QUAD – I.D. 2807 Taylor Creek NE

DEP 63–001(16) REV: 02/06/01 PAGE 1 OF 1



Document No. 0015397

SKETCH

REFERENCE MEASUREMENTS (at least three):

Description	Distance feet	Distance metres	Bearing (Give Basis)
NAIL & DISC #2247 IN POWER POLE	45.36'		S 32° W
SE CORNER OF FRAME HOUSE	165.46		N 2°30'W
NW CORNER OF BRICK HOUSE	115.53		S 33° E

STATEMENT OF METHOD TO DETERMINE CORNER LOCATION (lost corners only)

SURVEYORS CERTIFICATE: This is to certify that the monument and accessories indicated above are correctly described and shown as they were on 10.12.82 to the best of my knowledge and ability.

Signature — Registration No. 2247 — Seal
SOUTHEASTERN SURVEYING AND MAPPING CORP. 585 MAITLAND AVENUE ALTAMONTE SPRINGS, FLORIDA 32701 834-3007 — Firm or Agency — Address
10-15-82 Date

Checked By: S.S.
Accepted and Filed: 11-17-82 (Date) State Cadastral Surveyor

Send To: Bureau of Survey and Mapping
Department of Natural Resources
3900 Commonwealth Boulevard
Tallahassee, Florida 32303

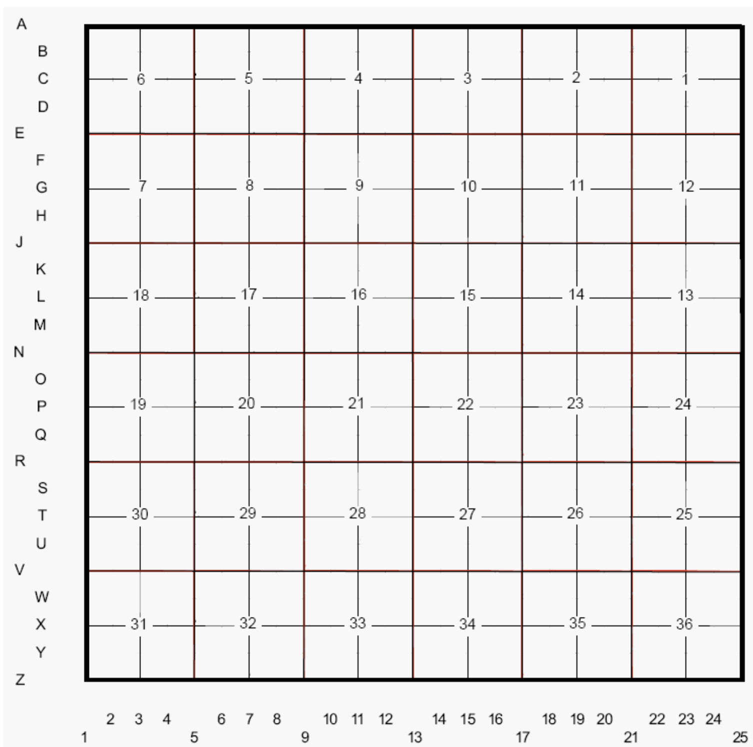
DNR 53-001(16)
Rev.12/1/79
Page 2 of 2

Day 3

BLM Unique Identifier System

The Bureau of Land Management (BLM) derived the Geographic Coordinate Data Base (GCDB) as way to describe the collection of geographic information representing the PLSS. This data is computed from official survey plats, field notes, and other associated information and is collected on a Township basis. It consists of Township, section, aliquot part, government lot, survey corners, and other PLSS data.

We are primarily going to look at the section corner information. Prior to the BLM developing an identifier system, the State of Florida used a system where each corner in a township was identified with an "Index Number". This consisted of a set of Letters (A-Z) for row notation, and a set of numbers (1-25) for column notation.



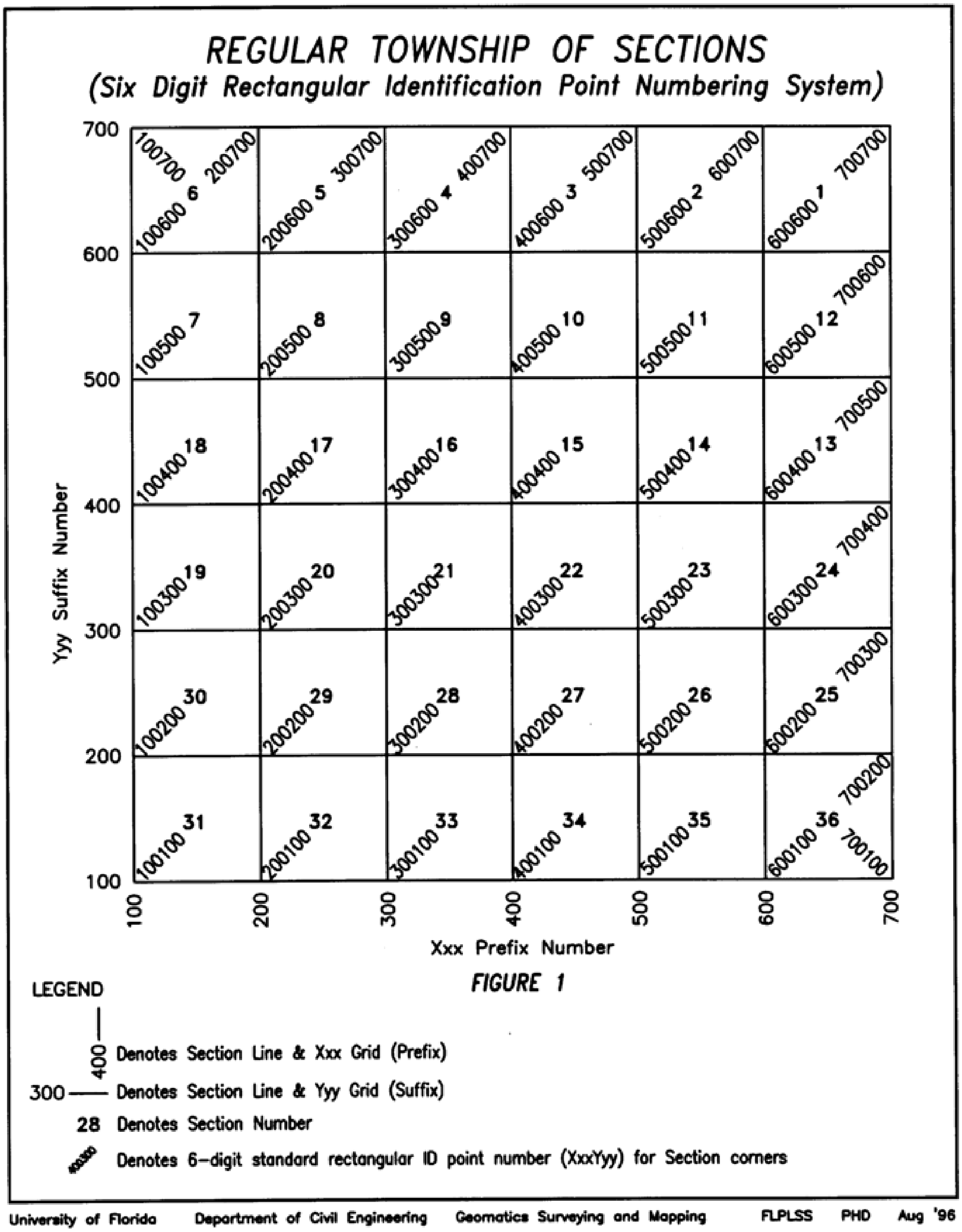
LABINS Index number system (Legacy)

Each combination of row and column would give a 'unique' ID within that particular township. While this system was simple, it was deficient however, when it came to corners along the township line, along grant lines, notating meander corners, as well describing offset corners. When the BLM system was developed in 1996, LABINS began the migration to a new way to identify corners that was much more comprehensive, and more complex.

LABINS has a PowerPoint demo that reviews the BLM system, and can be found here:
http://data.labins.org/2003/SurveyData/LandRecords/CCR/drawingfiles/plss_unid_profile.ppt

Day 3

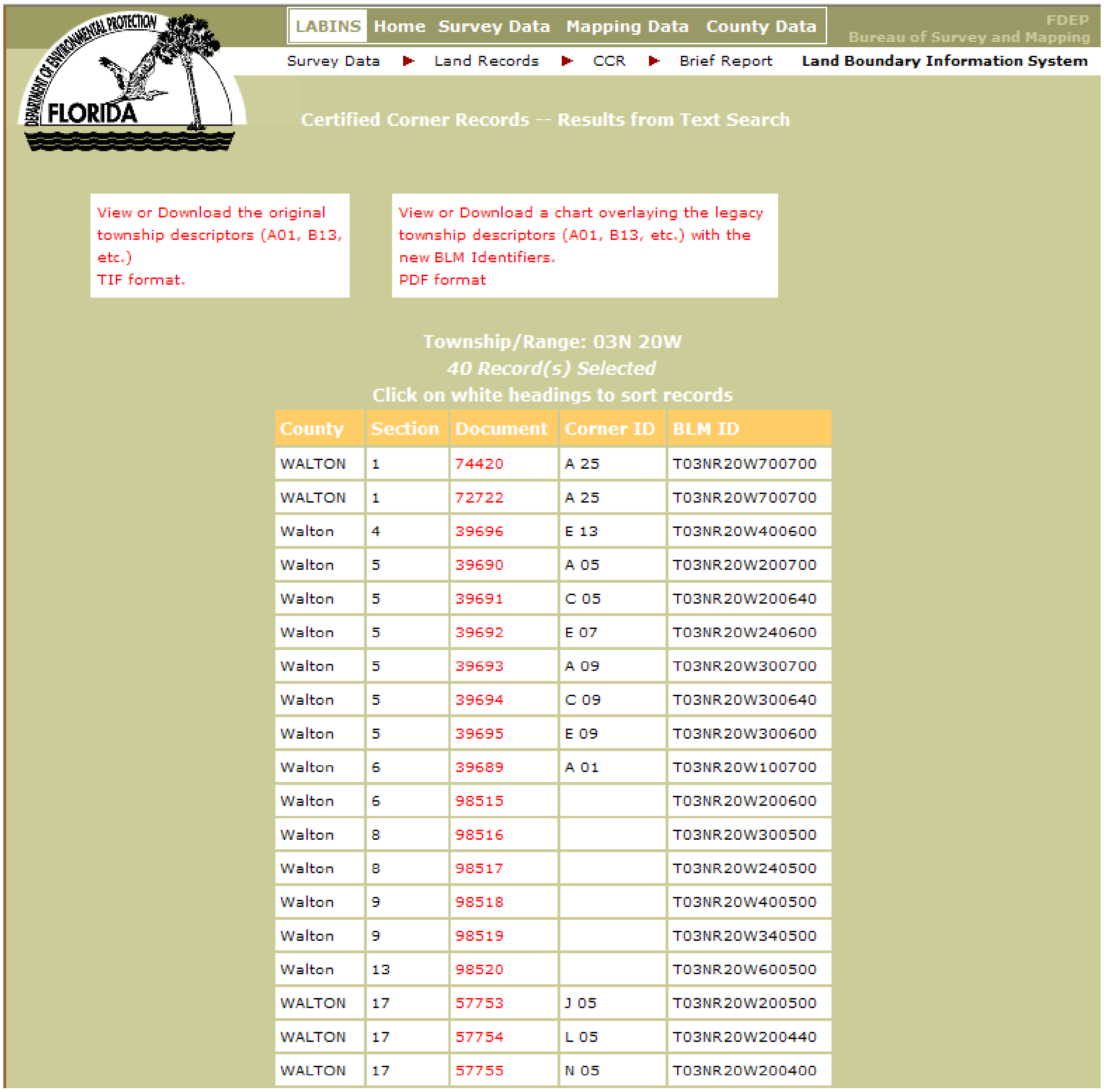
For simplified purposes the diagram on the following page shows the basic structure of the BLM system:



Florida PLSS Unique Identifier Program (BLM based)

Day 3

All CCR's in LABINS are now given this identifier system, and the legacy system of Index Numbers is no long maintained. When searching for a corner record in a particular township, you may see results like this:



LABINS Home Survey Data Mapping Data County Data

FDEP

Bureau of Survey and Mapping

Survey Data ▶ Land Records ▶ CCR ▶ Brief Report

Land Boundary Information System

Certified Corner Records -- Results from Text Search

View or Download the original township descriptors (A01, B13, etc.)
TIF format.

View or Download a chart overlaying the legacy township descriptors (A01, B13, etc.) with the new BLM Identifiers.
PDF format

Township/Range: 03N 20W

40 Record(s) Selected

Click on white headings to sort records

County	Section	Document	Corner ID	BLM ID
WALTON	1	74420	A 25	T03NR20W700700
WALTON	1	72722	A 25	T03NR20W700700
Walton	4	39696	E 13	T03NR20W400600
Walton	5	39690	A 05	T03NR20W200700
Walton	5	39691	C 05	T03NR20W200640
Walton	5	39692	E 07	T03NR20W240600
Walton	5	39693	A 09	T03NR20W300700
Walton	5	39694	C 09	T03NR20W300640
Walton	5	39695	E 09	T03NR20W300600
Walton	6	39689	A 01	T03NR20W100700
Walton	6	98515		T03NR20W200600
Walton	8	98516		T03NR20W300500
Walton	8	98517		T03NR20W240500
Walton	9	98518		T03NR20W400500
Walton	9	98519		T03NR20W340500
Walton	13	98520		T03NR20W600500
WALTON	17	57753	J 05	T03NR20W200500
WALTON	17	57754	L 05	T03NR20W200440
WALTON	17	57755	N 05	T03NR20W200400

All of the BLM ID's have been populated, but as you can see, the index numbers for newer CCR's are not. In addition to the corner number, the Township and Range identifier has also been added in order to make a particular corner truly unique.

Now that you have found where to access corner information and find the State Plane Coordinates that you need for your Case Study, where do these 'coordinates' come from and what do they mean? Let's take a look.

Day 3

Map Projections & Grids

Global Positioning System

The **Global Positioning System** (**GPS**) is a space-based global navigation satellite system that provides reliable location and time information in all weather and at all times and anywhere on or near the earth when and where there is an unobstructed line of sight to four or more GPS satellites. It is maintained by the United States government and is freely accessible by anyone with a GPS receiver. GPS was created and realized by the U.S. Department of Defense (DOD) and was originally run with 24 satellites. It was established in 1973 to overcome the limitations of previous navigation systems.

GPS consists of three parts: the space segment, the control segment, and the user segment. The U.S. Air Force develops, maintains, and operates the space and control segments. GPS satellites broadcast signals from space, which each GPS receiver uses to calculate its three-dimensional location (latitude, longitude, and altitude) plus the current time.

The Space Segment

The space segment is composed of 24 to 32 satellites (SV) in medium Earth orbit. Orbiting at an altitude of approximately 12,550 miles each SV has an orbital radius of about 16,500 miles. Each SV makes two complete orbits each day, repeating the same ground track each day. The orbits are arranged so that at least six satellites are always within line of sight from almost everywhere on Earth's surface.

The Control Segment

The control segment is controlled by the U.S. military and is composed of a master control station, an alternate master control station, four dedicated ground antennas and six dedicated monitor stations. The satellites are tracked and each is regularly updated with navigational changes, to synchronize the atomic clocks and adjust the ephemeris of each satellite. During any satellite maneuvers to change the orbit of a satellite, the satellite must be marked *unhealthy*, so receivers will not use it in their calculation. When the maneuver is carried out, and the resulting orbit tracked from the ground, a new ephemeris is uploaded and the satellite marked healthy again.

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User segment

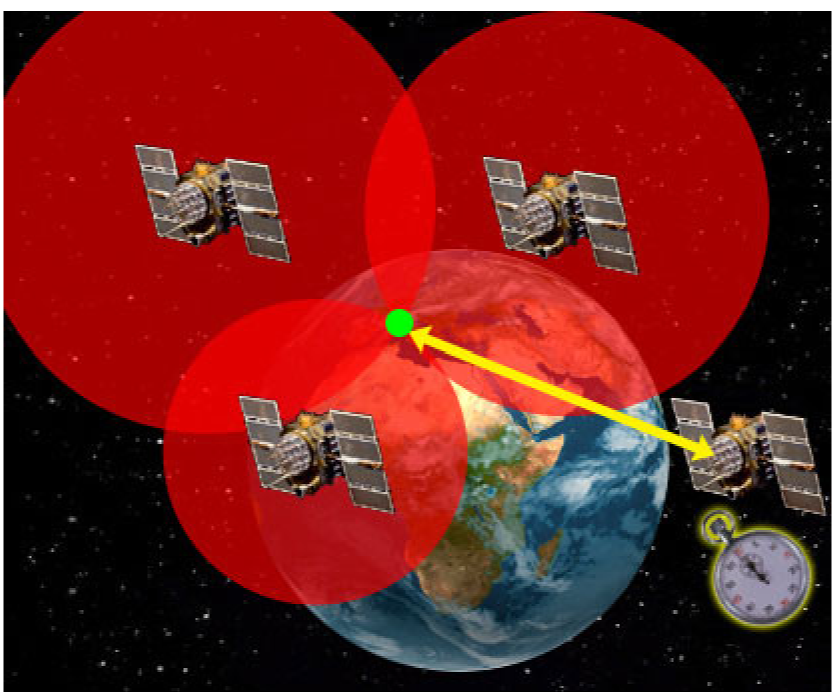
The user segment is composed of hundreds of thousands of U.S. and allied military users of the secure GPS Precise Positioning Service, and tens of millions of civil, commercial and scientific users of the Standard Positioning Service. In general, GPS receivers are composed of an antenna, tuned to the frequencies transmitted by the satellites, receiver-processors, and a highly stable clock. They may also include a display for providing location and speed information to the user. A receiver is often described by its number of channels or how many satellites it can monitor simultaneously. Originally limited to four or five, this has progressively increased over the years so that, as of 2007, receivers typically have between 12 and 20 channels.

Basic concept of GPS

A GPS receiver calculates its position by precisely timing the signals sent by GPS satellites high above the Earth. Each satellite continually transmits messages that include

- the time the message was transmitted
- precise orbital information (the ephemeris)
- the general system health and rough orbits of all GPS satellites (the almanac).

The receiver utilizes the messages it receives to determine the travel time of each message and computes the distances to each satellite. These distances along with the satellites' locations are used with the aid of trilateration, to compute the position of the receiver. This position is then displayed, perhaps with a moving map display or latitude and longitude; elevation information may be included. Many GPS units show derived information such as direction and speed, calculated from position changes.



Day 3

Three satellites might seem enough to solve for position, since space has three dimensions and a position near the Earth's surface can be assumed. However, even a very small clock error multiplied by the very large speed of light results in a large positional error. Therefore receivers use four or more satellites to solve for the receiver's location and time. The very accurately computed time is effectively hidden by most GPS applications, which use only the location. A few specialized GPS applications do however use the time; these include time transfer, traffic signal timing, and synchronization of cell phone base stations.

Accuracy

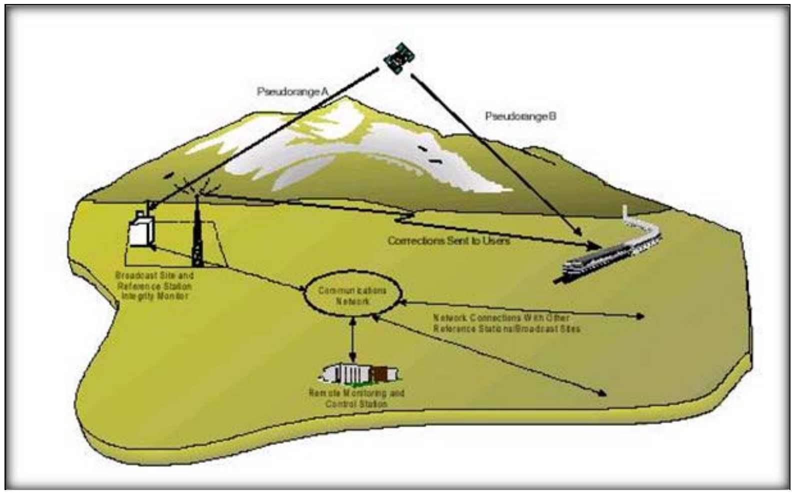
For non-military use, there are three general classifications of GPS receivers, recreational grade (10 m), mapping grade (< 1 m) and survey grade (+/-cm). There are vast differences in the cost as well as the accuracies of each type. Different units receive different types of signals or frequencies broadcast from the satellites, such as C/A code, Carrier Phase, L1 /L2 and P-Code each greatly affects the accuracy. The costs range from about $100 for a recreational grade (Garmin/Tom-Tom) to several $1000 for GIS or Mapping grade and over $10,000 for survey grade GPS. So the message here is “Not all GPS receivers are created equally”.

Affecting Accuracy

There are a myriad of things that can affect the quality of the GPS signal as well as the accuracy of the estimated position. This includes the currently disabled feature called Selective Availability (SA) that adds intentional, time varying errors of up to 100 meters (328 ft) to the publicly available navigation signals. This was intended to deny an enemy the use of civilian GPS receivers for precision weapon guidance. The atmospheric conditions in the ionosphere and troposphere both refract the GPS signals. This causes the speed of the GPS signal in the ionosphere and troposphere to be different from the speed of the GPS signal in space. Ephemeris (or orbital position), may not exactly model the true satellite motion or the exact rate of clock drift. Multipath is the effect of a GPS signal bouncing off a reflective surface prior to reaching the GPS receiver antenna is referred to as multipath. Because it is difficult to completely correct multipath error, even in high precision GPS units, multipath error is a serious concern to the GPS user. Lastly is satellite geometry, represented in most GPS receivers as PDOP. Dilution of precision (DOP) is the term used in GPS to specify the effect of GPS satellite geometry on GPS precision. Its’ a range with 1 being “Ideal”, 2-5 being “Good”, 5-10 being “Moderate”. Anything 20 and more is considered very poor with positions inaccurate by as much as 300 meters with a recreational grade device.

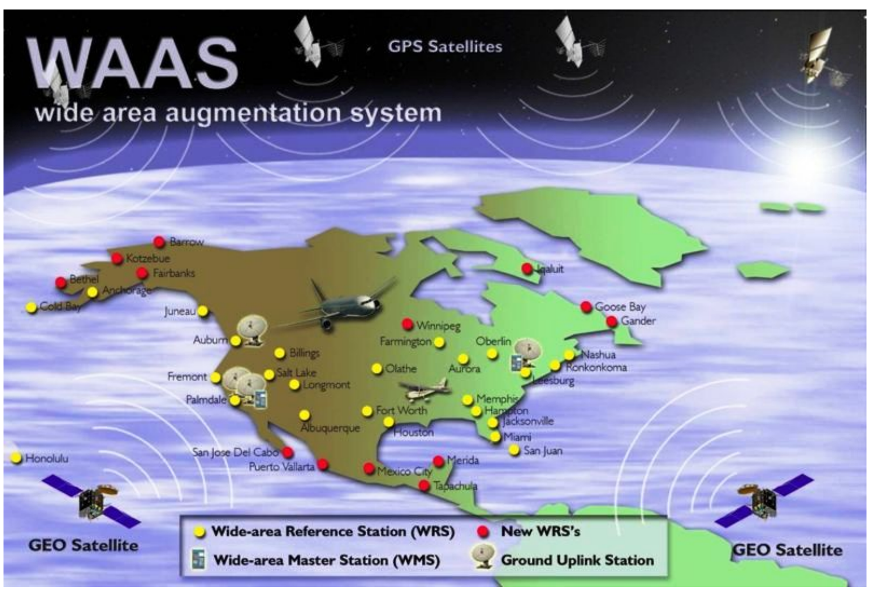
Day 3

Improving Accuracy



GPS receivers may also include an input for differential corrections to improve positioning accuracy. **Differential Global Positioning System** (DGPS) is an enhancement to Global Positioning System that uses a network of fixed, ground-based reference stations to broadcast the difference between the positions indicated by the satellite systems and the known fixed positions. The correction signal is typically broadcast over UHF radio modem. This provides accurate dynamic navigation information to travelers with 1- to 2- meter accuracy. When used in a static mode, DGPS offers a .1 to 1 meter service.

The **Wide Area Augmentation System**



(**WAAS**) is an air navigation aid developed by the Federal Aviation Administration to augment GPS, with the goal of improving its accuracy, integrity, and availability. Essentially, WAAS is intended to enable aircraft to rely on GPS for all phases of flight, including precision approaches to any airport within its coverage area. WAAS works similar to ground based DGPS with the exception that the corrections are sent to geostationary WAAS satellites which in turn broadcasted the messages (every 5 seconds) back to in a timely manner Those satellites broadcast the correction messages back to Earth over portions of the western hemisphere.

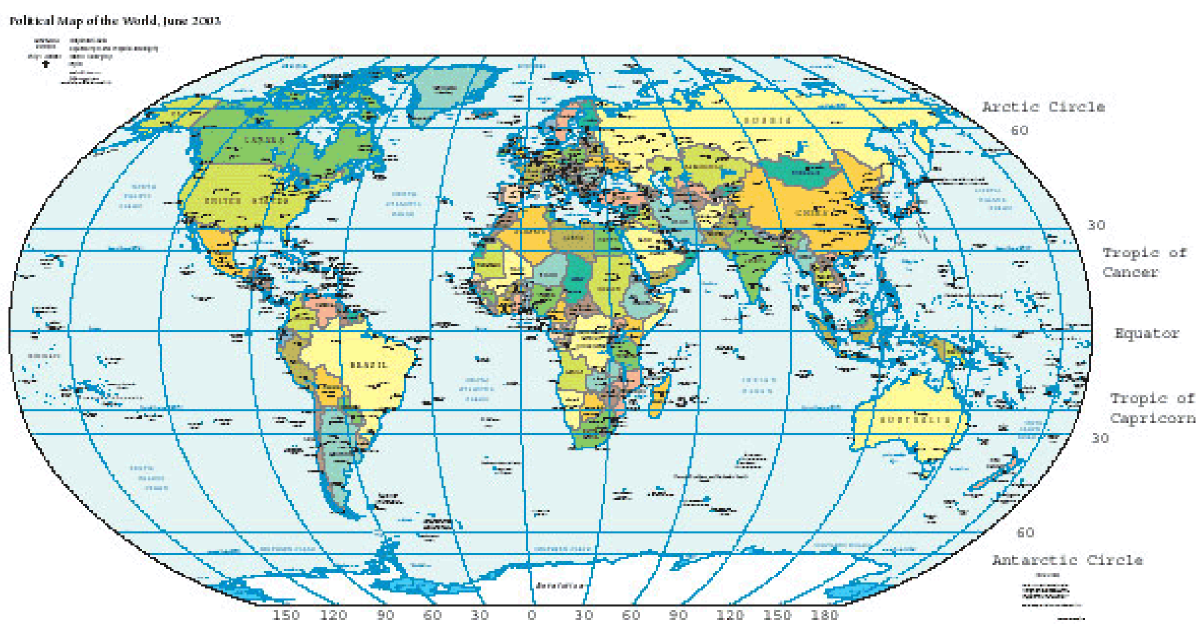
Day 3

Geographic Coordinate System

There are several types of grids (or coordinate systems) used to divide the earth's surface. Four of these are in common use on maps published in the United States as follows.

- Geographic . . . Uses degrees of latitude and longitude. One of the most common coordinate systems in use.
- UTM . . . Preserves shape, and allows for precise measurements in meters.
- State Plane . . . Developed for local surveying, with minimal distortion.
- Public Land Survey . . . This one was developed in Colonial America for surveying the vast tracts of land not yet settled. Not as precise in terms of a neat, even grid as others; this system was not derived from theory, but rather is a physically monumented grid.

A geographic coordinate system is a coordinate system that enables every location on the Earth to be specified by a set of numbers. The coordinates are often chosen such that one of the numbers represents vertical position, and two or three of the numbers represent horizontal position. A common choice of coordinates is latitude, longitude and ellipsoid height.



Latitude is the angle between the equatorial plane and a line that is normal to the reference ellipsoid, which approximates the shape of Earth to account for flattening of the poles and bulging of the equator. Lines joining points of the same latitude are called parallels, which trace concentric circles on the surface of the Earth, parallel to the equator.

Day 3

The North pole is 90° N; the South pole is 90° S. The 0° parallel of latitude is designated the equator, the fundamental plane of all geographic coordinate systems. The equator divides the globe into Northern and Southern Hemispheres.

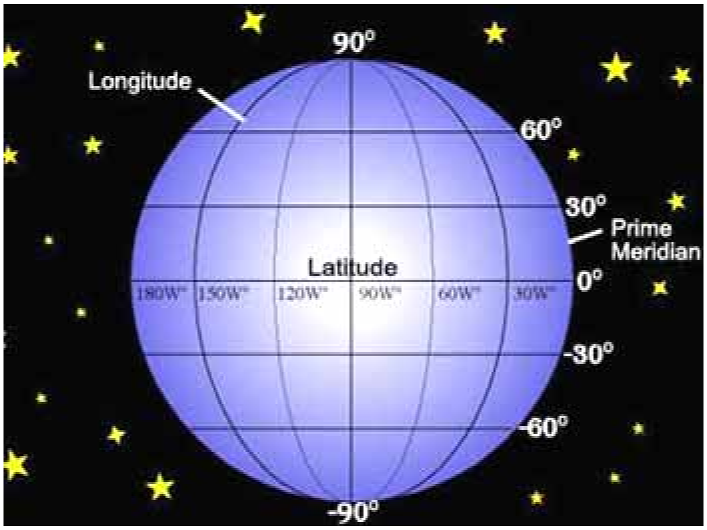
Longitude is the angle east or west of a reference meridian between the two geographical poles to another meridian that passes through an arbitrary point. All meridians are halves of great circles, and are not parallel. They converge at the north and south poles.

A line passing to the rear of the Royal Observatory, Greenwich (near London in the UK) has been chosen as the international zero-longitude reference line, the Prime Meridian. Places to the east are in the eastern hemisphere, and places to the west are in the western hemisphere. The antipodal meridian of Greenwich is both 180°W and 180°E.

A **geographic coordinate system** enables every location on the Earth to be specified in three coordinates, using mainly a spherical coordinate system.

The Earth is not a sphere, but an irregular shape approximating an ellipsoid; the challenge is to define a coordinate system that can accurately state each topographical feature as an unambiguous set of numbers.

One of the most common coordinate systems in use is the **Geographic Coordinate System**, which uses degrees of latitude and longitude to describe a location on the earth's surface. Lines of latitude run parallel to the equator and divide the earth into 180 equal portions from north to south (or south to north). The reference latitude is the equator and each hemisphere is divided into ninety equal portions, each representing one degree of latitude.

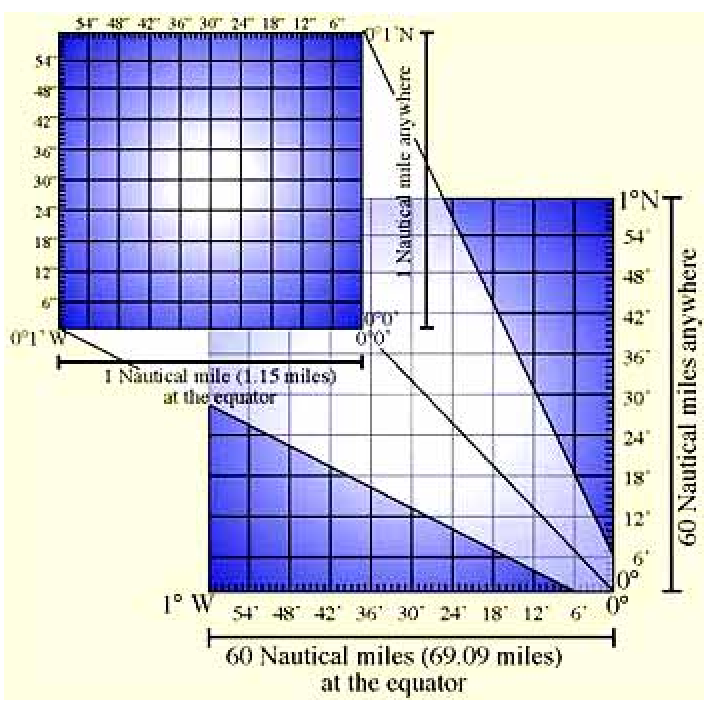


In the northern hemisphere degrees of latitude are measured from zero at the equator to ninety at the North Pole. In the southern hemisphere degrees of latitude are measured from zero at the equator to ninety degrees at the South Pole. To simplify the digitization of maps, degrees of latitude in the southern hemisphere are often assigned negative values (0 to -90°). Wherever you are on the earth's surface, the distance between lines of latitude is the same (60 nautical miles,), so they conform to the uniform grid criterion assigned to a useful grid system.

Lines of longitude, on the other hand, do not stand up so well to the standard of uniformity. Lines of longitude run perpendicular to the equator and converge at the poles. The reference line of longitude (the prime meridian) runs from the North Pole to the South Pole through Greenwich, England. Subsequent lines of longitude are measured from zero to 180 degrees east or west (values west of the prime meridian are assigned negative values for use in digital mapping applications) of the prime meridian.

At the equator and only at the equator the distance represented by one line of longitude is equal to the distance represented by one degree of latitude. As you move towards the poles, the distance between lines of longitude becomes progressively less until, at the exact location of the pole, all 360° of longitude are represented by a single point you could put your finger on (you probably would want to wear gloves, though). So, using the geographic coordinate system, we have a grid of lines dividing the earth into squares that cover approximately 4,773.5 square miles at the equator…a good start, but not very useful for determining the location of anything within that square.

To be truly useful, a map grid must divided into small enough sections that they can be used to describe with an acceptable level of accuracy the location of a point on the map. To accomplish this, degrees are divided into minutes (') and seconds ("). There are sixty minutes in a degree, and sixty seconds in a minute (3600 seconds in a degree). So, at the equator, one second of latitude or longitude = 101.3 feet.



Day 3

An alternative method of notation in the geographic coordinate system often used for many GIS applications (Geographic Information Systems, or GIS), is the decimal degree system. In the decimal degree system the major (degree) units are the same, but rather than using minutes and seconds, smaller increments are represented as a percentage (decimal) of a degree.

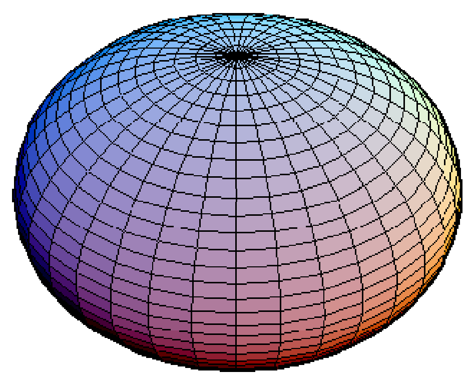
The decimals can be carried out to four places, resulting in a notation of DD.XXXX, DDD.XXX. When using four decimal places, the decimal degree system is accurate to within ± 36.5 feet (11.12 m).

However, because the accuracy of the fourth decimal place is often uncertain, decimal degree coordinates are often rounded to three decimal places. This results in an accuracy of ± 364.8 feet (111.2 m).

To demonstrate this, find a topographic map (or any other map that uses the geographic coordinate system), pick a point on that map, and describe it in terms of degrees, minutes and seconds. When you're done with that, try it using decimal degrees. Besides the fact that the grid on a map using the geographic referencing system is not constant from north to south, it is also just not very easy to use. Fortunately, both problems are solved to some extent by using the Universal Transverse Mercator coordinate system, which will be covered in shortly.

Ellipsoid

The concept of a spherical Earth offers a simple surface which is mathematically easy to deal with. The actual topographic surface is most apparent with its variety of land forms and water areas. This is, in fact, the surface on which actual Earth measurements are made. It is not suitable, however, for exact mathematical computations because the formulas which would be required to take the irregularities into account would necessitate a prohibitive amount of computations. The topographic surface is generally the concern of cartographers. Many astronomical and navigational computations use it as a surface representing the Earth.

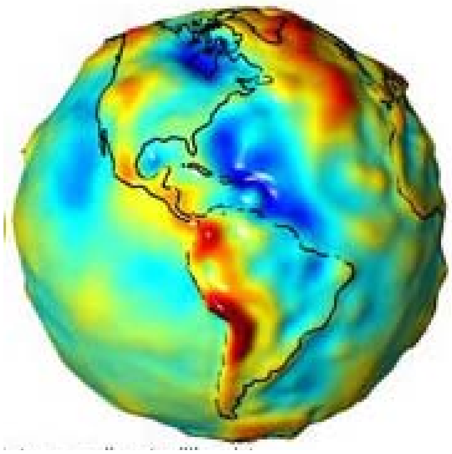


Familiar in our day-to-day use are:

Reference ellipsoid name	Equatorial radius (m)	Polar radius (m)	Where used
Clarke (1866)	6,378,206.40	6,356,583.80	North America
NAD 83	6,378,137.00	6,356,752.30	North America
WGS-84 (1984)	6,378,137.00	6,356,752.31	Global GPS

Day 3

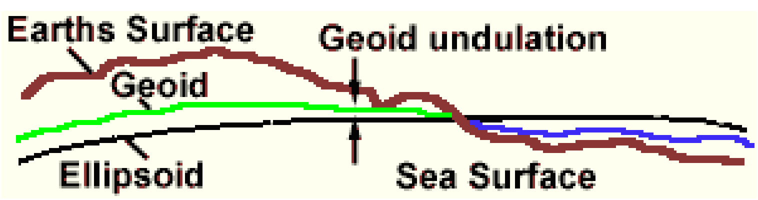
Geoid



The geoid is that equipotential surface which would coincide exactly with the mean ocean surface of the Earth, if the oceans were in equilibrium, at rest, and extended through the continents. The geoid surface is irregular, unlike the reference ellipsoid, but considerably smoother than Earth's actual physical surface. Sea level, if undisturbed by currents and weather, would assume a surface equal to the geoid. The Geoid and Ellipsoid are used extensively with GPS derived elevations called Orthometric Heights.

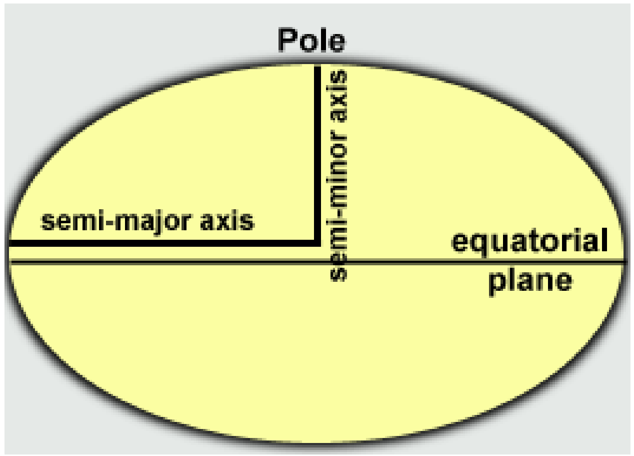
Reference Datum

A reference datum is a known and constant surface which can be used to describe the location of unknown points. On Earth, the normal reference datum is sea level. On other planets, such as the Moon or Mars, the datum is the average radius of the planet.



The term "reference datum" was used rather than 'above (or below) the earth's surface' or 'above (or below) sea level'. The reason for this is simple once you think about it…If you use the term 'above the earth's surface', what exactly does that mean? In other words, the earth's surface where? Similarly, although we tend to think of sea level as a constant, it is not the same everywhere on the globe, so sea level where? and sea level when? (High tide or low) become pertinent questions. So, to avoid these problems, a reference datum is needed that represents the same surface or elevation at all points on the earth and that remains constant over time. An example of a datum that could be used for the earth is a sphere with a radius equal to the average radius of the earth.

Day 3



Such a sphere would provide a constant surface to which elevations on the earth's actual surface could be referenced. However, the earth is not a perfect sphere; the radius of the earth is greater at the equator and less at the poles. The resulting shape is what is known as an 'oblate ellipsoid'. By using an oblate ellipsoid as a datum for the earth we have a shape that approximates the shape of the earth fairly well and provides a datum to which points all over the earth's surface can be referenced (hence the term 'reference datum').

Most 7.5 minute topographic maps still in circulation use the NAD-27 (North American Datum, 1927) referencing system based on the Clarke ellipsoid of 1866. Technological advances that allowed more precise measurements of the earth resulted in modifications of the Clarke ellipsoid, producing the GRS-80 (Geographic Referencing System, 1980).

More recent maps commonly use the NAD-83 referencing system which is based on the GRS-80 ellipsoid. The datum used for a map is printed on the front of a map. Although the reference ellipsoids used in the NAD-27 and NAD-83 are different, the changes are slight on large-scale maps.

What does all this mean? The coordinates that are used in mapping, typically State Plane coordinates, are necessary in reference to a particular datum. In other words, for a specific location on the ground, there will be a different set of coordinates depending on the datum being used. So to find and represent that location, or point, on your map, all of these components come into play.

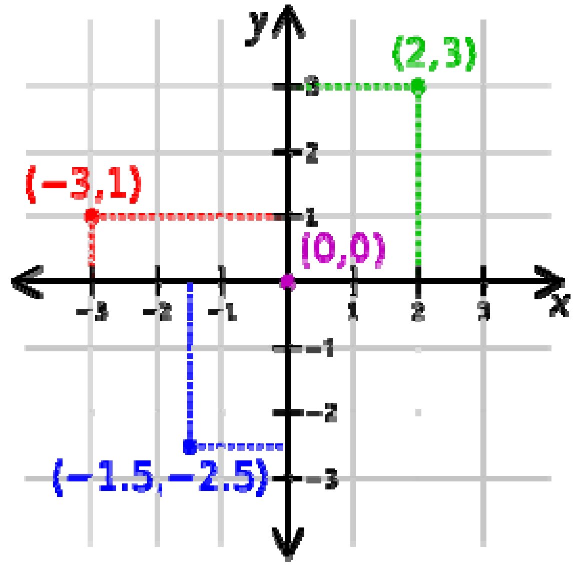
In order to represent a location that is from a 3 dimensional, or curved surface, and transfer it to a 2 dimensional map, the concept of coordinates needs to be understood.

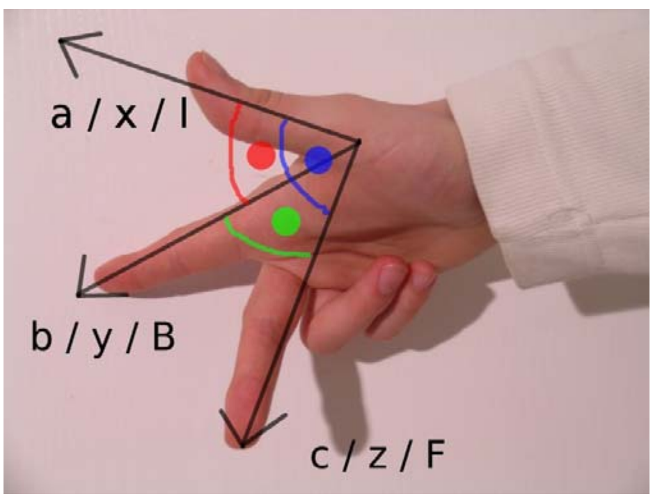
Day 3

Cartesian coordinates

A Cartesian coordinate system specifies each point uniquely in a plane by a pair of numerical coordinates, which are the signed distances from the point to two fixed perpendicular directed lines, measured in the same unit of length.

Each reference line is called a coordinate axis or just axis of the system, and the point where they meet is its origin. The coordinates can also be defined as the positions of the perpendicular projections of the point onto the two axes, expressed as a signed distances from the origin.





The usual way of orienting the axes, with the positive *x*-axis pointing right and the positive *y*-axis pointing up (and the *x*-axis being the "first" and the *y*-axis the "second" axis) is considered the *positive* or *standard* orientation, also called the *right-handed* orientation.

A commonly used mnemonic for defining the positive orientation is the *right hand rule*. Placing a somewhat closed right hand on the plane with the thumb pointing up, the fingers point from the *x*-axis to the *y*-axis, in a positively oriented coordinate system.

Distance between two points

The distance between two points of the plane with Cartesian coordinates (x1,y1) and (x2,y2) is

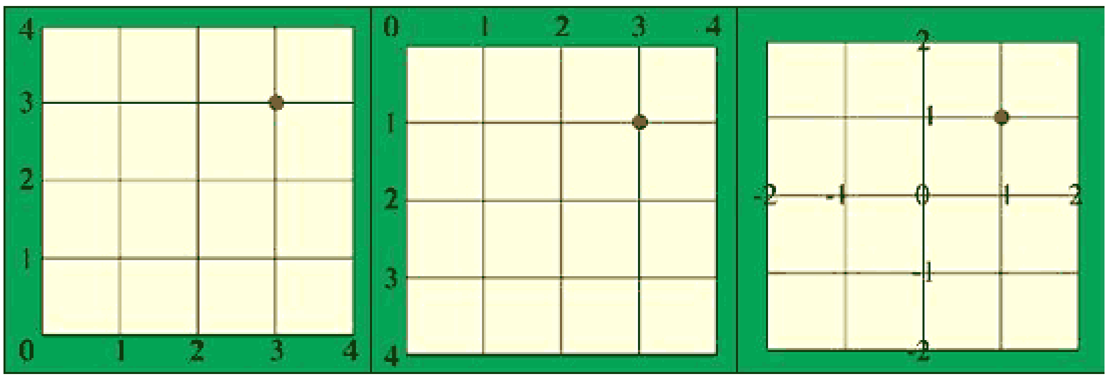
$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}.$$

This is the Cartesian version of Pythagoras' theorem.

Day 3

A grid system allows the location of a point on a map (or on the surface of the earth) to be described in a way that is meaningful and universally understood. Projecting the earth's surface (or a portion of it) is one of the ways outlined in the Map Projections page, allows for a representation of an area on a flat piece of paper. Once this is accomplished, it is necessary to set up a coordinate system on the map that will allow a point to be described in X-Y space.

However, in order to describe this location in a universally understandable manner a grid system is necessary. A simple grid is shown with the location of a point of interest that we want to describe.



In order for a point designation on a grid to be meaningful, there must be an origin to the grid which can be used to reference the point to. Once an origin is assigned then there is only one correct designation for the point, and anyone looking at the grid will assign it the same value and be able to interpret what someone else means when they describe a point located at 3,3.

A few examples of possible origins for the grid are shown. In the first example, the designation for the point would be 3, 3. In the second the designation would be 3, 1, and in the third it would be 1, 1. All of these designations describe the same point and the only thing that has changed is the **origin** of the grid. In order for any type of grid to be useful it is necessary for it to have an origin and uniform grid spacing (i.e. the distance between grid lines should remain constant).

Day 3

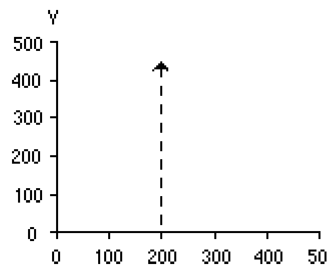
Plotting Points on a Grid

There are times when you are given a point and will need to find its location on a particular grid. This process combines the Cartesian system and the grid concept into a practical application, and is often referred to as plotting a point. This uses the same skills as identifying the coordinates of a point on a graph.

Example: Plot the point (200, 300).

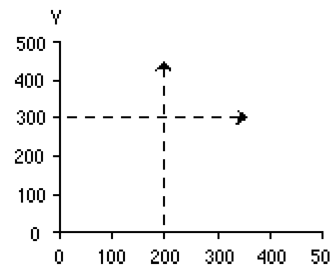
Step One

First, draw a line extending out from the *x*-axis at the *x*-coordinate of the point. In our example, this is at 200.



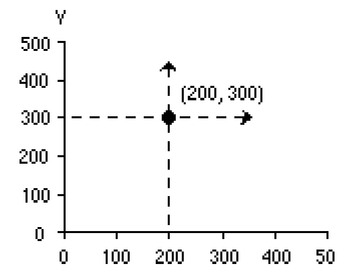
Step Two

Then, draw a line extending out from the *y*-axis at the *y*-coordinate of the point. In our example, this is at 300.



Step Three

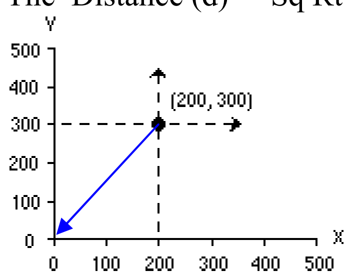
The point where these two lines intersect is at the point we are plotting, (200, 300).

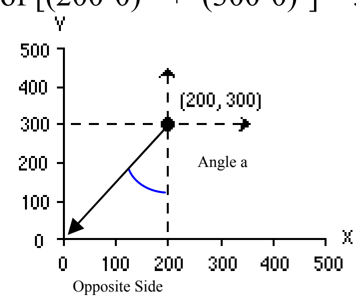


Calculate the Bearing and Distance from the origin (0,0) to the point (200,300):

Using the formula: $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$.

The Distance (d) = Sq Rt of $[(200\text{-}0)^2 + (300\text{-}0)^2] = 360.555$





Recalling the Sin formula from Course 01, where the Sin of an angle is the Opposite side divided by the Hypoteneuse (Sin 'Angle a' = Opp/Hyp);
The side opposite 'Angle a' is (200-0) or 200;
The Hypotenuese is the Distance (d) that we just calculated above.
The Sin of 'Angle a' = 200/360.555 or 0.5547.
In order to find the actual Angle in degrees-minutes-seconds,you must take the Inverse Sin (or Sin^{-1}) of 0.5547. This results in an angle of 33.69 decimal degrees.
Converting to DMS results in 33d41'24" for the anglular measurement.
The Bearing from the South to the West then would be: S33-41-24W

Day 3

Map Projections

What is a Projection?

Once a reference datum has been determined the elevation of any point can be accurately determined, and it will correlate to the elevation of any point on the earth's surface that has the same elevation and is using the same datum. But…how do you accurately represent the X and Y coordinates of that point? This question leads to one of the fundamental problems of mapmaking…how do you represent all or part of an ellipsoid object on a flat piece of paper? The answer to this question is a bit complicated, but understanding it is fundamental to understanding what maps actually represent (this statement will become clearer shortly).

In order to represent the surface of the earth on a flat piece of paper, the map area is projected onto the paper. There are many different types of projections, each with its own strengths and weaknesses.

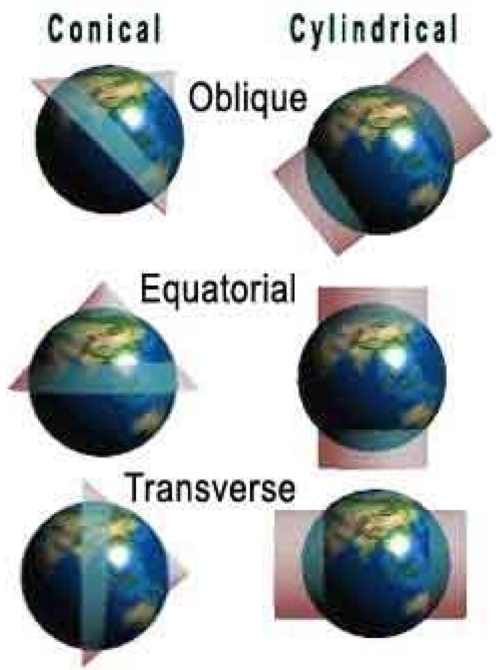
The simplest (and easiest to visualize) example of a projection is a planar projection. To understand this type of projection, imagine inserting a piece of paper through the earth along the equator. Now imagine that the earth is semi-transparent and you could shine a flashlight oriented along the (geographic) polar axis through the earth.

The resulting outline on the paper would be a map created using this type of projection (known as a transverse azimuthal or planar projection).

There are three main types of projections, based on the shape of the 'paper' onto which the earth is projected. The example above used an azimuthal (planar) piece of paper.

Day 3

The other main types, illustrated to below, are cylindrical and conical projections. These three types of projections can be further modified by the way the 'paper' is oriented when it is inserted into the earth.



In the example above, the plane was oriented along the equator, known as a transverse orientation (hence the 'transverse azimuthal' projection). Projections may also be equatorial (oriented perpendicular to the plane of the equator) or oblique (oriented at some angle that is neither parallel nor perpendicular to the plane of the equator.

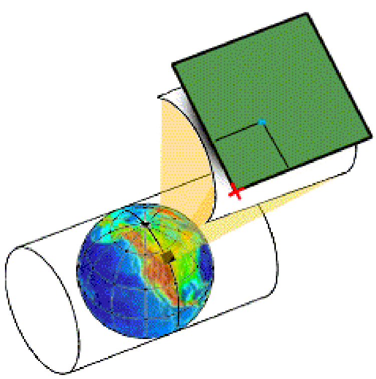
Day 3

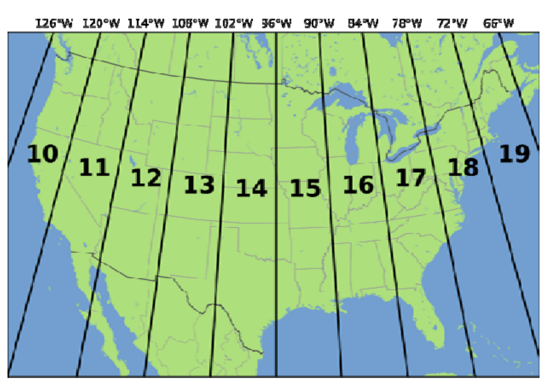
UTM - Universal Transverse Mercator
Geographic Coordinate System

The idea of the transverse mercator projection has its roots in the 18th century, but it did not come into common usage until after World War II. It has become the most used because it allows precise measurements in meters to within 1 meter.

A mercator projection is a ‘pseudo cylindrical’ conformal projection (it preserves shape). What you often see on poster-size maps of the world is an equatorial mercator projection that has relatively little distortion along the equator, but quite a bit of distortion toward the poles.

What a transverse mercator projection does, in effect, is orient the ‘equator’ north-south (through the poles), thus providing a north-south oriented swath of little distortion. By changing slightly the orientation of the cylinder onto which the map is projected, successive swaths of relatively undistorted regions can be created.

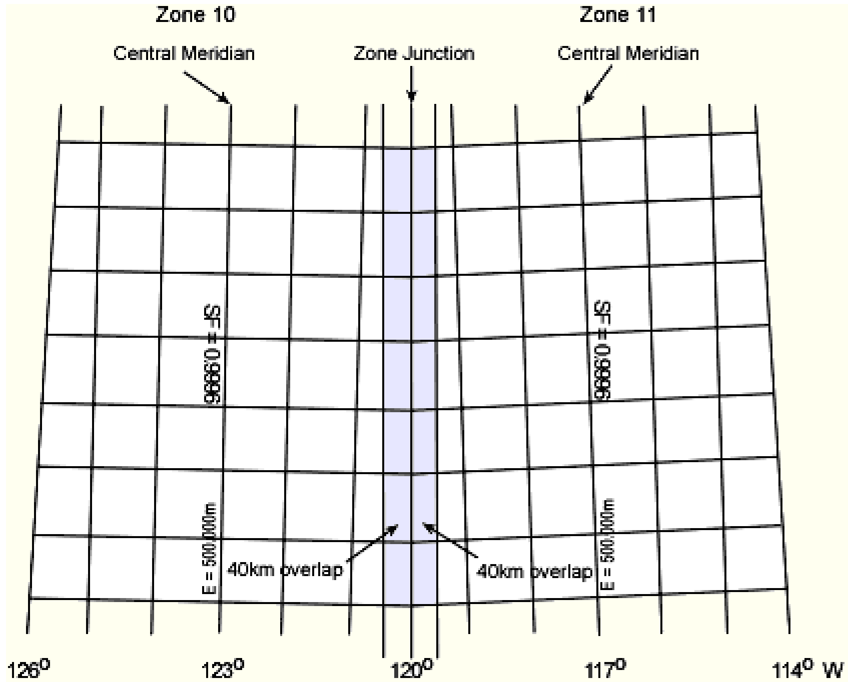




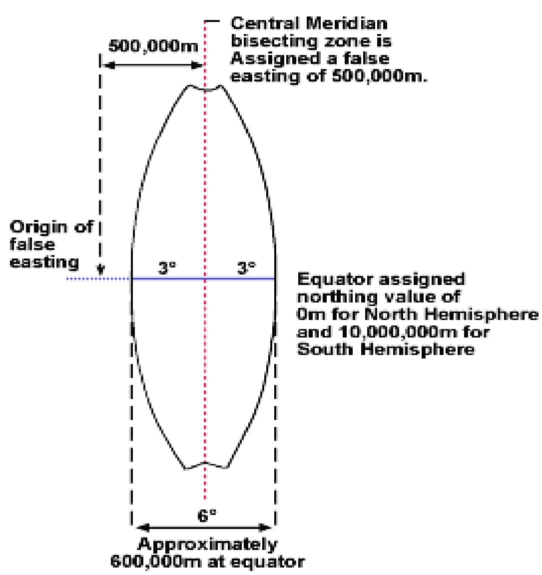
This is exactly what the UTM system does. Each of these swaths is called a UTM zone and is six degrees of longitude wide. The first zone begins at the International Date Line (180°, using the geographic coordinate system).

Day 3

The zones are numbered from west to east, so zone 2 begins at 174°W and extends to 168°W. The last zone (zone 60) begins at 174°E and extends to the International Date Line.



The zones are then further subdivided into an eastern and western half by drawing a line, representing a transverse mercator projection, down the middle of the zone. This line is known as the 'central meridian' and is the only line within the zone that can be drawn between the poles and be perpendicular to the equator (in other words, it is the new 'equator' for the projection and suffers the least amount of distortion). For this reason, vertical grid lines in the UTM system are oriented parallel to the central meridian. The central meridian is also used in setting up the origin for the grid system.



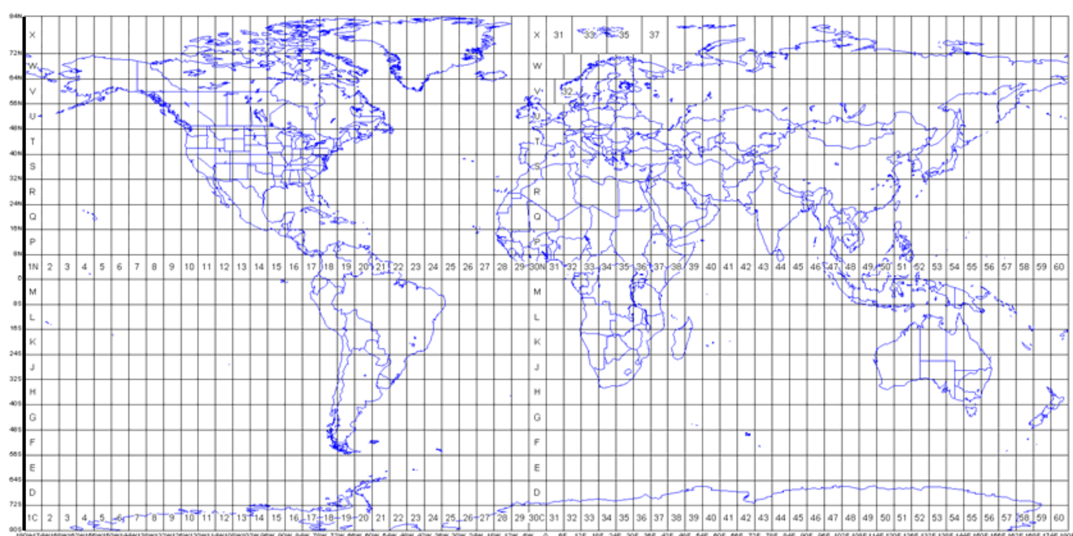
Day 3

Any point can then be described by its distance east of the origin (its '*easting*' value). By definition the Central Meridian is assigned a false easting of 500,000 meters. Any easting value greater than 500,000 meters indicates a point east of the central meridian. Any easting value less than 500,000 meters indicates a point west of the central meridian. Distances (and locations) in the UTM system are measured in meters, and each UTM zone has its own origin for east-west measurements.

To eliminate the necessity for using negative numbers to describe a location, the east-west origin is placed 500,000 meters west of the central meridian. This is referred to as the zone's 'false origin'. The zone doesn't extend all the way to the false origin. The origin for north-south values depends on whether you are in the northern or southern hemisphere. In the northern hemisphere, the origin is the equator and all distances north (or '*northings*') are measured from the equator. In the southern hemisphere the origin is the south pole and all northings are measured from there. Once again, having separate origins for the northern and southern hemispheres eliminates the need for any negative values. The average circumference of the earth is 40,030,173 meters, meaning that there are 10,007,543 meters of northing in each hemisphere.

UTM coordinates are typically given with the zone first, then the easting, then the northing. So, in UTM coordinates, Red Hill is located in zone twelve at 328204 E (easting), 4746040 N (northing). Based on this, you know that you are west of the central meridian in zone twelve and just under halfway between the equator and the north pole. The UTM system may seem a bit confusing at first, mostly because many people have never heard of it, let alone used it. Once you've used it for a little while, however, it becomes an extremely fast and efficient means of finding exact locations and approximating locations on a map.

Many topographic maps published in recent years use the UTM coordinate system as the primary grids on the map. On older topographic maps published in the United States, UTM grids are shown along the edges of the map as small blue ticks.



UTM Grid Zones

Day 3

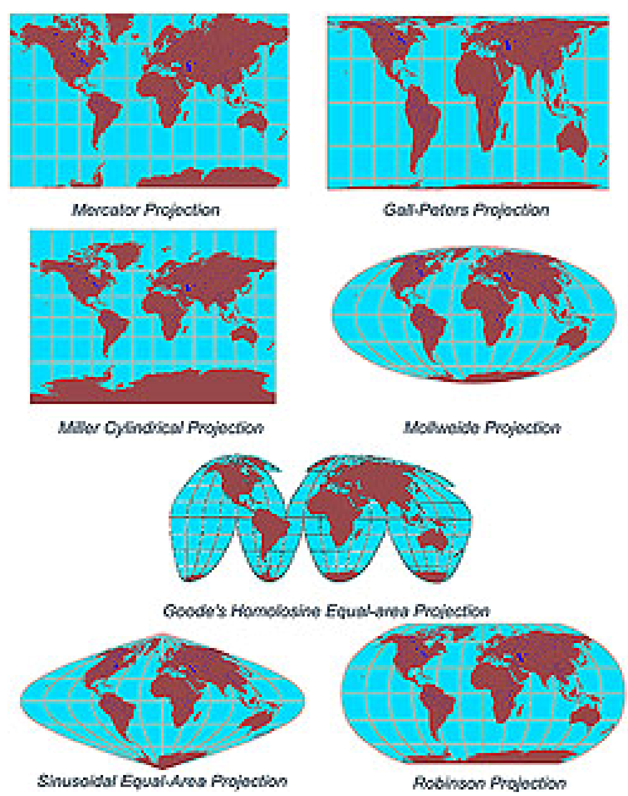
Map Projection Distortions

Each of the different types of projections has strengths and weaknesses. Knowledge of these different advantages and disadvantages for a particular map projection will often help in which map to choose for a particular project. The basic problem inherent in any type of map projection is that it will result in some distortion of the 'ground truth' of the area being mapped.

There are four basic characteristics of a map that are distorted to some degree, depending on the projection used. These characteristics include distance, direction, shape, and area. The only place on a map where there is no distortion is along the trace of the line that marks the intersection of our 'paper' with the surface of the earth.

Any place on the map that does not lie along this line will suffer some distortion. Fortunately, depending on the type of projection used, at least one of the four characteristics can generally be preserved.

A conformal projection primarily preserves shape, an equidistant projection primarily preserves distance, and an equal-area projection primarily preserves area.



These images show the earth using different projections. Notice how the continents look stretched or squashed depending on the projection.

Day 3

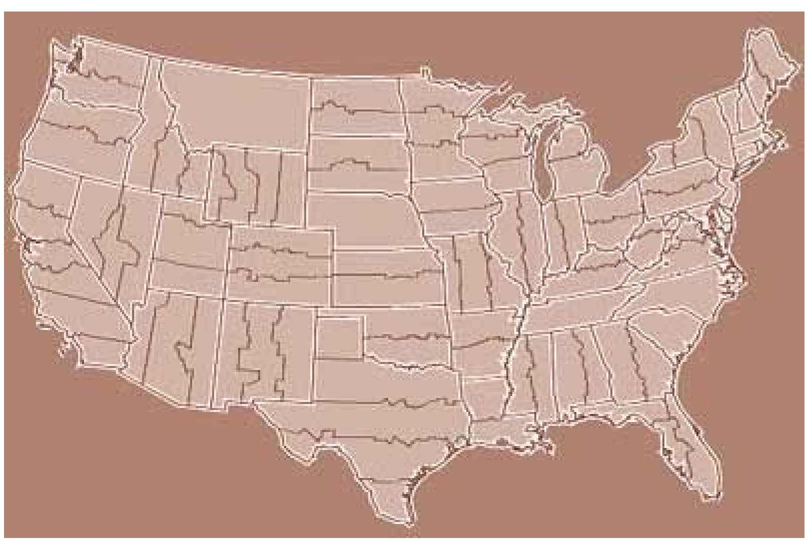
State Plane Coordinate System

The State Plane Coordinate System (**SPCS**) was developed in the 1930s by the U.S. Coast and Geodetic Survey to provide a common reference system for surveyors and mappers. The goal was to design a conformal mapping system for the country with a maximum scale distortion of one part in 10,000, which at the time was considered the limit of surveying accuracy. The State Plane Coordinate System (**SPCS**) is used for local surveying and engineering applications, but isn't used if crossing state lines.

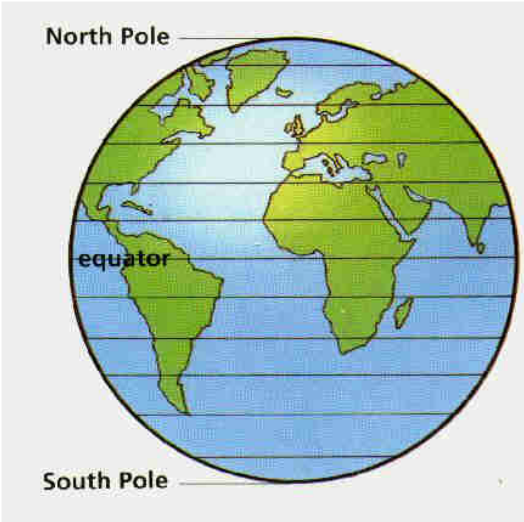
The State Plane grid system is very similar to that used with the UTM system, with the exception of where the origins for the grids are located. The easting origin for each zone is always placed an arbitrary number of feet west of the western boundary of the zone, eliminating the need for negative easting values. The northing origin, however, is not at the equator as in UTM, but rather it is placed at an arbitrary number of feet south of the state border.

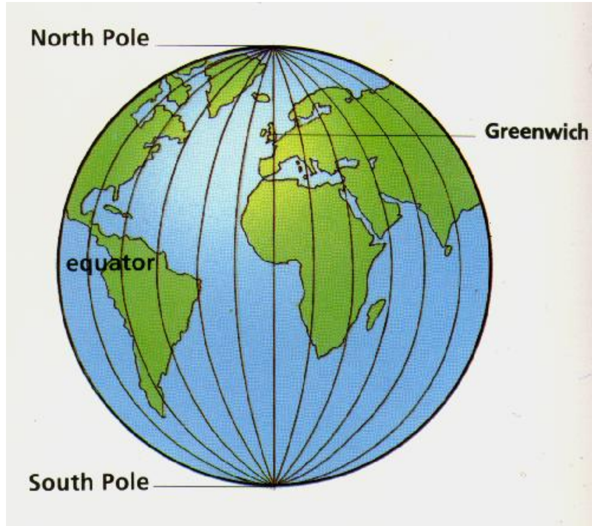
To maintain the accuracy of one part in 10,000 and minimize distortion, large states were divided into zones, and depending on their orientation different projections were chosen. The three conformal projections used are listed below.

- Lambert Conformal Conic... for states that are longer east–west, such as Tennessee and Kentucky.
- Transverse Mercator projection... for states that are longer north–south, such as Illinois and Vermont.
- The Oblique Mercator projection... for the panhandle of Alaska, because it lies at an angle.



Day 3





Projecting along a **L**atitude Line?

Use **L**ambert Conic projection
[Florida State Plane North]

Projecting along a **M**eridian (Longitude)?

Use Transverse **M**ercator projection
[Florida State Plane East and West]

The State Plane projection is either a Lambert (Conic) projection or a Transverse Mercator with specific standard parallels, central meridians, and arbitrary (false) easting and northing coordinate numbers for each zone. Each zone is unique; the same coordinates in one zone will not be for the same location in another zone.

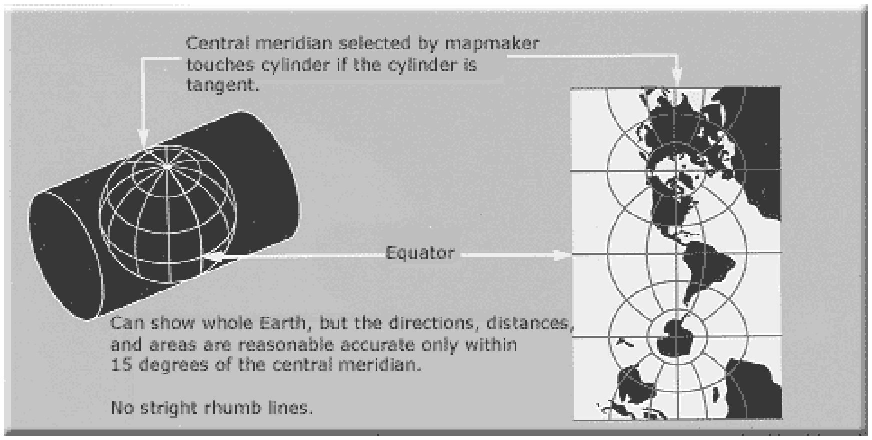
The number of zones in a state is usually determined by the area the state covers and ranges from one to as many as ten in Alaska. Each zone has a unique central meridian.

The State Plane Coordinate System (SPS or SPCS) is a set of 124 geographic zones or coordinate systems designed for specific regions of the United States. Each state contains one or more state plane zones, the boundaries of which usually follow county lines. Its popularity is due to at least two factors. First, it uses a simple Cartesian coordinate system to specify locations rather than a more complex spherical coordinate system (the geographic coordinate system of latitude and longitude). Second, the system is highly accurate within each zone (error less than 1:10,000).

Most state plane zones are based on either a Transverse Mercator projection or a Lambert conformal conic projection. The choice between the two map projections is based on the shape of the state and its zones. States that are long in the east-west direction are typically divided into zones that are also long east-west. These zones use the Lambert conformal conic projection, because it is good at maintaining accuracy along an east-west axis. Zones that are long in the north-south direction use the Transverse Mercator projection because it is better at maintaining accuracy along a north-south axis.

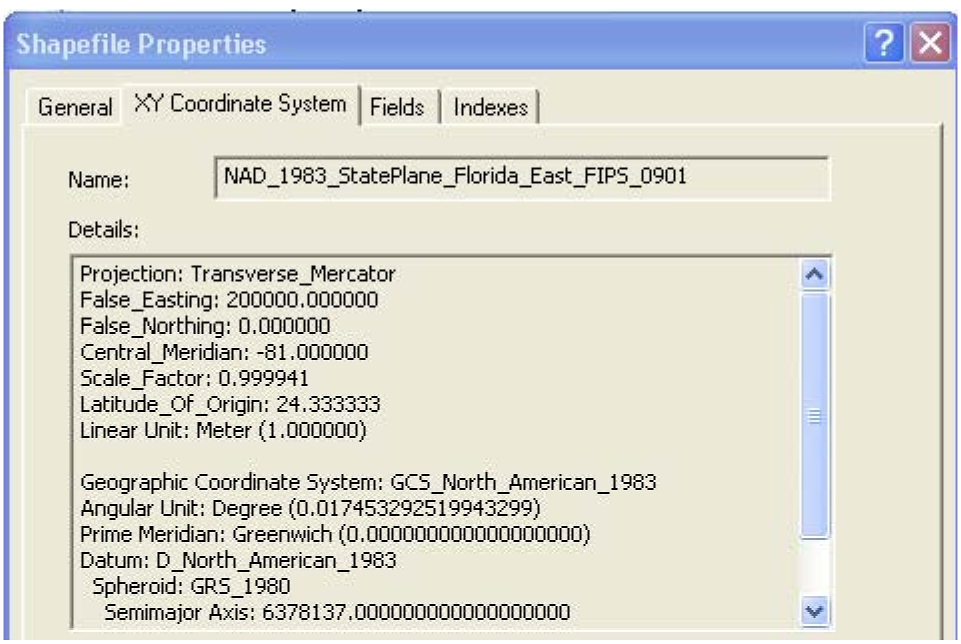
Day 3

Transverse Mercator



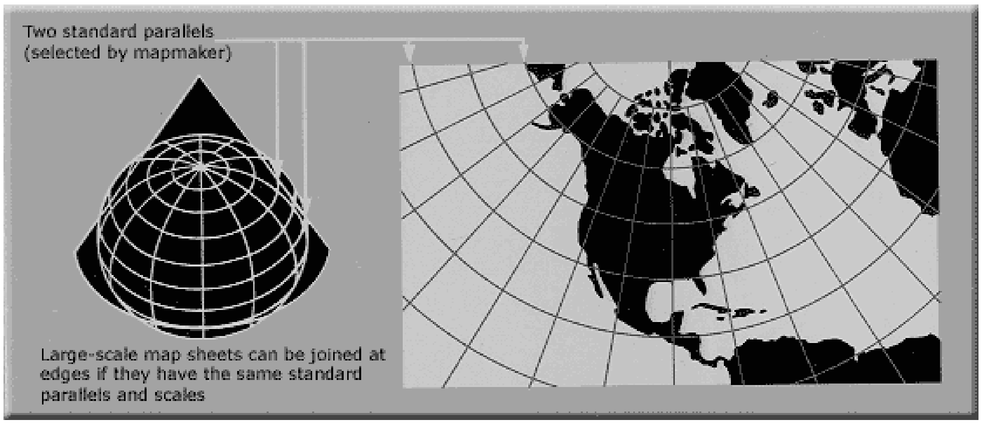
Used by USGS for many quadrangle maps at scales from 1:24,000 to 1:250,000. Also used for mapping large areas that are mainly north–south in extent. Distances are true only along the central meridian selected by the mapmaker or else along two lines parallel to it, but all distances, directions, shapes, and areas are reasonably accurate within 15° of the central meridian. Distortion of distances, directions, and size of areas increases rapidly outside the 15° band. Because the map is conformal, however, shapes and angles within any small area (such as that shown by a USGS topographic map) are essentially true. Central meridian and each meridian 90° from it are straight. Other meridians are complex curves concave toward central meridian.

Florida State Plane West and East use the Transverse Mercator Projection



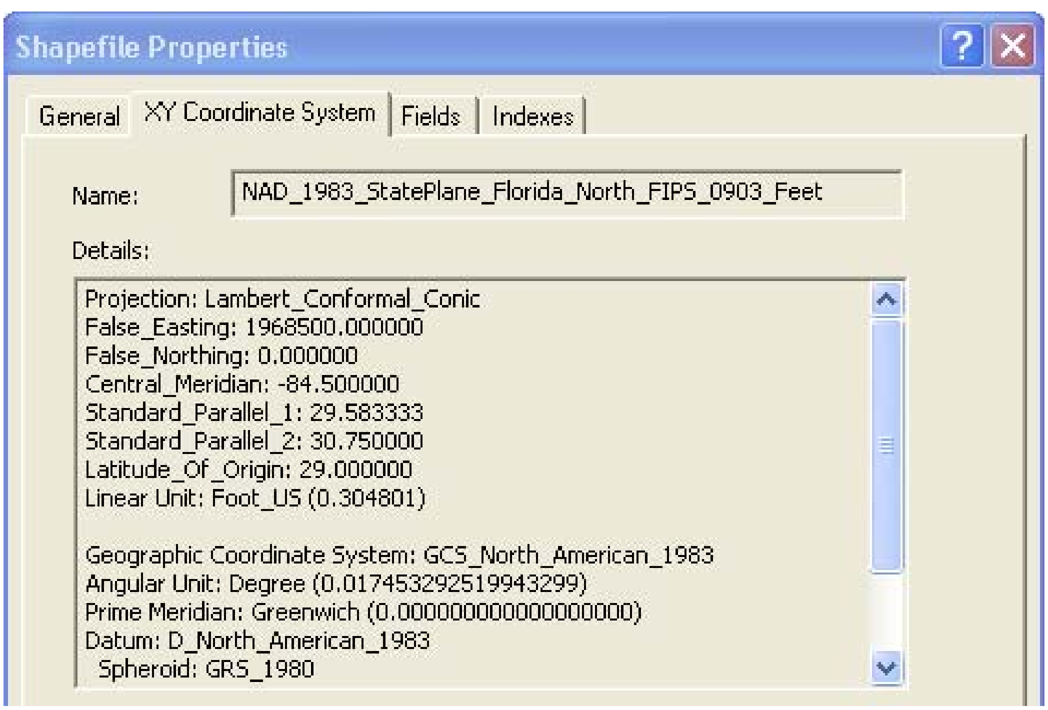
Day 3

Lambert Conformal Conic



This projection is used by USGS for many 7.5 and 15-minute topographic maps and for the State Base Map series. It is also used to show a country or region that is mainly east-west in extent, and is one of the most widely used map projections in the United States today. A critical advantages is that it retains conformality. The distances true only along standard parallels; and reasonably accurate elsewhere in limited regions. The cardinal directions are also reasonably accurate. Distortion of shapes and areas are minimal at standard parallels, but increase at the farther reaches. Shapes on large-scale maps of small areas essentially true.

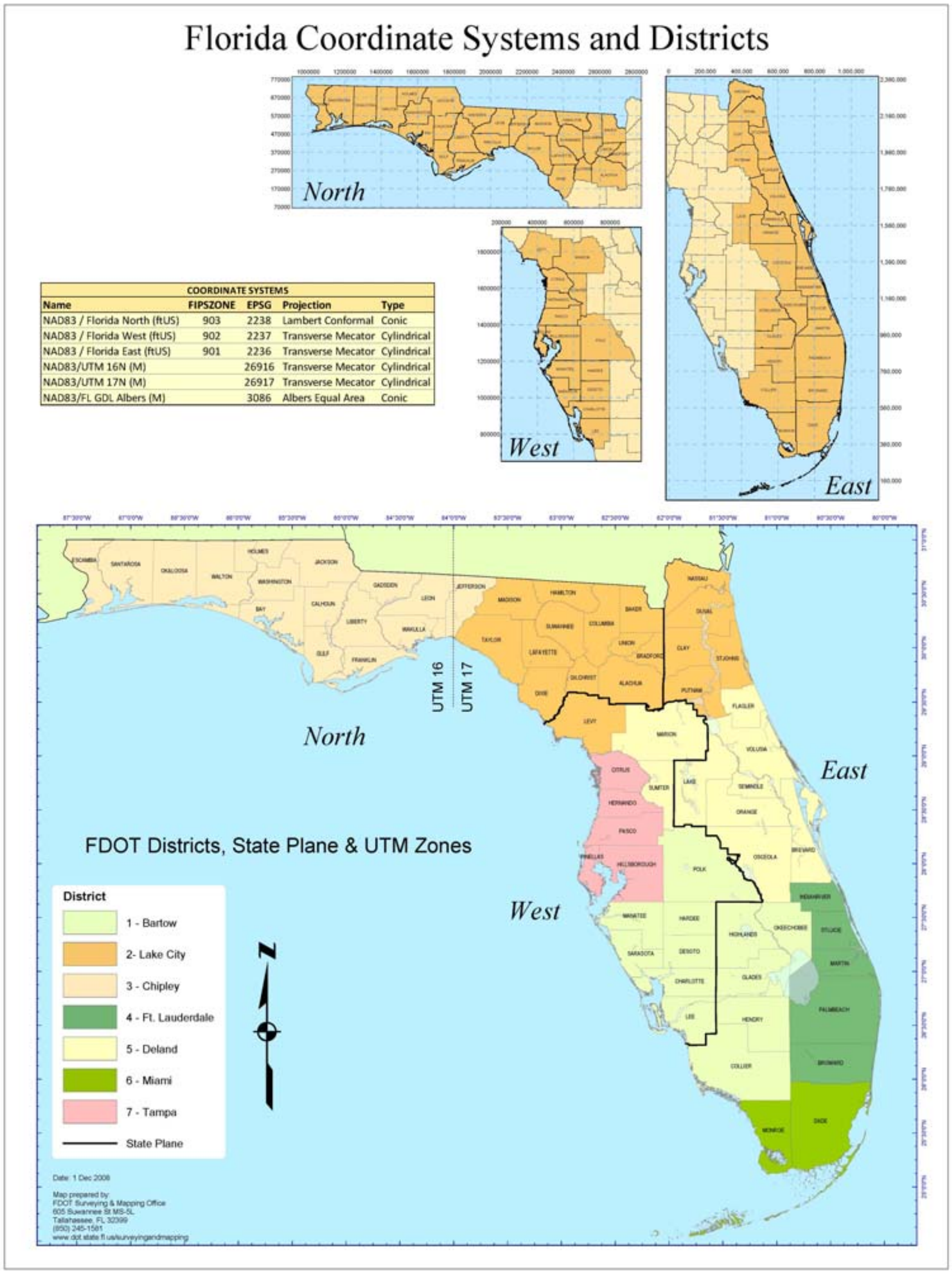
Florida State Plane North uses the Lambert Conformal Conic Projection



Day 3

Florida State Plane Coordinate System

Because Florida is shaped with both a latitudinal, and a longitudinal component, it has both Transverse Mercator, and Lambert Conformal Conic based projections for the Three State Plane Coordinate zones. The state is also split into two UTM zones, 16 and 17.



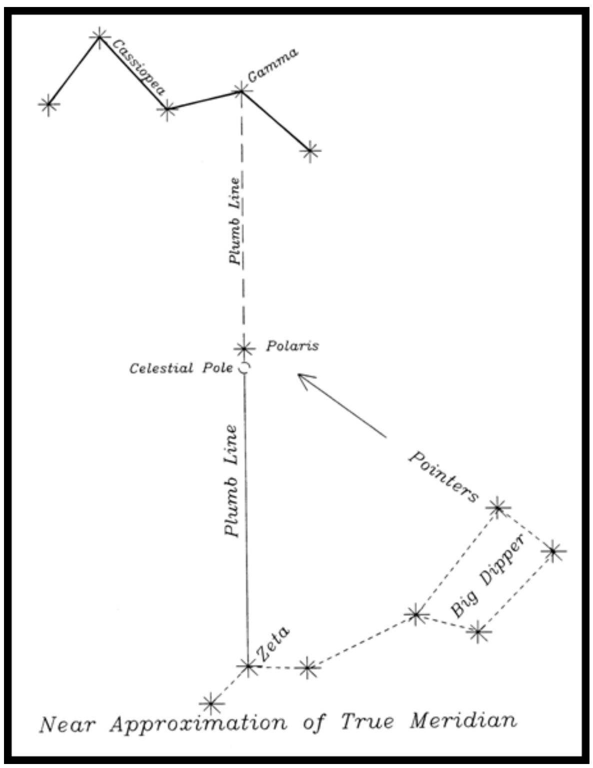
Florida State Plane North is a Lambert Conformal conic projection. This is based on the panhandle portion of Florida running parallel to the equator. The peninsular part of Florida runs roughly along meridian lines, so the two State Plane Systems located there (East and West) are both based on a Transverse Mercator projection.

Day 3

Grid North, Magnetic North & True North

While the use of the Surveyor's Compass is relatively simple (not many moving parts), understanding magnetic north adds an additional step to the surveying process. Magnetic North and True North (the axis of the earth) are not one and the same. There is a difference between the two called the "*Variation*". This differs across the U.S. and changes over time. A calibration to the bearings is necessary so that the readings are close to true north.

The original surveyors were very clever and made use of a simple fact that has been known and used by navigators for centuries. The compass will always point to Magnetic North where ever it might be, but find Polaris (the north star) and you'll always be looking True North. An exercise carried out at night by the original surveyors gave them a reading of that difference no matter where they were.

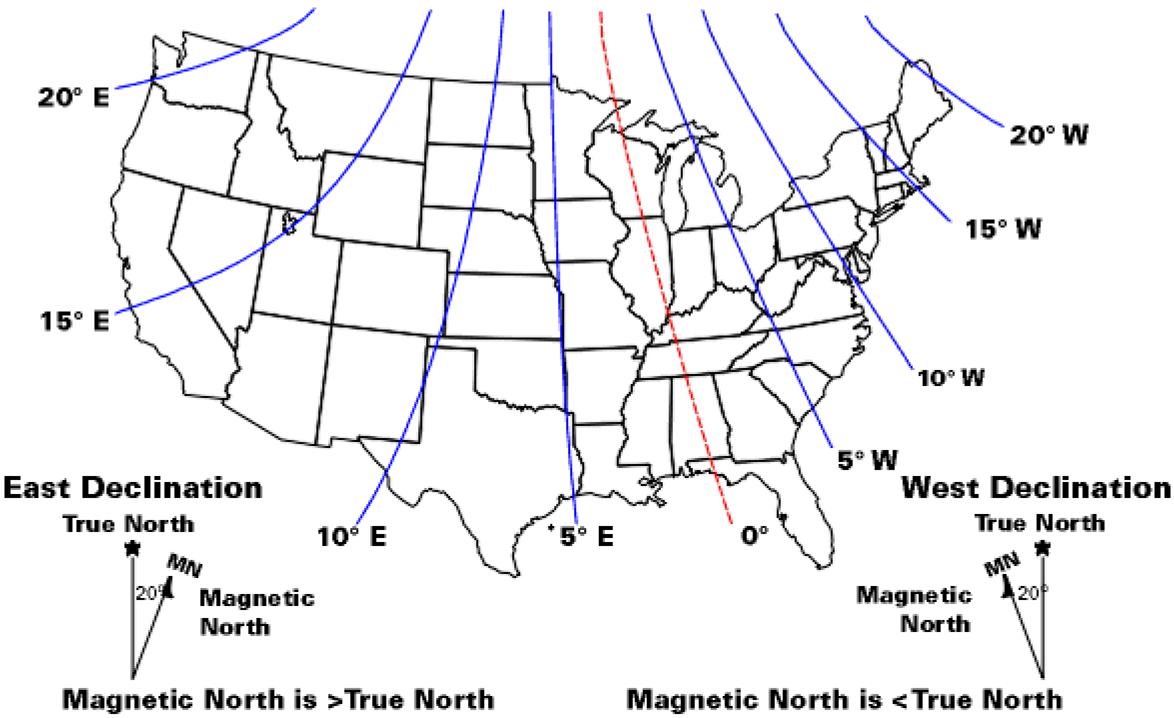


After sunset and in the dark of night, the surveyors would find an open field. The Compass man would set up his compass over a marked location where he could see to the north. Then one of the chainmen would walk north in the clearing some distance with a light source (lantern or candle). The Compass man would then find Polaris (the north star) in the northern sky and then, using a plumb bob, direct the chainman either left or right to be in line with his position and Polaris (the north star). The chainman would then leave a marked location. In the morning, the compass was again set up over the original mark and the "bearing" was read to the mark left to the north by the chainman. This bearing was the "Variation" or difference between magnetic north and true north by Polaris.

These two North's can be defined as:

True North: the direction of a meridian of longitude which converges on the North Pole. All lines of longitude are true north lines.

Magnetic North: the direction indicated by a magnetic compass. Magnetic North moves slowly with a variable rate over time. Magnetic North typically has a year associated with it, as well as annual charts for reference.



This leaves us with a third North to define:

Grid North: the direction of a grid line which is parallel to the central meridian on a particular grid, typically State Plane.

As previously discussed, the horizontal angular difference between True North and Magnetic North is called the "Variation". This is also known as "*Magnetic Variation*", or "*Magnetic Declination*".

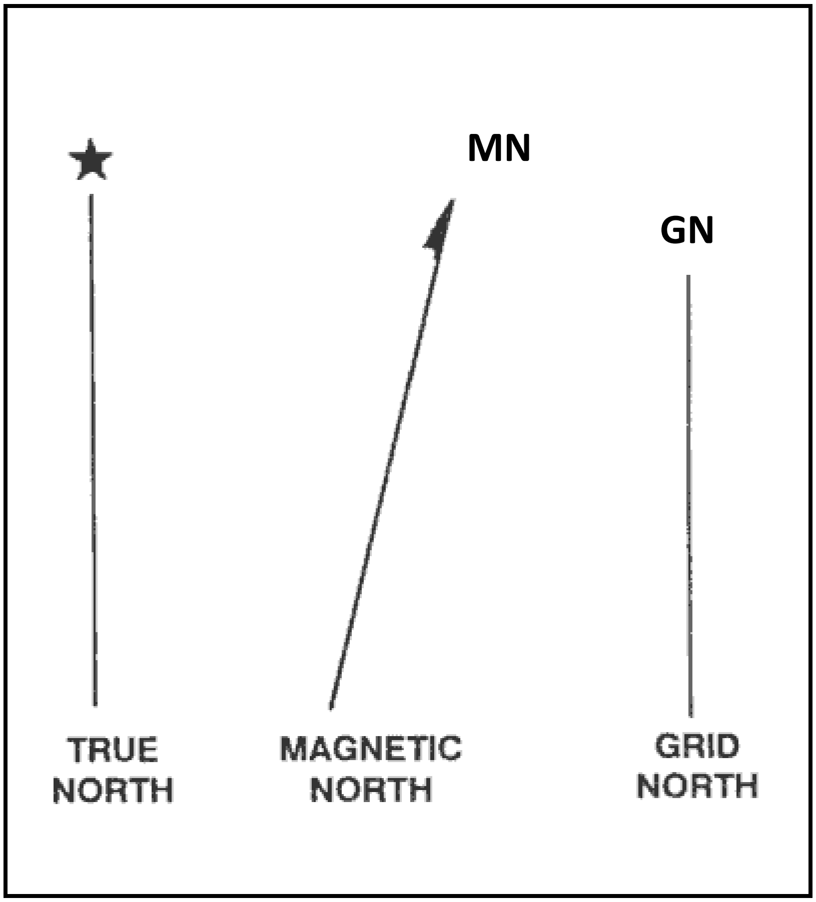
The horizontal angular difference between Grid North and Magnetic North is called *"Grid Magnetic Angle"* It is this angle which needs to be applied when converting between magnetic and grid bearings.

Day 3

Calculating Magnetic Variation

BASE LINES

In order to measure something, there must always be a starting point or zero measurement. To express direction as a unit of angular measure, there must be a starting point or zero measure and a point of reference. These two points designate the base or reference line. There are three base lines— true north, magnetic north, and grid north. The most commonly used are magnetic and grid.



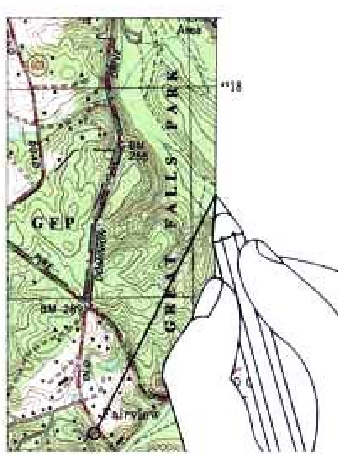
Typical designations for the Three North's.

To determine the direction, or bearing, from one point to another, you need a compass as well as a map. Most compasses are marked with the four cardinal points—north, east, south, and west—but some are marked additionally with the number of degrees in a circle (360: north is 0 or 360, east is 90, south is 180, and west is 270). Both kinds are easy to use with a little practice. One thing to remember is that a compass does not really point to true north, except by coincidence in some areas. The compass needle is attracted by magnetic force, which varies in different parts of the world and is constantly changing. When you read north on a compass, you're really reading the direction of the magnetic north pole. A diagram in the map margin will show the difference (declination) at the center of the map between compass north (magnetic north indicated by the MN symbol) and true north (polar north indicated by the "star" symbol). This diagram also provides the declination between true north and the orientation of the Universal Transverse Mercator (UTM) grid north (indicated by the GN symbol). The declination diagram is only representational, and true values of the angles of declination should be taken from the numbers provided rather than from the directional lines. Because the magnetic declination is computed at the time the map is made (check the date), and because the position of magnetic north is constantly changing, the declination factor provided on any given map may not be current.

Example

Taking a compass bearing from a map (see figures):

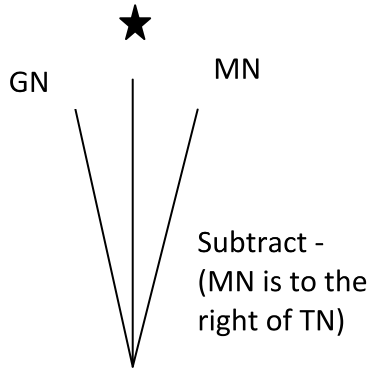
1. Draw a straight line on the map passing through your location and your destination and extending across any one of the map borders.
2. Center the compass where your drawn line intersects the map border, align the compass axis N-S or E-W with the border line, and read on the compass circle the true bearing of your drawn line. Be careful to get the bearing in the correct sense because a straight line will have two values 180° apart. Remember north is 0, east is 90, and so on.

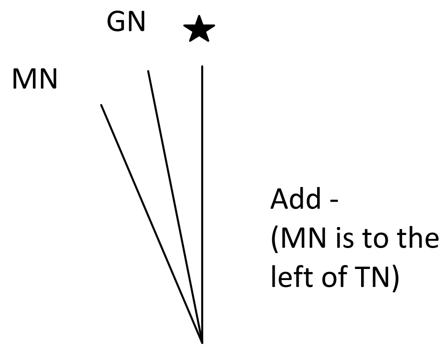


(1) Drawing a straight line over the map edge

(2) Reading the compass on the map

Day 3





(3) Using the magnetic declination diagrams

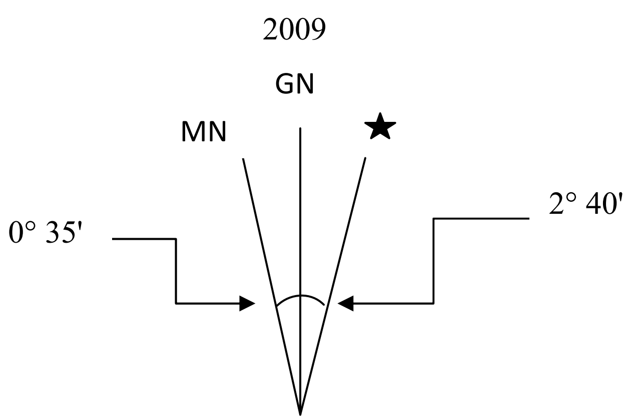
3. To use this bearing, you must compensate for magnetic declination. If the MN arrow on the map magnetic declination diagram is to the right of the true north line, subtract the MN value. If the arrow is to the left of the line, add the value. Then, standing on your location on the ground, set the compass so that "zero degrees or North" aligns with the magnetic north needle, read the magnetic bearing that you have determined by this procedure, and head off in the direction of this bearing to reach your destination.

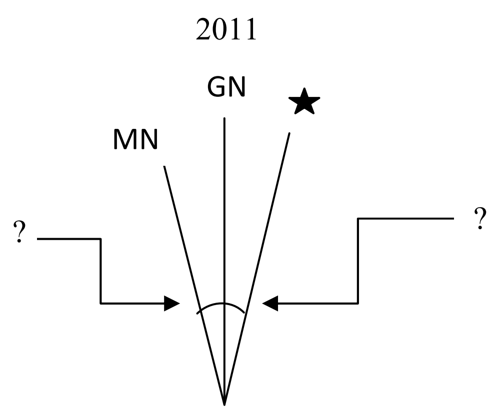
Calculate the variation over time:

Magnetic North (MN) is shown to be 0° 35' west of Grid North (GN) as of December 2009, with an estimated rate of change of 10' east per year.

The difference between True North and Grid North is given to be 2° 40' E.

Therefore the difference between Magnetic North and True North is 0° 35' plus 2° 40' which equals 3° 15' for 2009.





What is the estimated difference between Magnetic North and True North for December of 2011?

Day 3

Review Questions

1. True/False – Coordinates in one State Plane Projection represent the same coordinate location in a different State Plane Projection); in other words, they can be used interchangeably.

2. A geographic coordinate system enables every location on the Earth to be specified with how many coordinates? ___________

3. True/False – The Earth is a perfect sphere.

4. GPS receivers typically use at least how many satellites to solve for location and time? _____

5. To enhance positional accuracy, ground based reference stations may be used in addition to the satellite array. This is called __________ Global Positions System.

6. True/False – Coordinates using one reference Datum (Say NAD 27) represent the same coordinate location using a different reference Datum (say NAD 83); in other words, they can be used interchangeably.

7. What are the three main types of Projections?

8. UTM projections are broken down into 'zones' of how many degrees each?

9. Florida has how many State Plane Projections? _______

10. The difference between Magnetic North, and True North is called? _____________.

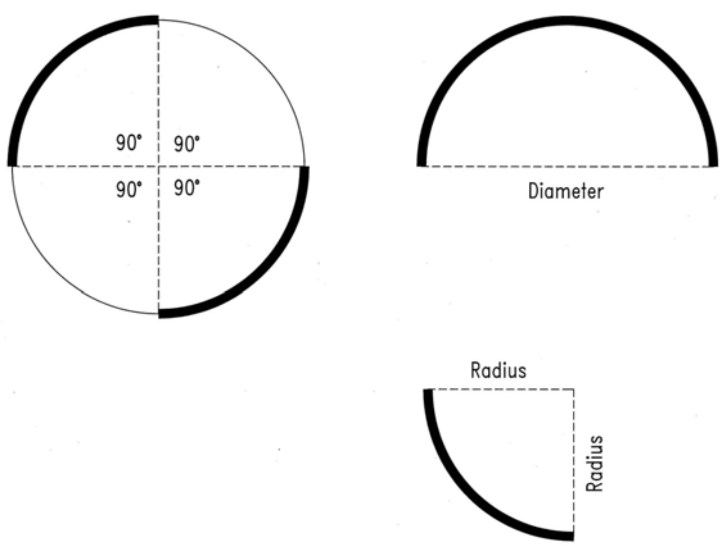
Review Mathematics for the Cadastralist

Angular Measure

The Circle

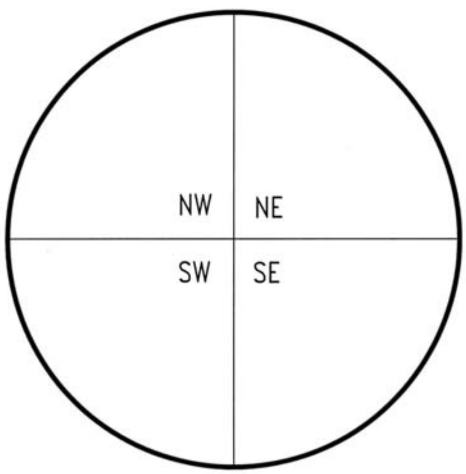
A circle is a set of points that are all a fixed distance from a given point. The given point is known as the center. The distance from the center to a point on the circle is called the radius. The circumference is the distance you would have to walk if you walked all the way around the circle. The diameter is the farthest distance across the circle; it is equal to twice the radius. The circle is a polygon without “straight” lines. In descriptions, we deal most often with a part of a circle, known as the arc.

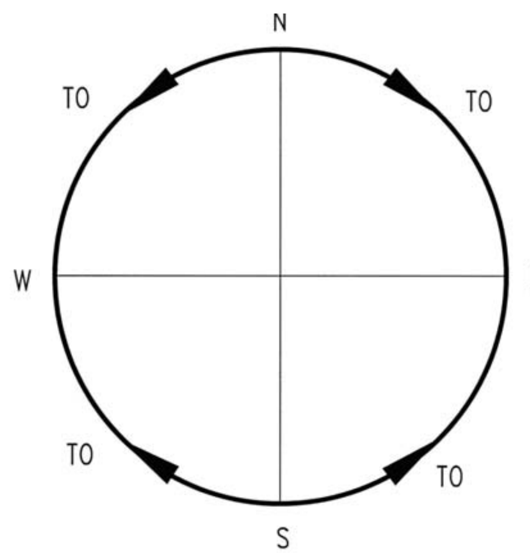
CIRCLE	=	360 PLUS DEGREES SYMBOL	=	360º
MINUTE	=	60 PLUS MINUTE SYMBOL	=	60'
SECOND	=	60 PLUS SECOND SYMBOL	=	60"



The Quadrant

There are four quadrants of a Surveyor's Compass. These are called the Northeast, Northwest, Southwest and Southeast quadrants. The measurement of a bearing does not exceed 90 degrees.





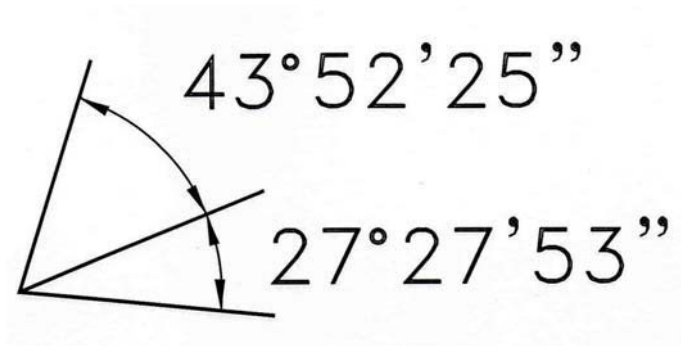
Surveyor's Quadrants	Direction
	1. North to East
	2. South to East
	3. South to West
	4. North to West

The Addition of Angular Measure

Write each angle down as degree - minute - second. Add, as in regular addition but in **vertical columns** moving from right to left as shown below. Since any part of a degree (minutes or seconds) can NOT be over 60, subtract 60 (or a multiple of 60) from whatever column needs it and then add one (or more) to the column to the left. W**ork in columns**.

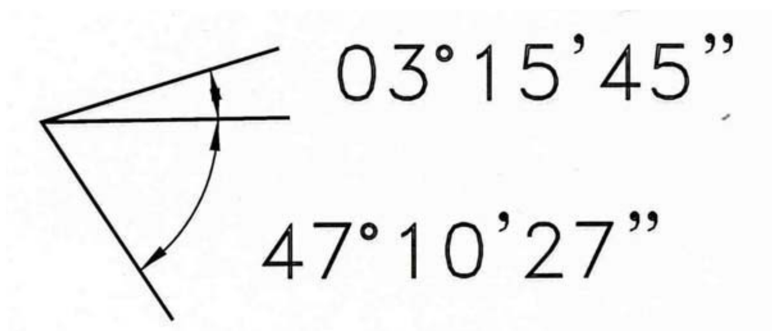
EXAMPLE 1:

	degree	minutes	seconds
	43°	52'	25"
+	27°	27'	53"
	70°	79'	78"
–	00°	00′	60″
	70°	79′	18″
+	00°	01′	00″
	70°	80′	18″
–	00°	60′	00″
	70°	20′	18″
+	01°	00′	00"
	71°	20′	18"



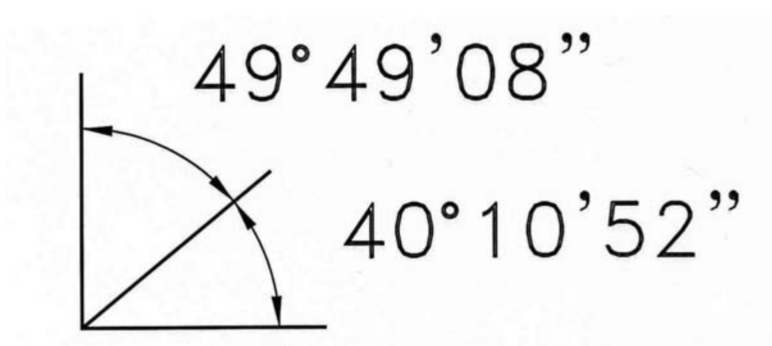
EXAMPLE 2:

	47°	10'	27"
+	03°	15'	45"
	50°	25'	72"
–	00°	00′	-60"
	50°	25′	12″
+	00°	01′	00″
	50°	26'	12"



EXAMPLE 3:

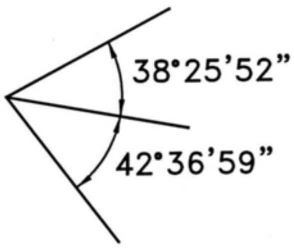
	49°	49'	08"
+	40°	10'	52"
	89°	59'	60"
–	00°	00′	60″
	89°	59′	00″
+	00°	01′	00″
	89°	60′	00″
–	00°	60′	00″
	89°	00′	00″
+	01°	00′	00″
	90°	00′	00″

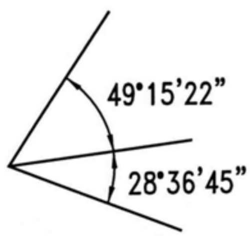


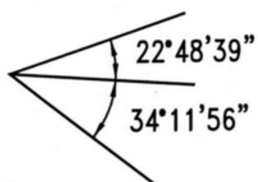
The Addition of Angular Measure

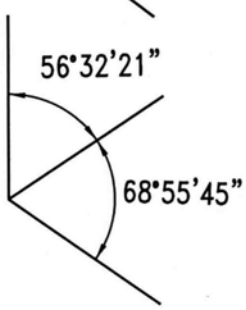
Problems

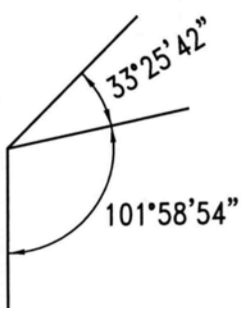
Working Area:

1. 

2. 

3. 

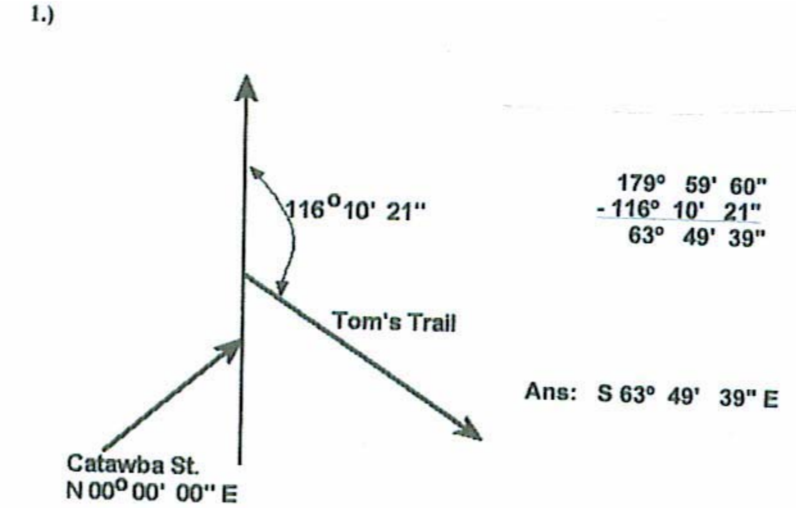
4. 

5. 

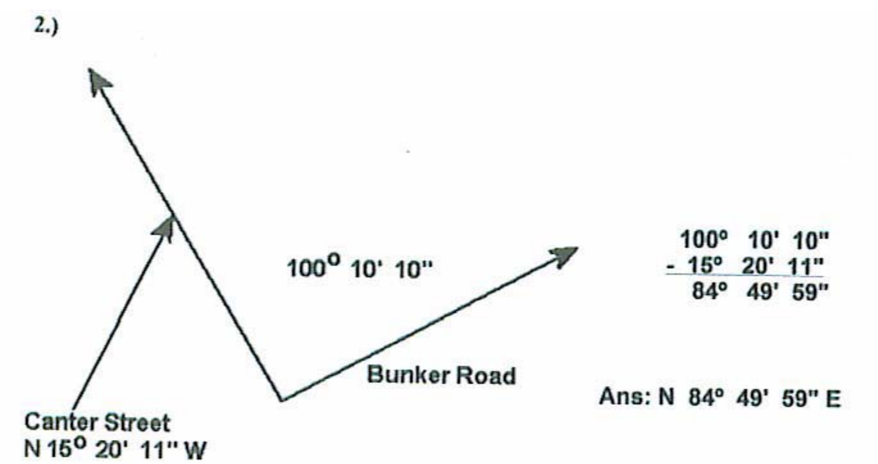
Notice that ALL of our angle parts (columns) are at least two numbers. Keep each column two numbers even when done with the column. It just doesn't look correct to show an angle or

Use of Angles and Bearings

Maps, plats and surveys historically have used bearings and angles in a graphic representation for the Cadastral Mapper. Sometimes only the angles appear on the survey. Thus the mapper must compute the bearings from the angles incidental to his work.



(Seldom will you see a bearing such as N.00° 00’00”E. Normally it is written as North.)



Convert Angular Measurement to Decimal Degree

13. 85º13’46”____________________________________

14. 89º01’05” ____________________________________

15. 31º11’15” ____________________________________

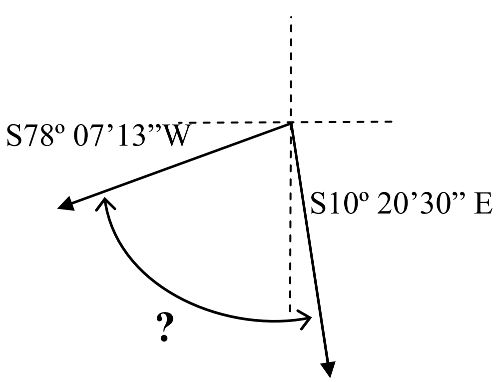
Convert Decimal Degrees to Degrees Minutes Seconds

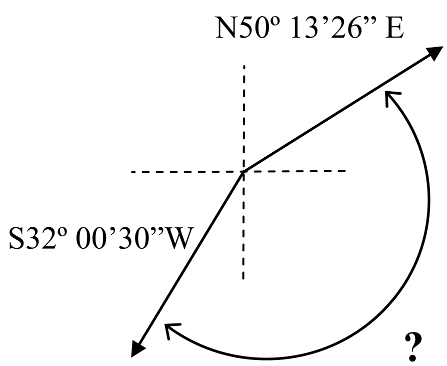
16. 89.39583333____________________________________

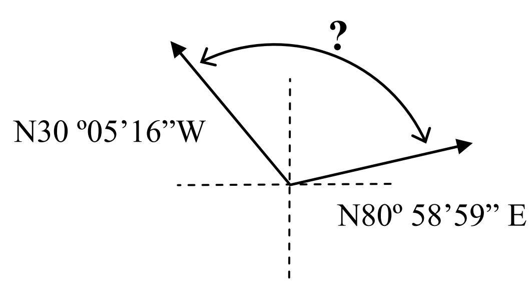
17. 25.61555556____________________________________

18. 46.38972222____________________________________

Determine Angles

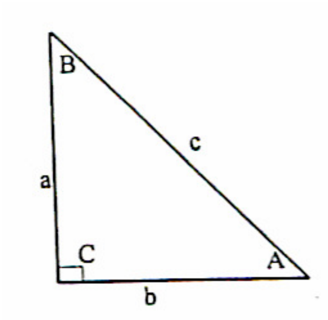






19.________________________20._________________________21.______________________

The Right Triangle and Basic Trigonometric Functions



The angles of this triangle are A, B and C and the sides are a, b and c. From this plane right triangle the following formula is stated (without proofs):

$$\mathbf{a^2 + b^2 = c^2}$$

This is known as Pythagorean Theorem for the Greek citizen that is credited with the evolution of the formula.

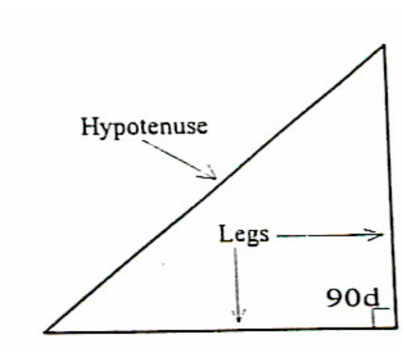
Where c is the hypotenuse, C is the 90 degree angle and the sum of angles A and B equal 90 degrees, the following statements are true (of any right triangle):

Parts of the Right Triangle

The right angle is formed where two lines meet at 90 degrees.

The hypotenuse is the side across from the right angle.

The other two sides are referred to as legs.

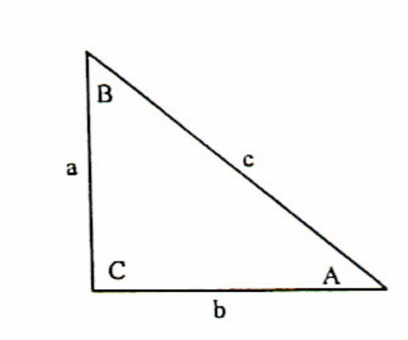


The Right Triangle with All Three Sides

The Pythagorean Theorem

Setting up the triangle:

Normally **a**, **b** & **c** (**lower case letters**) refer to the sides of a triangle: **a** is for altitude, **b** is for base and **c** is the third side called the hypotenuse. The hypotenuse is always <u>across</u> from the right angle. Normally the angles across from the other two sides are labeled with the (**upper case letters) A** and **B.** This general rule is applicable to all triangle solving situations and is the standard configuration for all triangles.



The Pythagorean Theorem states: $a^2 = c^2 - b^2$

or

$$a = \sqrt{c^2 - b^2}$$

The product of a number multiplied by itself is said to be the square of that number. It is also referred as taking it to the second power (x^2).

Square Root

What is meant by the square root of a number?

The square root of any number that is a perfect square, is one of the two equal factors of the number. Thus, 3*3 = 9 or 5*5 = 25. The numbers 3 and 5 respectively are the equal factors (square roots) of the nine and twenty-five.

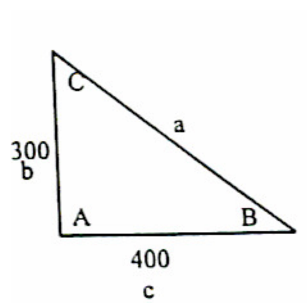
When a number is not a perfect square, the square root cannot be exactly determined. However, with your calculator it can be found approximately to any degree of accuracy that you will need in mapping (example: 25.123456789).

So 3*3 = 9, thus the square root of 9 is 3. The symbol used to indicate the square root sign is the combination of the radical sign and the bar called the vinculum.

$\overline{\qquad\qquad}$ ↓ the bar or vinculum

Radical sign → $\sqrt{}$

Pythagorean example and problem (more on this later):



$a^2 = 300^2 + 400^2$

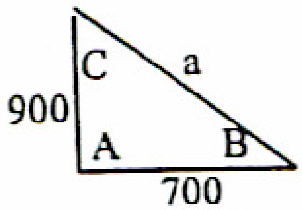
$a = \sqrt{90000 + 160000}$

$a = \sqrt{250000}$

$a = 500$

Exercises: Find the hypotenuse (all triangles are right triangles)

1.



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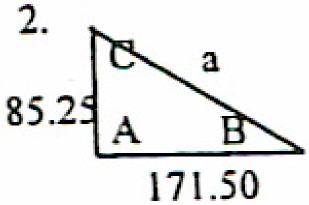

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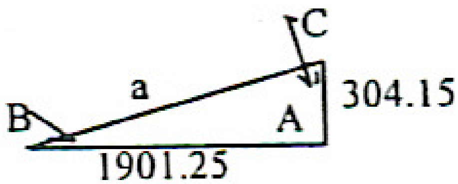

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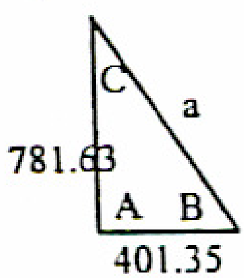
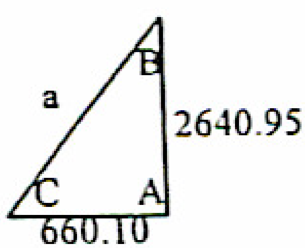
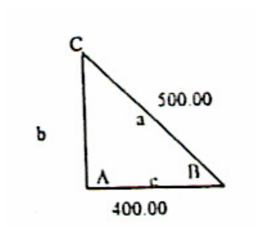


5.



Now that we can calculate the hypotenuse, what about the other two sides?

Example:



$b^2 = 500^2 - 400^2$

$b = \sqrt{250000 - 160000}$

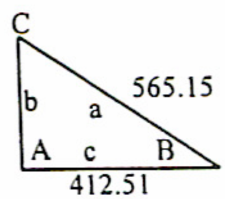
$b = \sqrt{90000}$

$b = 300$

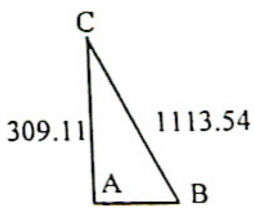
Exercise: Find the missing side.

(All are right triangles.)

1.



2.



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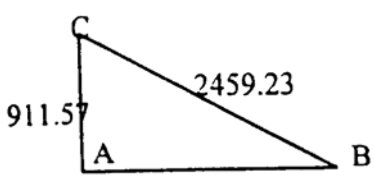

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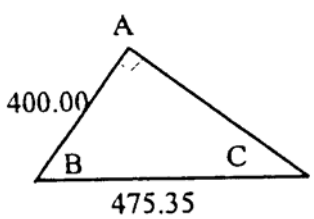


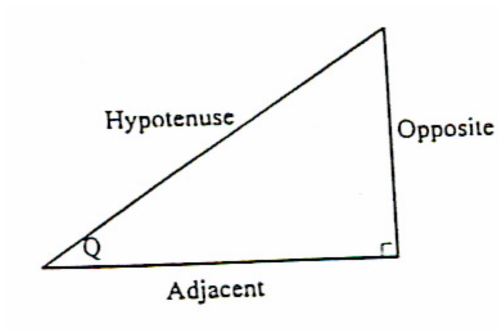
Trigonometry - The study of the properties of triangles and the trigonometric functions and of their applications.

Trigonometric Function(s) - A ratio resulting from the relationship of quotient of the following:

Sine = opposite divided by hypotenuse (full name)

Cosine = adjacent divided by hypotenuse (full name)

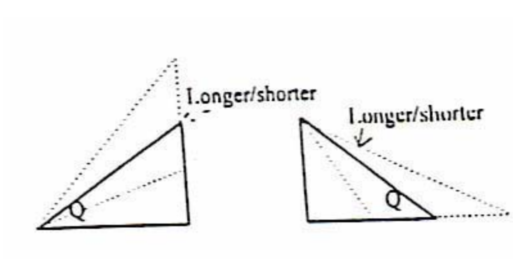
Tangent = opposite divided by adjacent (full name)



While these are different than already discussed, they are correct for trigonometry. What we discussed previously was geometry

The Ratio

What happens to the opposite side when you increase or decrease the angle Q? What happens when you increase or decrease the adjacent side? What happens to angle Q when you increase or decrease the opposite?



What Happens When You Have A
Sine, Cosine or Tangent

Years ago (before today's calculators) there were publications of tables that had the relationship between the sides of a triangle and the angles already figured out. The publications were called natural functions of sines, cosines, tangents and cotangents. Today, we have calculators and computers that give us, upon the press of a key, the same numerical values that we may need. A typical old book would be *Eight-Place Tables of Trigonometric Functions for Every Second of Arc* by Jean Peters which was first published in 1939 and used by surveyors since then.

Without regard as to the application of a triangle solution, let us have a calculator exercise relative to the sines, cosines, and tangent buttons on the calculator.

Given angle:		**(converted to decimal degrees)**	**(get the function)**
sines			
53º 12' 43"	=	decimal 53.211944	sin = .800856231927
22º 15' 21"	=	decimal 22.255833	sin = .378742845476
30º 00' 00"	=	decimal 30.000000	sin = .500000000000
cosines			
01º 12' 30"	=	decimal 1.2083333	cosine = .999777626949
25º 30' 00"	=	decimal 25.500000	cosine = .902585284350
89º 34' 15"	=	decimal 89.570833	cosine = .007490301332
tangents			
44º 23' 45"		decimal 44.395833	tangent = .979129900235
01º 25' 36"		decimal 1.4266666	tangent = .024905178040
88º 23' 55"		decimal 88.398611	tangent = 35.7694872175

Now convert the (sin, cos and tan) inversely to the degree, minute and second via the decimal equivalent.

Trig value:		decimal equivalent:	angle equivalent:
sin	.99993421	____________________	____________________
	.34478589	____________________	____________________
	.55634892	____________________	____________________
	.75436781	____________________	____________________
	.12345678	____________________	____________________
cos	.99346521	____________________	____________________
	.00034679	____________________	____________________
	.55563289	____________________	____________________
	.21378956	____________________	____________________
	.89722331	____________________	____________________
tan	.98547832	____________________	____________________
	.35245890	____________________	____________________
	.04672981	____________________	____________________
	.87402670	____________________	____________________
	.56487912	____________________	____________________

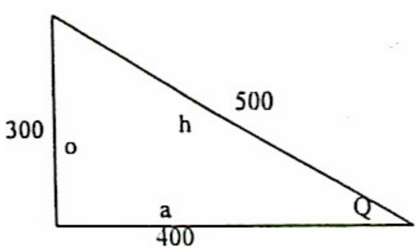
Basic Functions and the Ratio

The sine (sin) function relative to angle Q:

1) sin Q = opposite/hypotenuse sin = o/h

2) opposite = hypotenuse * sin Q o = h * sin

3) hypotenuse = opposite/sin Q h = o/sin



sin = o/h = 300/500 = .6000

o = h * sin = 500 * .60000 = 300

h = o/sin = 300/.60000 = 500

The Non-Algebraic Solution of the Right Triangle

also

Known as the Method of the Great Indian Chief SOHCAHTOA

There is a non-algebraic solution to right triangle formulas it is called the three part cover up method. See examples below.

SOH

S = O/H

Sine = Opposite / Hypotenuse

CAH

C = A/H

Cosine = Adjacent / Hypotenuse

TOA

T = O/A

Tangent = Opposite / Adjacent

<u>JUST REMEMBER THE GREAT INDIAN CHIEF'S NAME</u>**:** ***SOHCAHTOA***

Whatever function needed is covered up:

A. First draw circle as shown and enter the "o," "sin" and "h" as shown.

B. If you need the sin (angle), then cover up sin. o and h remains (opposite/hypotenuse). Because they are on different sides of the horizontal line, the answer is the product of a division.

C. If you need the o, then cover up the o, and sin and h remains. Because they are on the same side of the horizontal line, the answer is the product of a multiplication (sin*h).

D. If you need the h then cover up the h and o and sin remains (o/sin).

The answer for COS is the same as SIN, draw the circle and enter a, cos and h (adjacent, cosine and hypotenuse). Remember, when looking for cos, you are looking for an angle.

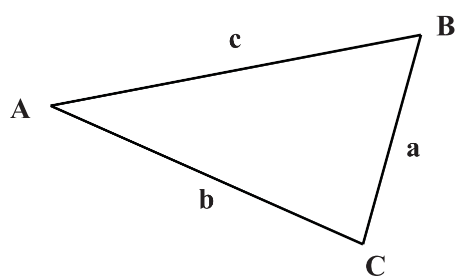
The answer for TAN is the same as SIN, draw the circle and enter “o” (opposite), “tan” and “a” (adjacent). Remember, when looking for tan, you are looking for an angle.

BASIC PRINCIPLES
Trigonometry

There are basically two triangles that are the basis of the study of Trigonometry. These are known as the right triangle and oblique triangle (the acute triangle is another form of the oblique in that the angles are not greater than 90º and the obtuse triangle where one of the three angles is greater than 90º). We have already discussed the right triangle which is the key to the whole system of computations of three sided polygons. We will now discuss the oblique triangle. The oblique triangle uses the same principles as the right triangle, but adds some new rules as we shall see below.

Oblique triangles

Oblique triangles are triangles that do not have a ninety degree angle. These triangles can be solved by subdividing them into a set of right triangles. Fortunately mathematicians have done this for us and have given us a set of formulas for solving this type of problem. Remember, however, that any oblique triangle can be solved by making several right triangles out of it. If we are given a typical oblique triangle as shown below the formulas are as follows.



THE LAW OF SINES:

$$\frac{a}{\text{Sin } A} = \frac{b}{\text{Sin } B} = \frac{c}{\text{Sin } C}$$

THE LAW OF COSINES:

$$c^2 = a^2 + b^2 - (2ab \cos C)$$

With the basic right triangle problems and the two laws stated above, most of the cadastral mapping problems can be solved. There is also a Law of Tangents which can be used. It is covered in another part of this course.

Now that we have some of the basic formulas established, let's attempt some problems. The oblique triangle shown previously will be the figure to which these problems are related.

Problem 1.

If angle C = 42º 32' 48", and angle B = 31º 54' 12", and side a = 125.34', what are the remaining values of the triangle? Find the area.

b =

c =

A =

Area =

Problem 2.

If angle A = 108º 23’ 32”, and side a = 234.56,’ and side b = 197.35’, what are the remaining values of the triangle? Find the area.

c =

B =

C =

Area =

Problem 3.

If angle B = 35º 37’ 23”, and side a = 212.67’, and side c = 274.89’, what are the remaining values of the triangle? Find the area.

A =

C =

b =

Area =

Problem 4.

If side a = 289.12', side b = 175.24', and side c = 212.34', what are the other values of the triangle? Find the area.

A =

B =

C =

Area =

Day 3

Calculating Bearing & Distances between Coordinates

Point 1: N 1320335.678
E 691417.218

(Sometimes written 1320335.678, 691417.218)

Point 2: N 1320886.597
E 691822.247

Point 3: N 1320336.631
E 691828.205

Set your calculator to have a floating decimal point. To do this hit the yellow 2^{nd} button, then hit the number 4.

Calculating for Distance between coordinates:

Distance calculation between Point1 and Point 2 above.

First you will need to figure the **change** in the Northing and Easting coordinates.
Subtract the smaller of the Northing coordinates from the larger.
Subtract the smaller of the Easting coordinates from the larger.

Change in Northing coordinates = 1320886.597 - 1320335.678= 550.919

Change in Easting coordinates = 691822.247 - 691417.218 = 405.029

You next square the two totals above for the change in the coordinates, add them together, then take the square root of that number to obtain your distance between the two points. **Do not round your figures until the final answer**.

Distance between two points = $\sqrt{550.919^2 + 405.029^2} = \sqrt{303511.7446 + 164048.4908} =$

$\sqrt{467560.2354} =$ **683.78 feet**

The distance is 683.78 feet between Point 1 and Point 2

Day 3

To solve for the bearing between two points the formula is as follows:

First you take the change in the Easting coordinates between Points 1 & 2 and divide it by the change in the northing coordinates, multiply that by Tan^{-1} (hit yellow 2^{nd} key then TAN key). You will then get a decimal degree equivalent of the bearing. You need to convert that into degrees, minutes and seconds. Then you will need to look at your grid and determine the direction of the bearing (i.e. NE, NW, SE, or SW).

Bearing calculation between Point 1 and Point 2:

$$\text{Bearing} = \text{TAN}^{-1} \times \frac{\text{Change in Easting}}{\text{Change in Northing}} = \text{Bearing of line between two points (given in decimal degrees)}$$

$$\text{Bearing} = \text{TAN}^{-1} \times \frac{405.029}{550.919} = 36.32287677 = 36^{\circ}\ 19'\ 22'' = \mathbf{N\ 36^{\circ}\ 19'\ 22''\ E}$$

(HINT: If you are using a Texas Instruments TI-30Xa calculator, to convert the decimal degrees into Deg/Min/Sec you hit the yellow 2^{nd} button
then hit the = key)

Day 3

Now solve for the bearing and distance from Point 2 to Point 3
Show your work below:

Change in Northing =
Change in Easting =

Distance =

Bearing =

Now solve for the bearing and distance from Point 3 to Point 1
Show your work below:

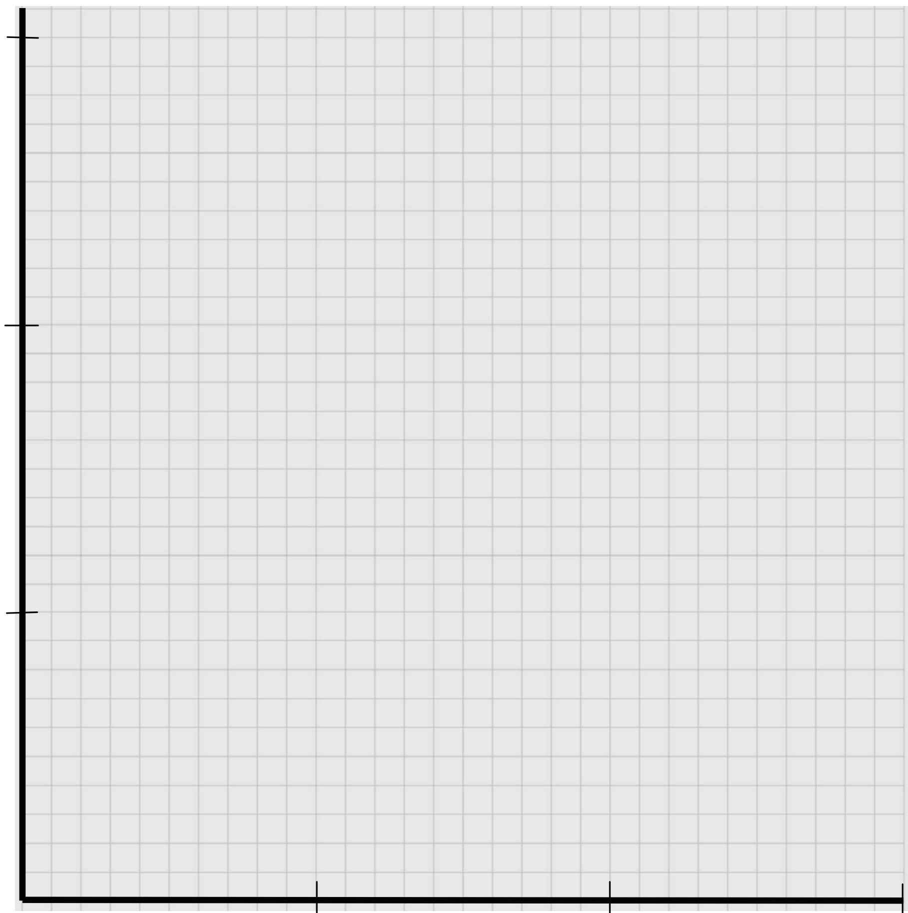
Change in Northing =
Change in Easting =

Distance =

Bearing =

Day 3 Practice

Coordinates



(X = 5000, Y = 0)

Plot the following coordinates:

Point 1:	Point2:	Point 3:
X = 300	X=300	X=326.19
Y = 5300	Y= 7946.81	Y=7946.81

12.) What is the Angle between Line 1-2 and Line 1-3?

____

13.) What is the Bearing from Point 1 to Point 3?

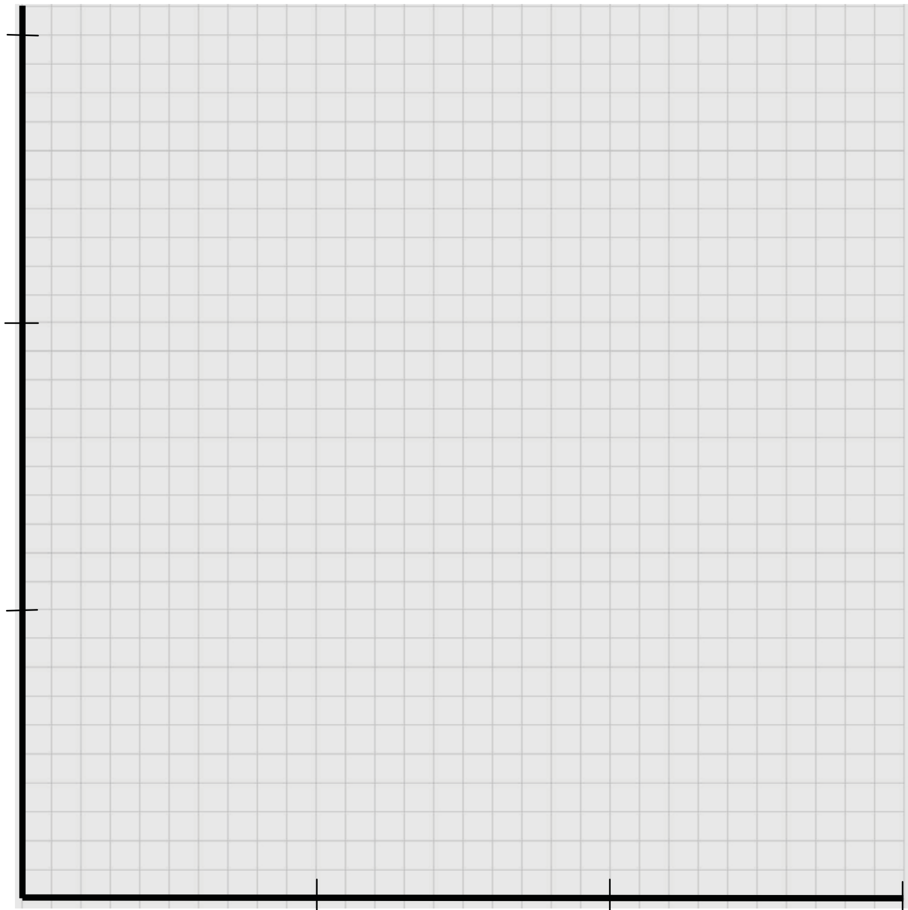
____

14.) What is the Distance from Point 1 to Point 3?

____

Day 3 Practice

Coordinates



(X = 1,400,000, Y =500,000)

Plot the following coordinates:

Point 1:	Point2:	Point 3:
X = 1,402,800	X=1,400,232.83	X=1,402,730.83
Y = 500,500	Y= 500,468.75	Y= 503,162.40

15.) What is the Angle between Line 1-2 and Line 1-3?

____

16.) What is the Angle between Line 1-2 and Line 2-3?

____

17.) What is the Angle between Line 1-3 and Line 3-2?

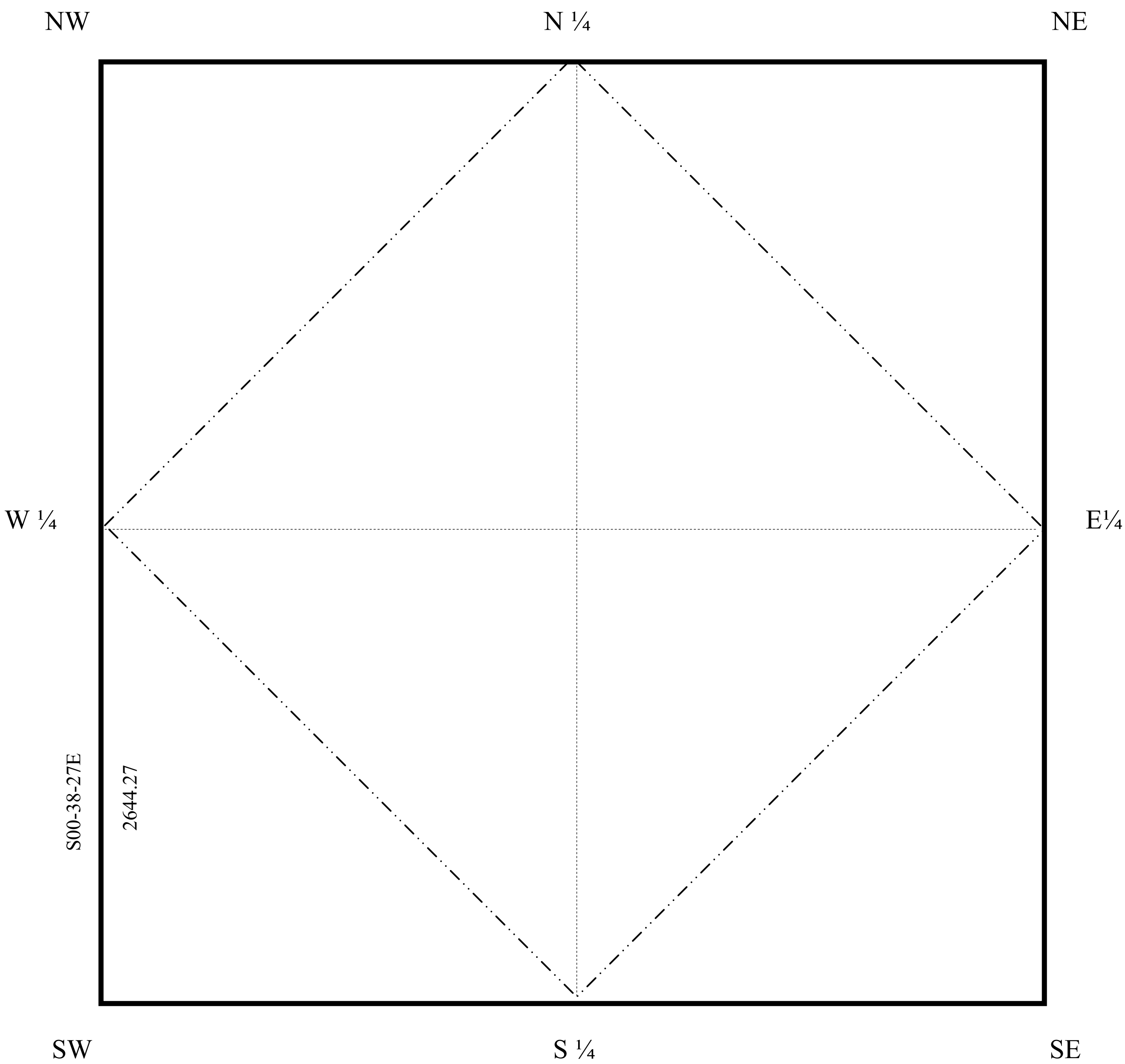
____

18.) What is the distance from Point 2 to Point 3?

____

Day 3

Case Study Worksheet
Solve for the center of the Section:



Two Corner coordinates will be furnished, as no CCR's have been filed for these locations:
West Quarter corner: **550,947.7380, 1,547,303.5317**
Southwest corner: **550,997.3100, 1,544,659.4200**

Day 4

Plats and Surveys

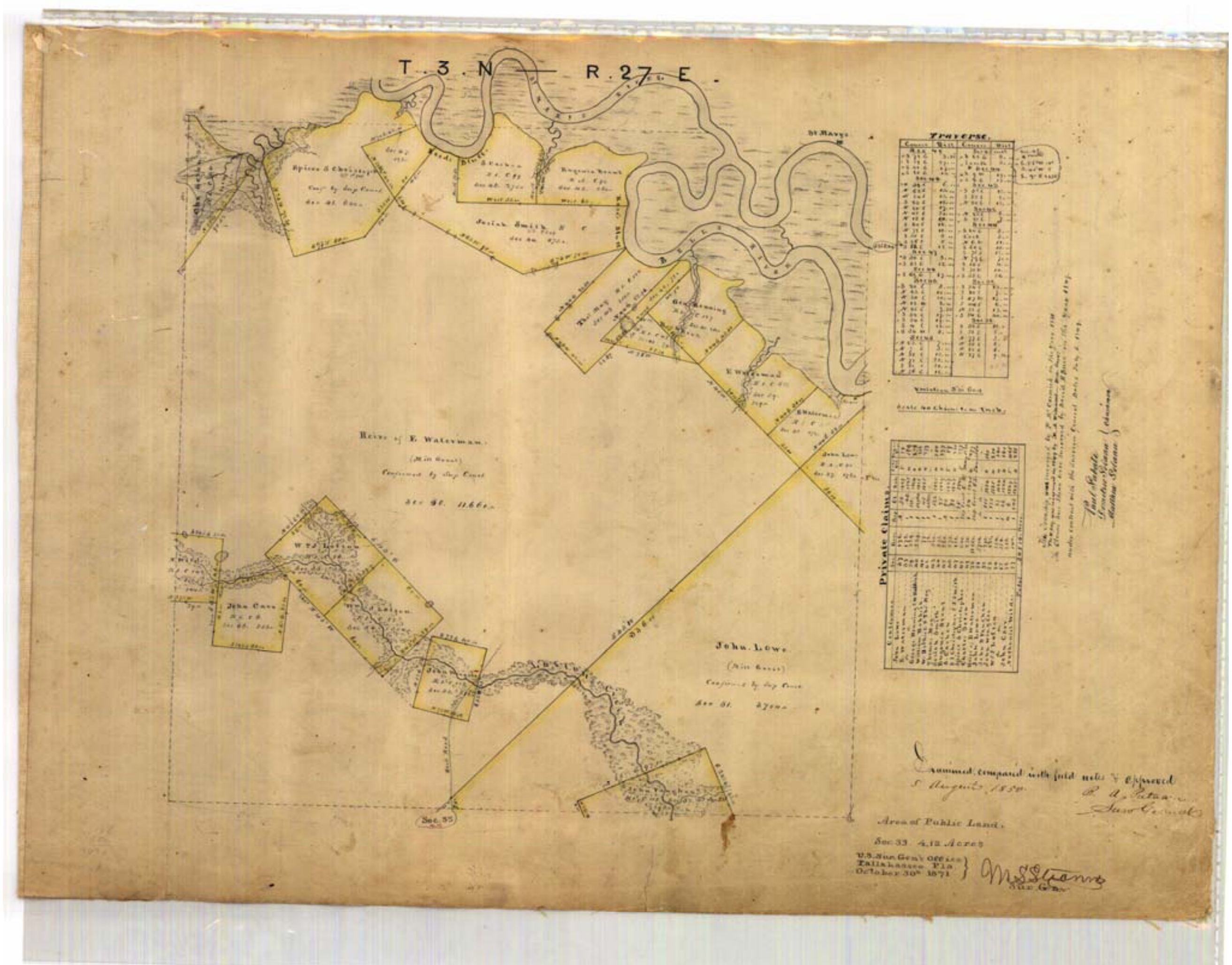
The Public Land Survey System for the Cadastral Mapper

Day 4

Intro to Plats, Surveys, and Condominiums

A **plat** is a graphical representation, drawn to scale, that indicates the divisions of a particular tract of land, with courses and distances noted for various bounds, typically noting the use(s) and containing the quantity of land encompassed.

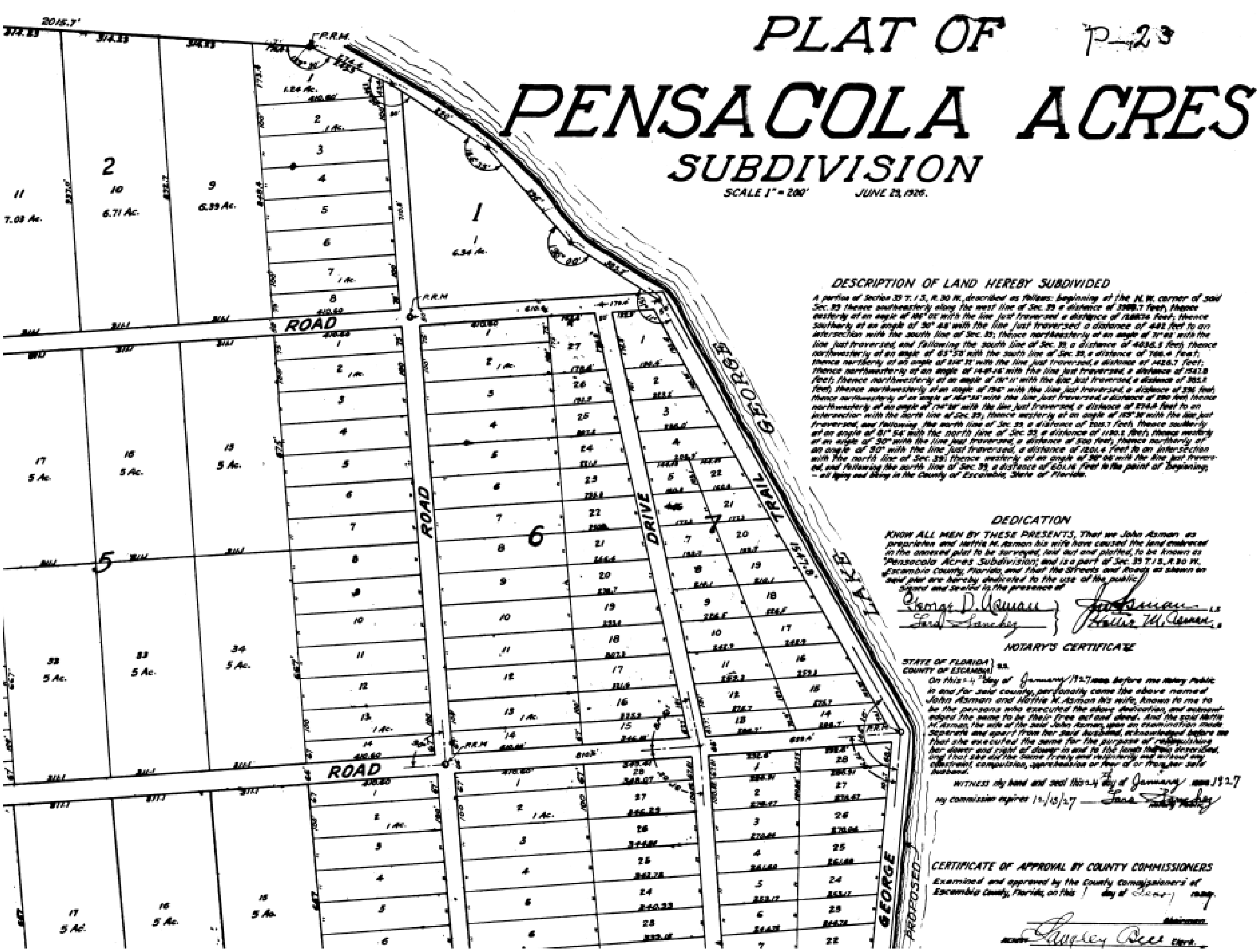
Historically speaking in the PLSS, the mapper will encounter U.S. General Land Office (GLO) township plats drawn by government surveyors subdividing the public lands; first into sections, then into smaller aliquot parts, often showing the distance and bearing between section and other survey corners, usually along meanders around bodies of water. These township plats sometimes also included topographic, vegetation, and other characteristic information, so as to be useful for the prospective purchaser.



Township 3 North, Range 27 East, Tallahassee Meridian

Day 4

Municipal plats show land typically subdivided first into blocks, then into individual lots, with streets and alleys for access. Most plats encountered are usually for the purpose of selling the described lots; this has become known as the typical “subdivision”. Most modern planning has gone away from blocks and now usually refer solely to lots of a particular subdivision. After the filing of a plat at the Clerk of the Court in a “Plat Book” or other official book, the legal descriptions referred to in a deed or other instrument can then refer simply to block and lot, and plat book and page of the recorded subdivision, rather than aliquot descriptions of sections, or lengthy metes and bounds descriptions.



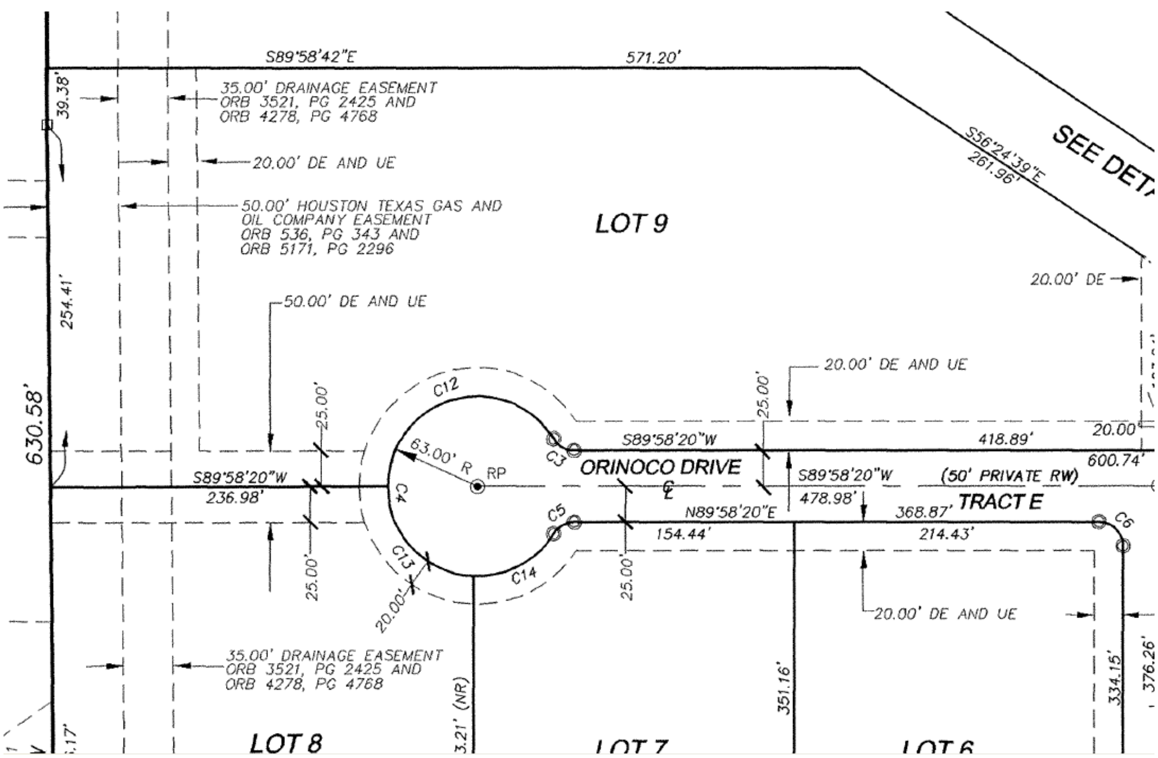
Plat Book 1, Page 23- filed Escambia County Clerk of the Circuit Court

Day 4

Reasons for platting

A local governing body such as the Board of County Commissioners, City Commission, or other applicable government must approve and accept the plat for public recording, after having met certain statutory and local requirements. This typically occurs after internal departments usually comprising the development review committee have reviewed them for local ordinance compliance.

- Creation of uniform tracts of lands, useful for residential or commercial development; typically governed by zoning and/or land use regulations.
- Designation of roads or other rights of way, ensuring that all subdivided property has access to a public right of way.
- Creation of utility, drainage, conservation, or other easements. Having these easements on the face of the plat makes them easy to find and refer to.
- Dedication of land for other public uses, such as parks, conservation, stormwater retention, etc.

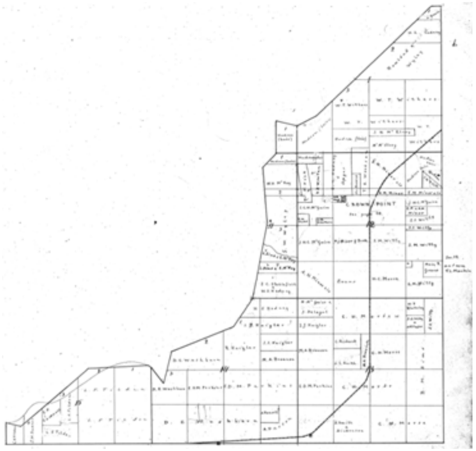


Detail of subdivision plat showing various easements

Day 4

Types of plats

A **Township Plat** covers a wide variety of map types. Originating as a group of small landholdings often agricultural in nature, the township is a formal civil legal unit, but of no specific size. The plat of which would show the various owners of land that comprised that particular township.   As the PLSS developed, the survey township became a defined unit of land to be subdivided. The plat of which would show the sub-units, or sections, of land to be sold in a graphical form. Later, as tax maps, the township plat would show both the section information, and the respective owners.



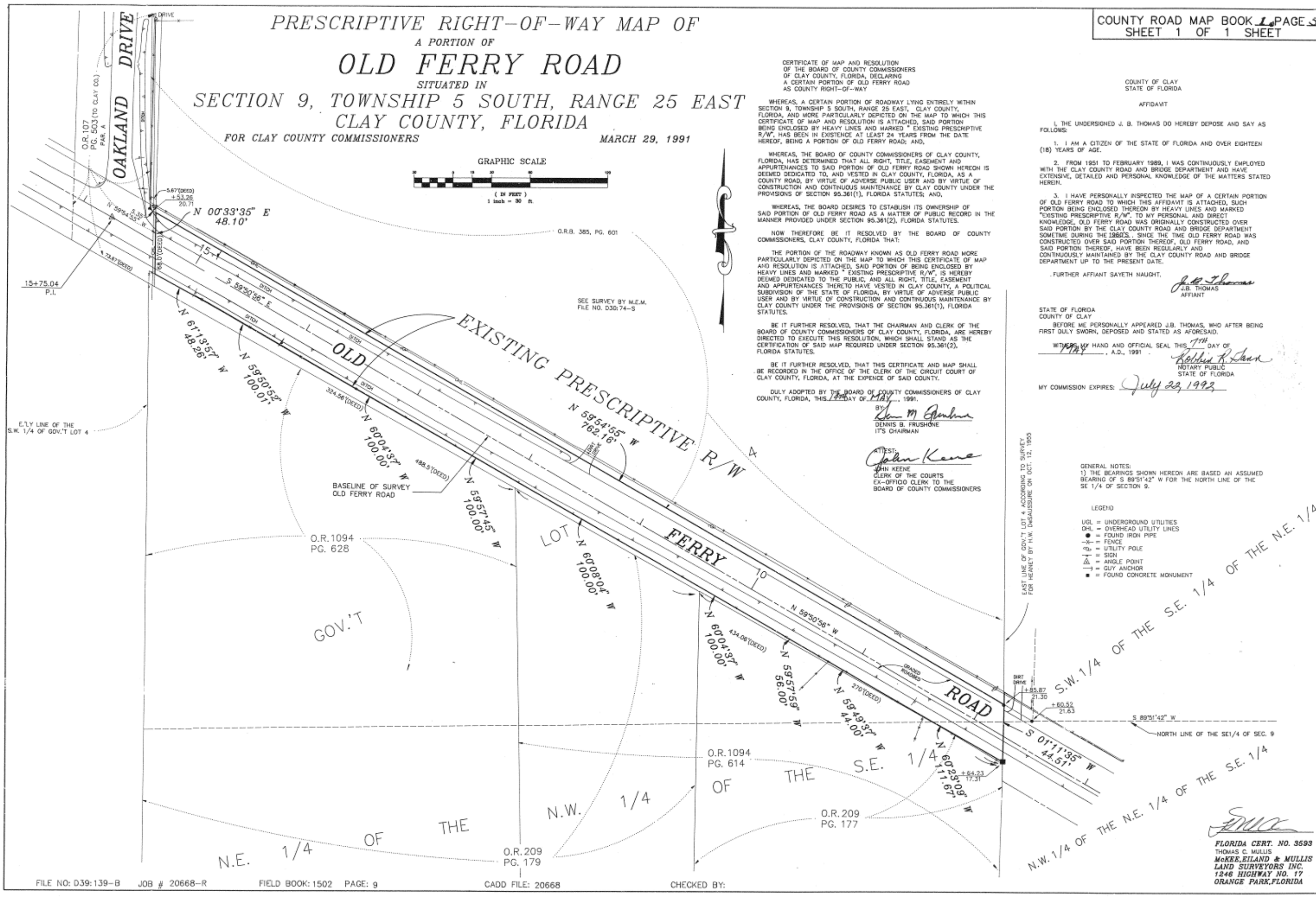
A **Subdivision Plat** occurs when a landowner divides land into smaller parcels. Typically the plat will go through a review process with the local governing authority, and comply with all existing regulations. The owner must show clear title to the land prior to subdividing, and a boundary survey must be performed and prepared under the responsible direction and supervision of a professional surveyor in order to prepare the plat.

An unrecorded subdivision is a subdivision of land that has not gone through the proper review process to meet applicable codes and regulations. Sales may have occurred based on the lot designations of the unrecorded subdivision, however there may or may not be a public record to show the layout.

Subdivisions can be vacated, in part or in their entirety, sometimes by the filing of a plat returning said lands to acreage. Often the vacation is performed by a resolution enacted by the local governing authority describing the lands to be vacated. Subdivisions can also be replatted into an entirely different configuration. The replat will have a new and different book and page in the official records, superseding the original plat. A replat is also usually used to correct a significant error, or errors, in the original plat, where a surveyor’s affidavit is insufficient.

Day 4

A **Road Plat** is typically used to show interest (fee or otherwise) in lands used for public travel. Through the common laws of right-of-way certain rights may be vested with public at large by continuous and unobstructed usages and/or maintenance for a period of time. The Road Plat will show the limits of such usage, and may ultimately be used to convey title.



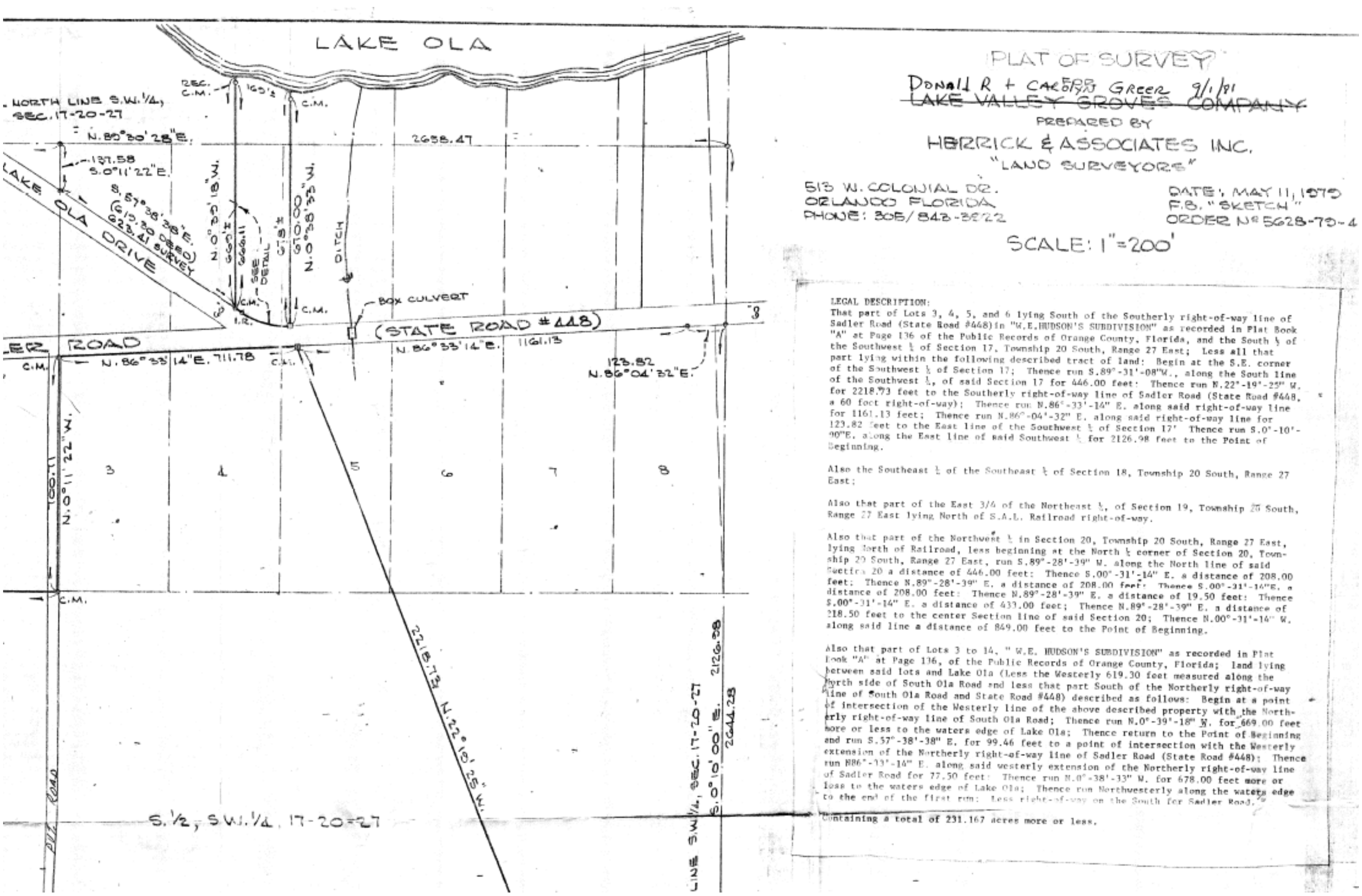
WHEREAS, THE BOARD OF COUNTY COMMISSIONERS OF CLAY COUNTY, FLORIDA, HAS DETERMINED THAT ALL RIGHT, TITLE, EASEMENT AND APPURTENANCES TO SAID PORTION OF OLD FERRY ROAD SHOWN HEREON IS DEEMED DEDICATED TO, AND VESTED IN CLAY COUNTY, FLORIDA, AS A COUNTY ROAD, BY VIRTUE OF ADVERSE PUBLIC USER AND BY VIRTUE OF CONSTRUCTION AND CONTINUOUS MAINTENANCE BY CLAY COUNTY UNDER THE PROVISIONS OF SECTION 95.361(1), FLORIDA STATUTES; AND,

WHEREAS, THE BOARD DESIRES TO ESTABLISH ITS OWNERSHIP OF SAID PORTION OF OLD FERRY ROAD AS A MATTER OF PUBLIC RECORD IN THE MANNER PROVIDED UNDER SECTION 95.361(2), FLORIDA STATUTES.

Old Ferry Road Right-of-Way Map, Clay County, FL

Day 4

A **Plat of Survey** is the graphical drawing of a particular tract of land. It may also be defined by any or all of the above, but is not limited solely to large quantities of land. A plat of survey can be for any description of land. This is a generic term used for any and all surveys.



Sample of a "Plat of Survey"

Day 4

Plats in Florida

Platting of lands in Florida is governed under Florida Statutes Chapter 177; the purpose of which is to establish minimum requirements, and create powers in local governing bodies to regulate and control such platting.

Also covered in F.S. 177 is the confirmation of the mean high-water line as recognized in the State Constitution and defined in F.S. 177.27(15) as the boundary between state sovereignty lands and uplands subject to private ownership, as well as other standards and procedures to establish datums, and determine mean high and low-water lines.

Additionally, the Statues provide a means for identification, restoration, and preservation of controlling corner monuments established during the original cadastral surveys, to which the vast majority of titles to lands in Florida are related and on which they are dependent.

Reading a plat

Contents of a Plat

Prior to recording, every plat or replat of a subdivision submitted to an approving agency of the local governing body must be accompanied by a boundary survey of the platted lands, and a title opinion of an attorney, or certification by an abstractor or title company.

Plats contain a number of informational elements:

- The Plat should have a distinct name, and a brief description of the general location by Section, Township, and Range, (or the name of the Grant or other non-PLSS identification) and the name of the city, town, or village; county, and state. The legal description will describe the property boundaries, typically indicated by bearing and distance, if not an aliquot part of a section(s), and shall be the same as in the title certification. (FS 177.051, 177.091(10))
- The Book and Page of plat filed for record. (FS 177.111)
- The Dedication will indicate the owner(s) of record, and will indicate that streets, alleys, easements, right-of-way, and public area shown on the plat, unless otherwise stated, shall be dedicated to the public for the uses and purposes thereon stated. (FS 177.081, 177.085)
- The certification blocks provide information on the surveyor and approving authorities, and the date(s) approved by each. (FS 177.071)

- There is typically a Location Map or Key Map, North Arrow, Legend, and Notes pertaining to the plat. The Notes may contain special instructions regarding tracts within the plat. (FS 177.091 (6))
- Adjoining subdivisions are referenced by Book & Page. (FS 177.091 (17))
- An easement is usually indicated by a dashed line, although it is also common to have to look them up in supplementary documents (such as a title report). (FS 177.091 (16), (28))
- Streets are usually indicated by a graphical outline of the adjoining right of way, and are required to show the street name and width. Record Book & Page are helpful. (FS 177.091 (15))

Plat Vacations

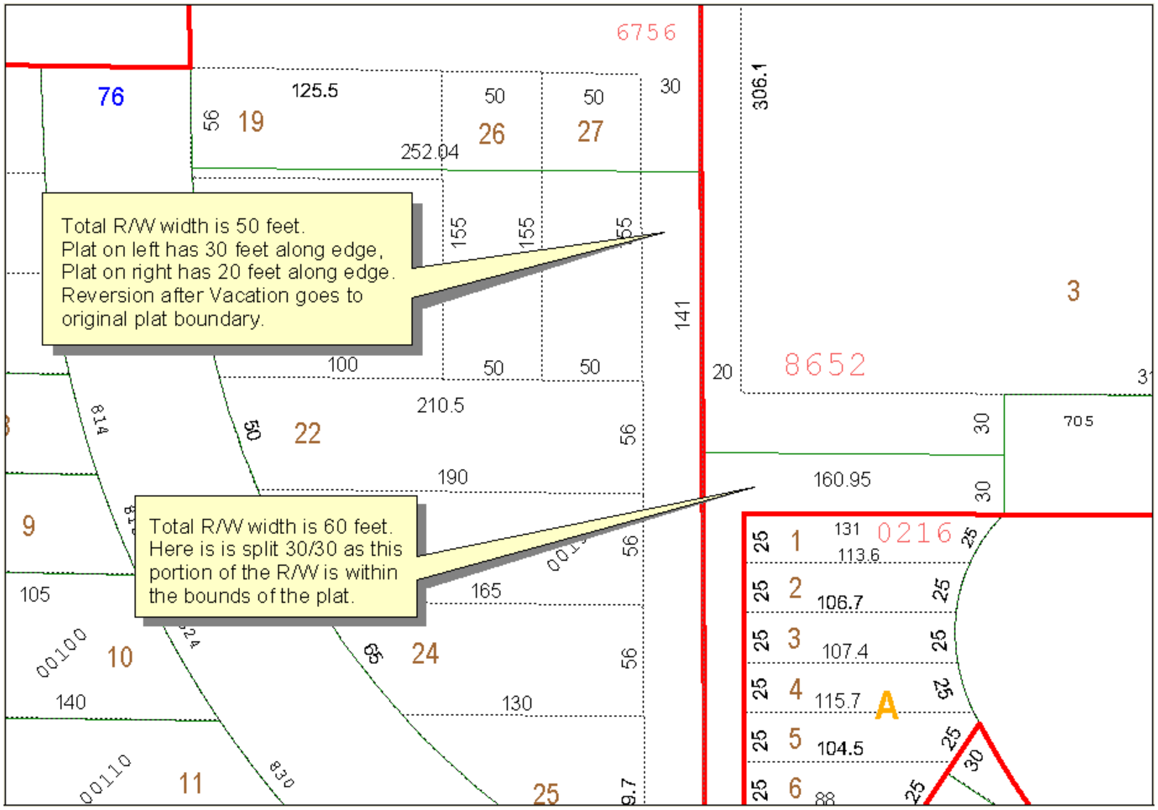
Vacating of a plat, portions thereof, or streets therein, is done for several reasons. Many plats were filed in the "land boom" times of the early part of the 20th century. Many of the plats were never realized, and in some cases no deeds were ever titled out for any of the lots. Often the parcel has been carried on the roll as a metes and bounds description, and not referenced to any plat book and page. When these lands are going to be platted (again) the first recorded plat will be vacated per FS 177.101(1).

This can also apply to a large portion of a plat similar to the above where some lands have been sold off, but re-platting of the remainder will not adversely affect the convenient access of the previously sold lands. (FS 177.101 (2)).

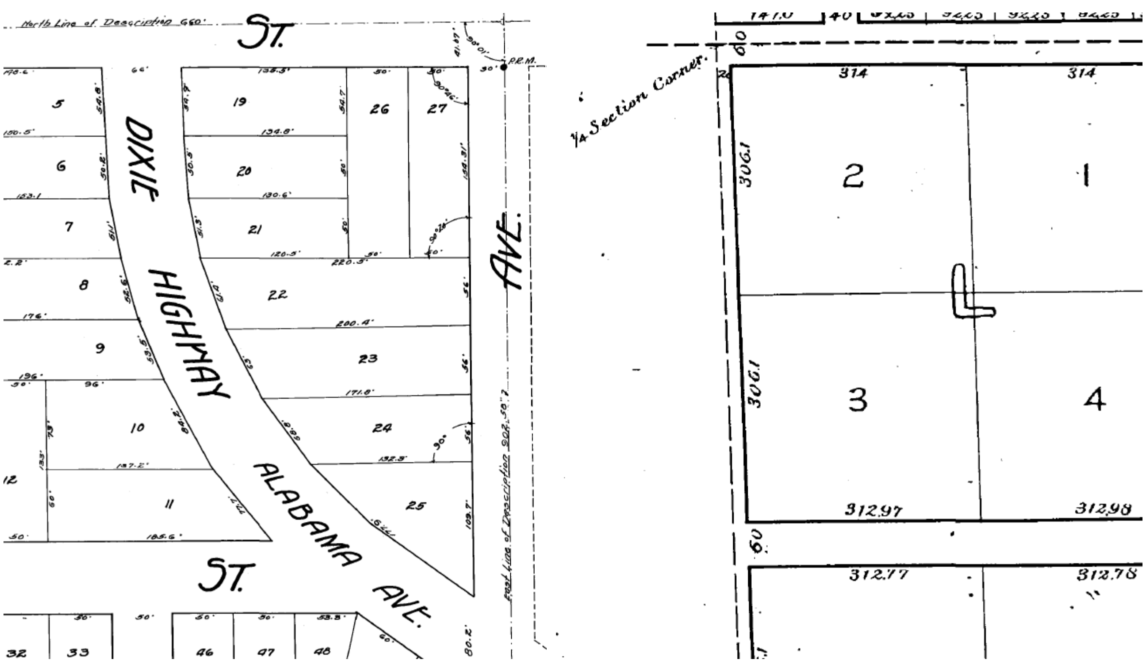
A whole or partial vacation of a plat may be enacted to return the property covered by such plats either in whole or in part into acreage so long as such vacation will not affect the ownership or right of convenient access of persons owning other parts of the subdivision. (FS 177.101 (3))

Reversionary interest of platted streets can sometime cause confusion. Generally, the rule is been that the reversionary interest of a vacated street conveys to the abutting lot owners of record, and goes to the centerline. This is true for streets internal to the plat. However, when a street along the edge of the plat is vacated, the Statute (FS 177.085) indicates, by the words "…or other appropriate boundary", that something different is happening. Here, the mapper should be aware of the actual legal description of the subdivision, and the interest held therein.

Day 4



Reversionary interest cannot convey outside of the originally owned and platted lands (with certain exceptions). See the above example for clarification.



Plat on left shows 30 feet of R/W along edge, while Plat on right shows 20 feet of R/W

Day 4

In addition to the Florida Statutes, the Florida Administrative Code (FAC) administers rules to govern certain practices in order to fulfill the statutory requirement(s). These rules are set up through the Department of State, and govern various professions including surveying and engineering.

The following are excerpts from FAC Section 5J-17 that pertain to platting:

5J-17.050 Definitions.

(10) Survey: the orderly process of determining facts of size, shape, identity, geodetic location, or legal location by viewing and applying direct measurement of features on or near the earth's surface using field or image methods; defined as follows according to the type of data obtained, the methods used, and the purpose(s) to be served:

(b) Boundary Survey: a survey, the primary purpose of which is to document the perimeters, or any one of them, of a parcel or tract of land by establishing or re-establishing corners, monuments, and boundary lines for the purposes of describing the parcel, locating fixed improvements on the parcel, dividing the parcel, or platting.

5J-17.051 General Survey, Map, and Report Content Requirements.

5J-17.052 Specific Survey, Map, and Report Requirements.

(2) Boundary Survey, Map, and Report:

(a) Boundaries of Real Property:

7. Surveys of all or part of a lot(s) which is part of a recorded subdivision shall show the following upon the map:

a. The lot(s) and block numbers or other designations, including those of adjoining lots.

b. A comparison between recorded directions and distances with field measured directions and distances when they vary.

c. A comparison between the recorded directions and distances with field measured directions and distances to the nearest street intersection, right of way intersection or other identifiable reference point.

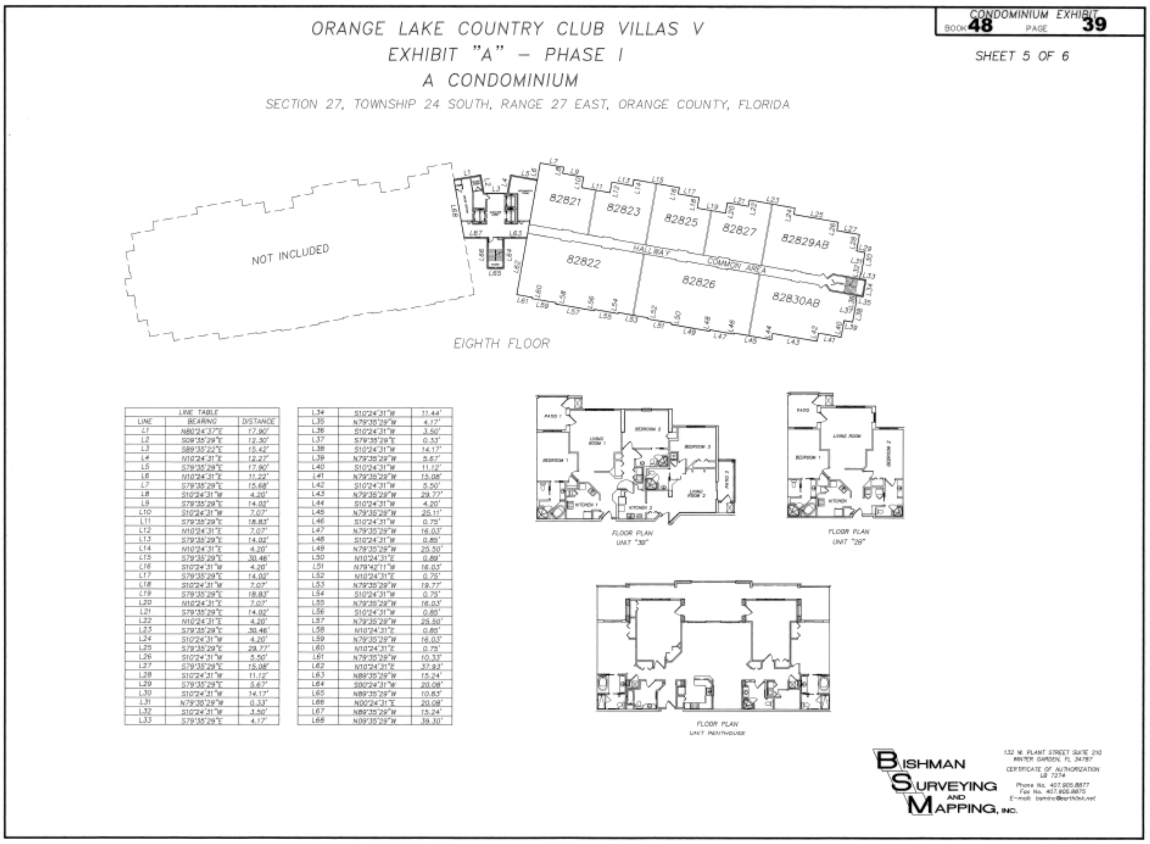
d. The dimensioned remaining portion of a lot(s) when part of a lot is included within the description.

Day 4

Condominiums

A condominium is defined as form of ownership of real property which is comprised entirely of units that may be owned by one or more persons, and in which there is, appurtenant to each unit, an undivided share in the common elements.

The common elements are those parts of the real property, land and building that are not defined as a ‘unit’. The unit is defined as a part of the condominium property that is subject to exclusive ownership, and is specified in the declaration. It is usually, but not always, accompanied by a graphical representation of the property defined therein.



Sample of a floor plan and unit layout

While some condominiums are filed in books similar to plats, it is not true of the time. However, a ‘Declaration of Condominium’ will be filed in the Public Records. Rules and Statutes for Condominiums are not as strict as they are for plats, so there is a lot more variation on what can be found in the public records. F.S 718 gives recognition to the condominium form of ownership of real property.

Day 4

Review Questions

1. Which particular Florida Statue covers the subdivision platting requirements?.

   a.) 193 b) 718 c) 695 d) 177

2. Name 4 reasons for subdividing land through the platting process.
   1.
   2.
   3.
   4.

3. True/False – A replat can be used to correct a significant error, or errors, in the original plat.

4. True/False – Road plats show the limits of usage and maintenance for a particularly defined segment of road.

5. True/False – Unrecorded plats typically have gone through the proper County processes.

6. Name 4 elements that a plat should contain:
   1.
   2.
   3.
   4.

7. True/False – When any street in a plat is vacated, the reverted interest is always split down the middle of the road, with half going to one side, and half going to the other.

8. The initials FAC stand for what? Which section of the FAC pertains to surveying?

9. True/False – The unit of a condominium has an undivided share in the common elements.

10. Which particular Florida Statue covers condominium requirements?

    a) 193 b) 718 c) 695 d) 177

Appendix

A. Words & Definitions

“Alley” means a right-of-way providing a secondary means of access and service to abutting property.

“Block” includes “tier” or “group” and means a group of lots existing within well-defined and fixed boundaries, usually being an area surrounded by streets or other physical barriers and having an assigned number, letter, or other name through which it may be identified.

“Common elements” means the portions of the condominium property not included in the units.

“Condominium” means that form of ownership of real property created pursuant to this chapter, which is comprised entirely of units that may be owned by one or more persons, and in which there is, appurtenant to each unit, an undivided share in common elements.

“Easement” means any strip of land created by a subdivider for public or private utilities, drainage, sanitation, or other specified uses having limitations, the title to which shall remain in the name of the property owner, subject to the right of use designated in the reservation of the servitude.

“Lot” includes tract or parcel and means the least fractional part of subdivided lands having limited fixed boundaries, and an assigned number, letter, or other name through which it may be identified.

“P.C.P.” means permanent control point

“P.R.M.” means a permanent reference monument

“PLSS” – Public Land Survey System

“Plat” - a plan or map, as of land.

“Right-of-way” means land dedicated, deeded, used, or to be used for a street, alley, walkway, boulevard, drainage facility, access for ingress and egress, or other purpose by the public, certain designated individuals, or governing bodies.

“Street” includes any access way such as a street, road, lane, highway, avenue, boulevard, alley, parkway, viaduct, circle, court, terrace, place, or cul-de-sac, and also includes all of the land lying between the right-of-way lines as delineated on a plat showing such streets, whether improved or unimproved, but shall not include those access ways such as easements and rights-of-way intended solely for limited utility purposes, such as for electric power lines, gas lines, telephone lines, water lines, drainage and sanitary sewers, and easements of ingress and egress.

“Subdivision” means the division of land into three or more lots, parcels, tracts, tiers, blocks, sites, units, or any other division of land; and includes establishment of new streets and alleys, additions, and resubdivisions; and, when appropriate to the context, relates to the process of subdividing or to the lands or area subdivided.

“Survey” - to determine the exact form, boundaries, position, extent, etc., of (a tract of land, section of a country, etc.) by linear and angular measurements and the application of the principles of geometry and trigonometry.

“State plane coordinates” means the system of plane coordinates which has been established by the National Ocean Service for defining and stating the positions or locations of points on the surface of the earth within the state and shall hereinafter be known and designated as the “Florida State Plane Coordinate System.” For the purpose of the use of this system, the zones established by the National Ocean Service in NOAA Manual NOS NGS 5, State Plane Coordinate System of 1983, shall be used, and the appropriate projection and zone designation shall be indicated and included in any description using the Florida State Plane Coordinate System.

“TIITF” - Trustees of the Internal Improvement Trust Fund

Appendix

B. Florida Statutes and Florida Administrative Codes

that Cadastral Mappers should be aware of:

F.S. 95.16 Real property actions; adverse possession under color of title.
F.S. 95.18 Real property actions; adverse possession without color of title.
F.S. 95.361 Roads presumed to be dedicated.
F.S. 177 Land Boundaries, subsections 177.011-177.151 (Platting)
F.S. 192.011 All property to be assessed.
F.S. 192.032 Situs of property for assessment purposes
F.S. 193.011 Factors to consider in deriving just valuation.
F.S. 193.085 Listing all property.
F.S. 193.114 Preparation of assessment rolls
F.S. 195.002 Supervision by Department of Revenue
F.S. 195.022 Forms to be prescribed by Department of Revenue.
F.S. 195.027 Rules and regulations
F.S. 195.062 Manual of instructions
F.S. 197.192 Land not to be divided or plat filed until taxes paid.
F.S. 253 State Lands
Title XL Real and Personal Property Chapters 689-723, incl:
F.S. 689 Conveyances of Land and Declarations of Trust
F.S. 695 Record of Conveyances of Real Estate
F.S. 704 Easements (there is always a right to get to your parcel when it is landlocked)
F.S. 718 Condominiums

http://www.leg.state.fl.us/Statutes/index.cfm?Mode=Constitution&Submenu=3&Tab=statutes

F.A.C. 12D-1.009 Mapping Requirements. (See DOR Cadastral Mapping Guidelines)
F.A.C. 12D-8 Assessment Roll Preparation and Approval.
F.A.C. 5J-17.050, 17.051, & 17.052 Minimum Technical Standards for surveys

https://www.flrules.org/Default.asp

Appendix

C. Summary of Florida Land Ownership Events

Pre-history To 1513	Native Americans
April 2, 1513	Ponce de Leon claimed *La Florida* for Spain
Feb 10, 1763 - Sep 3, 1783	British control territory of Florida
Sep 3, 1783 – Feb 22, 1821	Spain regains control of Florida
February 22, 1821	Florida acquired from Spain by U.S.
March 4, 1824	Territory of Florida established
April 22, 1826	Right of Pre-emption Act
August 4, 1842	Armed Occupation Act passed
March 3, 1845	Florida Statehood
Sep 28, 1850	Swamp and Overflowed Lands Act
May 20, 1862 (revised 1866)	Homestead Act.
May 27 – Aug 24, 1908	Closing Gov. Land Office in Florida.

OFFICE OF SURVEYOR GENERAL OF FLORIDA

Name	Appointment or Date of Commission	Remarks
Robert A. Butler	July 9,1824	Office opened at Tallahassee
Valentine Y. Conway	March 17,1842	Office moved to St. Augustine (October 6,1843)
Robert A. Butler	August 11,1845	
Benjamin A. Putnam	April 11,1849	
John Westcott	April 29,1853	
Francis L. Dancy	May 13,1858	
M. L. Stearns	April 17,1869	Office moved to Tallahassee
Joshua W. Gilbert	March 18,1873	
LeRoy D. Ball	May 11,1875	
Malachi Martin	March 1,1881	
William H. Hicks	November21,1884	
James F. McClellan	April 27,1885	
William D. Bloxham	November 14,1885	
John C. Slocum	October 28,1889	
William H. Milton Jr.	April 12,1894	
Richard L. Scarlett	October 29,1897	
Edmund C. Weeks	March 5,1902	
Charles H. Parlin	May 4,1906	Office closed June 30,1908

Records transferred to State of Florida on August 24,1908.

Appendix

General Instructions Issued to Surveyor General by Year:

1819
1831
1842
1845
1850
1855
1864
1881
1890
1894
1902
1973

DEP - Division of State Lands link:
http://www.dep.state.fl.us/mainpage/programs/lands.htm

Here some other DEP links:
http://www.dep.state.fl.us/lands/info/history.htm

http://www.dep.state.fl.us/lands/surv_map/default.htm

http://www.dep.state.fl.us/lands/title/default.htm

Appendix

D. Linear Measure / Long Measure

1	Mile	=	80	Chains
		=	320	Rods
		=	5,280	Feet
1	Gunter Chain	=	4	Rods
			66	Feet
			100	Links
1	Rod	=	5 1/2	Yards
			16 1/2	Feet
			25	Links
1	Link	=	0.66	Feet
			7 7/8	Inches
1	Pole	=	16 1/2	Feet

Square Measure

1	Sq Mile	=	640	Acres			
1	Acre	=	10	Sq Chains			
			160	Sq Rods			
			43,560	Sq Feet			
1	Sq Rod	=	30.25	Sq Yards			
			272.25	Sq Feet			
1	Sq Foot	=	144	Sq Inches			
1	Furlong	=	220	Yards	=	1/8	Mile

Appendix

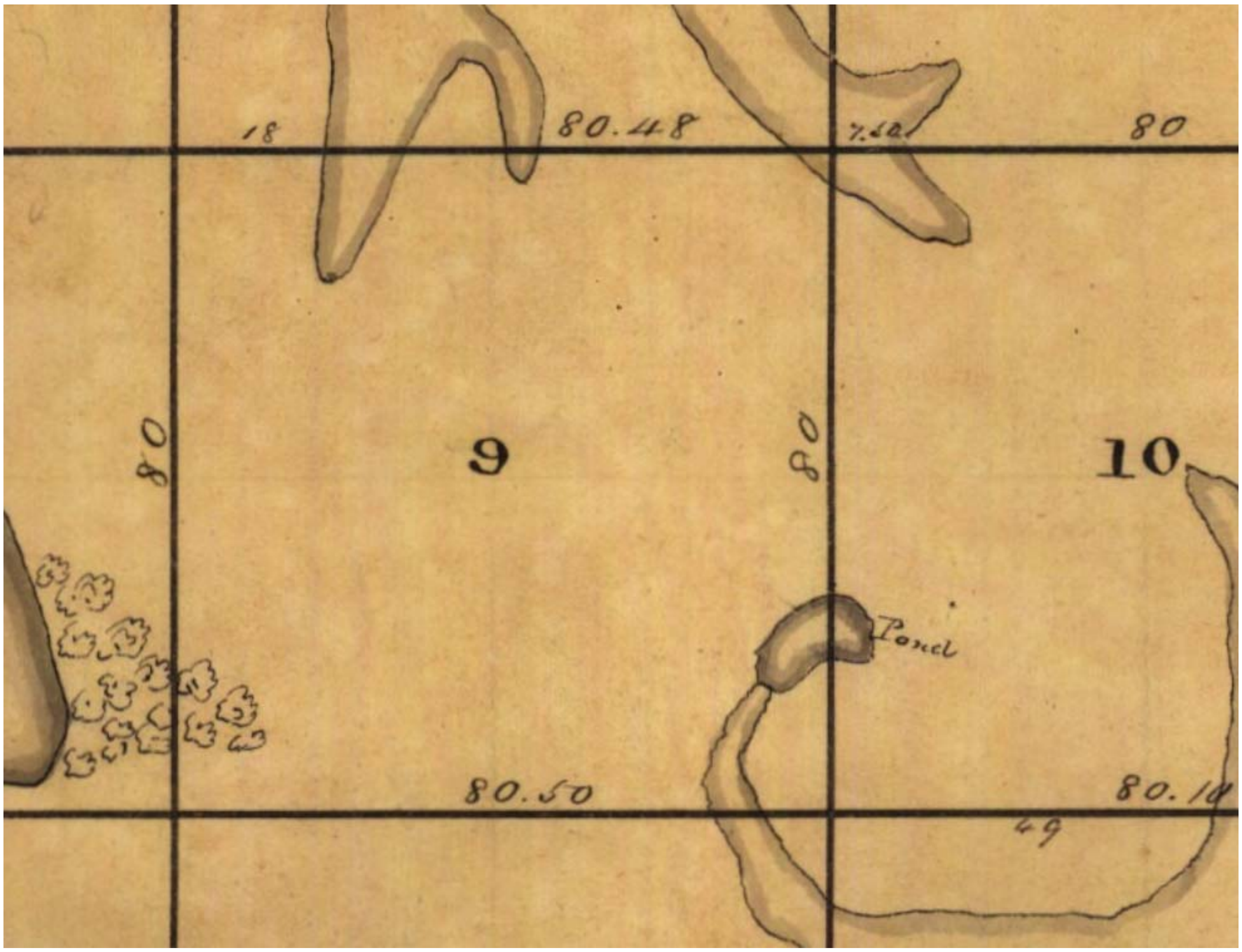
E. Case Study Information and Data:

Two Corner coordinates will be furnished, as no CCR's have been filed for these locations:

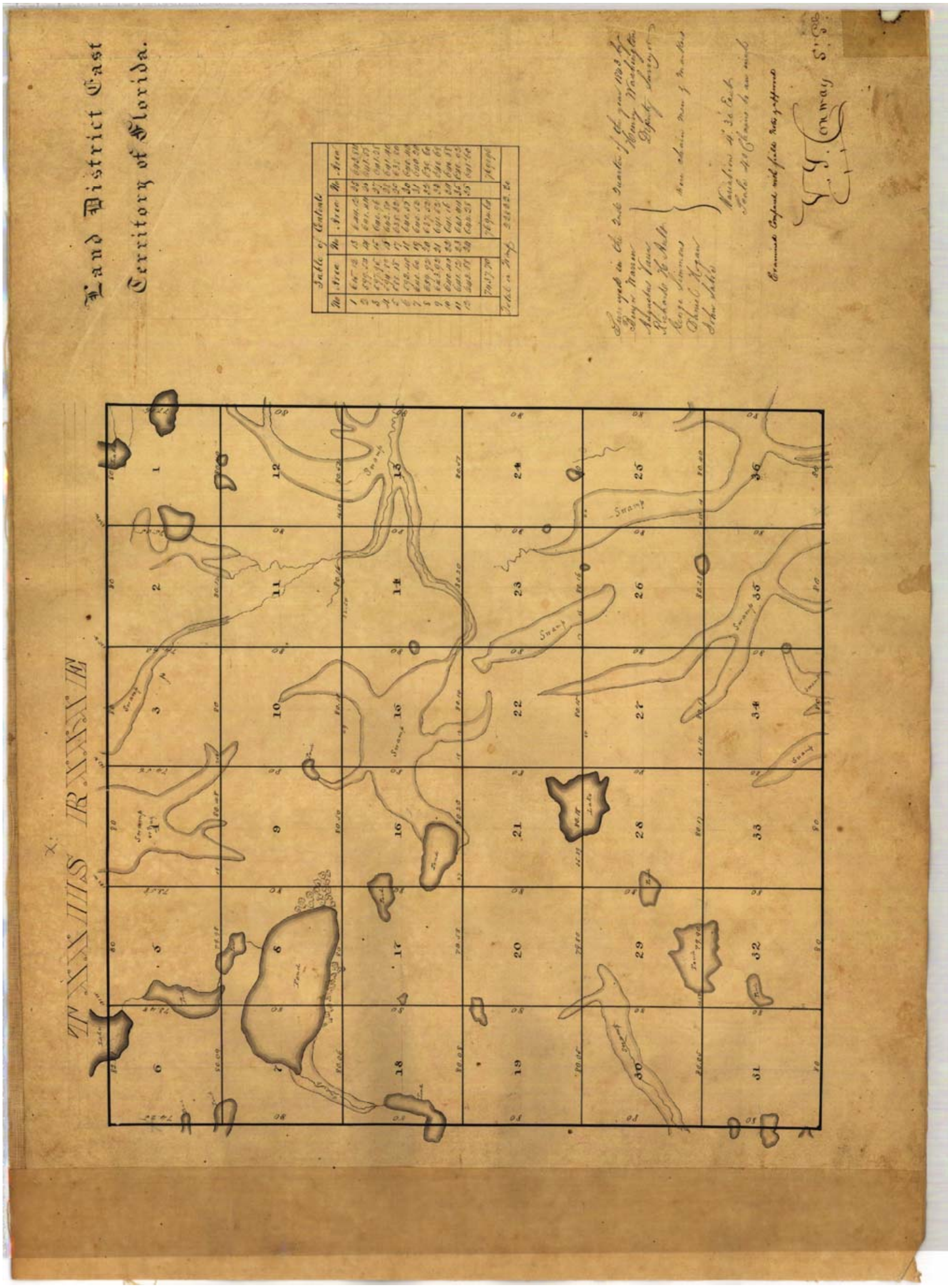
Section 9, Township 22 South, Range 30 East – West Quarter corner: **550,947.7380, 1,547,303.5317**

Section 9, Township 22 South, Range 30 East – Southwest corner: **550,997.3100, 1,544,659.4200**

The remaining corners have CCR's and are contained in this appendix. Use the coordinates as shown on those corners.



Detail of Section 9, Township 22 South, Range 30 East Tallahassee Meridian



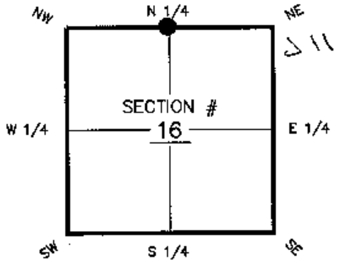
Original government survey plat for Township 22 South, Range 30 East Tallahassee Meridian

DOC. # 071707

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
CERTIFIED CORNER RECORD

CORNER DESCRIPTION:

Depict corner with ●



N.1/4 corner of Section 16
Twp 22 South, Rge 30 East
Tallahassee Base Meridian,
Orange County(s), Florida

MONUMENTATION DESCRIPTION (EVIDENCE FOUND OR METHOD TO SET)

SEE CERTIFIED CORNER RECORD NUMBER 061826

FOUND 5/8" IRON BAR & CAP "R.E.P.S. LB 4741"

Comments:
The purpose of this certified corner record is to record state plane coordinate values on the previous certified corner record referenced above. No attempt was made to prove the validity of the location as shown on said previous existing certified corner.

HORIZONTAL POSITION AND HEIGHT INFORMATION (if determined):

Latitude N 28° 34' 58.52483" Longitude W 81° 19' 10.18665"

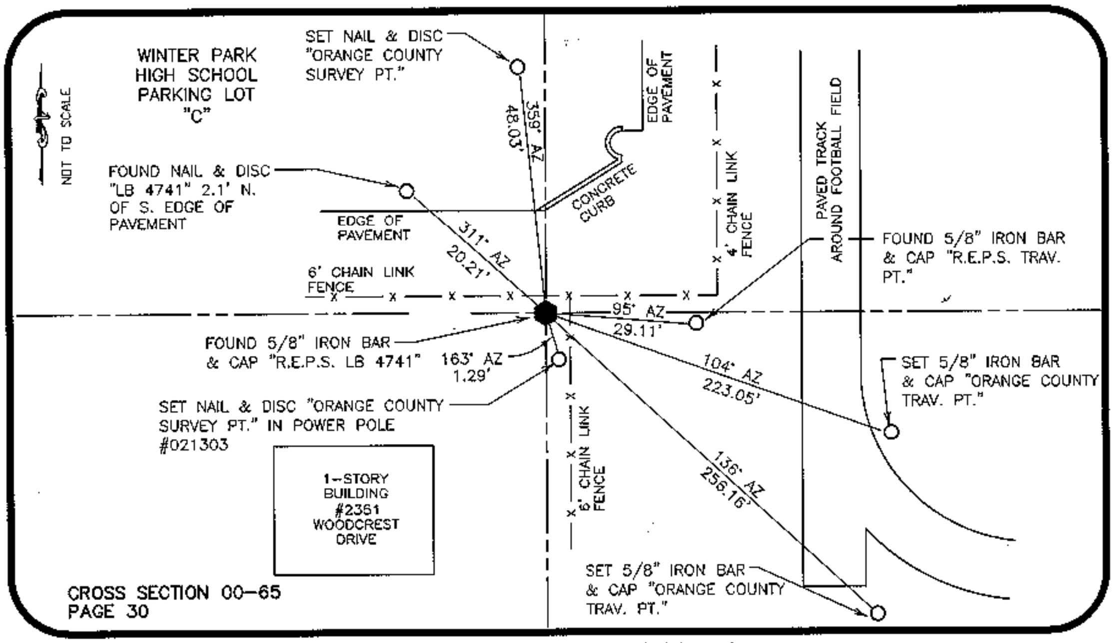
Y(NORTHING–Ft.) 1544776.7643 X(EASTING–Ft.) 553628.2708 Zone FL East

Convergence –00° 09' 10.29" Scale factor 0.9999532303

Coordinate determination (circle one): Field traverse GPS

Horizontal datum (circle one): NAD27 NAD83(1986) NAD83(1990) other (explain)

Accuracy (circle one): 1st 2nd 3rd other ______



Please complete sketch in black ink or type.

SURVEYORS CERTIFICATE:

I certify the monument and accessories indicated above were field located on JANUARY 5, 2001

George W. Masser (SIGNATURE)	4307 (PSM NO.)
04-18-01 (DATE)	
Jones, Wood & Gentry, Inc. (FIRM OR AGENCY)	1 (LB NO.)
136 East Robinson Street (ADDRESS)	
Orlando (CITY)	Florida (STATE) 32801 (ZIP)

EMBOSSED SEAL OVER SIGNATURE

SEND ORIGINAL TO:
Department of Environmental Protection
Bureau of Survey and Mapping
3900 Commonwealth Boulevard
Mail Station 105
Tallahassee, Florida 32399

D.E.P. USE ONLY

Completeness checked by: CS

Accepted and filed: 6-1-01 Date

B.L.M. – I.D. 340500

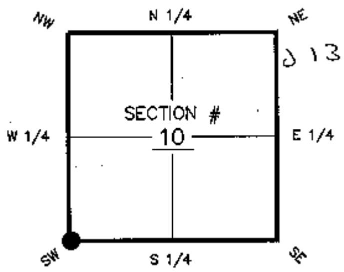
QUAD – I.D. 1064 Orlando East

DOC. # 071691

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
CERTIFIED CORNER RECORD

CORNER DESCRIPTION:

Depict corner with ●



SW. corner of Section 10 Twp 22 South, Rge 30 East Tallahassee Base Meridian, Orange County(s), Florida

MONUMENTATION DESCRIPTION (EVIDENCE FOUND OR METHOD TO SET)

SEE CERTIFIED CORNER RECORD NUMBER 0032366

FOUND 6"x 6" CONCRETE MONUMENT WITH 1-1/4" IRON PIPE WITH PUNCH HOLE

313

Comments:
The purpose of this certified corner record is to record state plane coordinate values on the previous certified corner record referenced above. No attempt was made to prove the validity of the location as shown on said previous existing certified corner.

HORIZONTAL POSITION AND HEIGHT INFORMATION (if determined):

Latitude N 28° 34' 57.26324" Longitude W 81° 18' 39.56649"

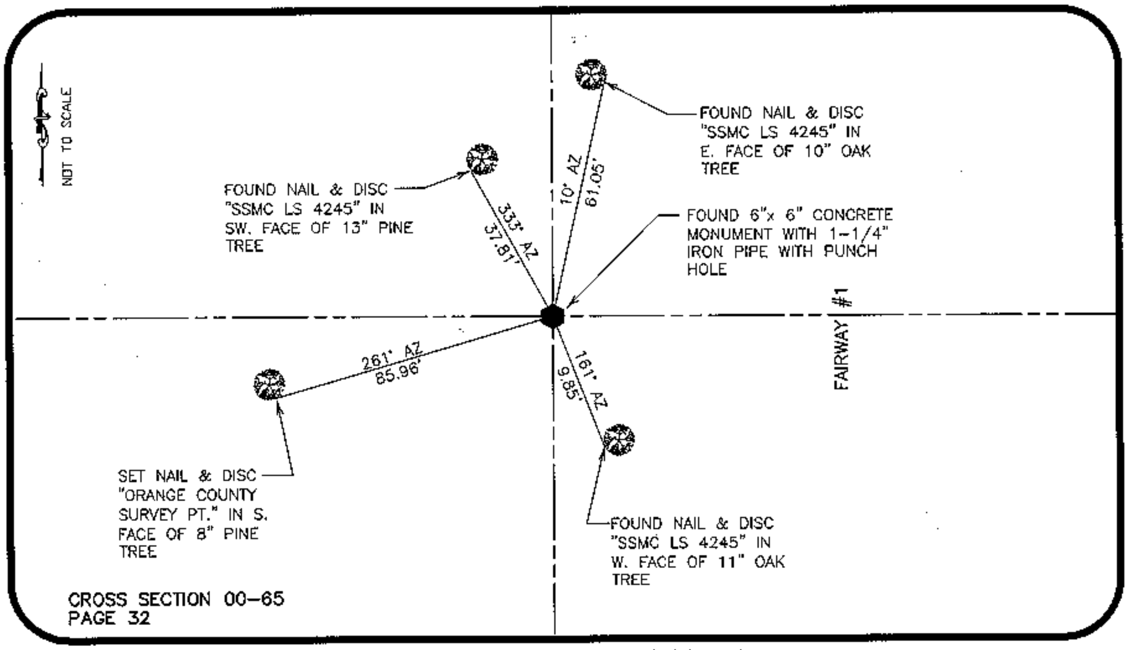
Y(NORTHING-Ft.) 1544642.1606 X(EASTING-Ft.) 556357.7223 Zone FL East

Convergence -00° 08' 55.63" Scale factor 0.9999525973

Coordinate determination (circle one): Field traverse GPS

Horizontal datum (circle one): NAD27 NAD83(1986) NAD83(1990) other (explain)

Accuracy (circle one): 1st 2nd 3rd other ________



Please complete sketch in black ink or type.

SURVEYORS CERTIFICATE:

I certify the monument and accessories indicated above were field located on JANUARY 8, 2001

George W. Massey (SIGNATURE)	4307 (PSM NO.)
04-18-01 (DATE)	
Jones, Wood & Gentry, Inc. (FIRM OR AGENCY)	1 (LB NO.)
156 East Robinson Street (ADDRESS)	
Orlando (CITY)	Florida (STATE) 32801 (ZIP)

EMBOSSED SEAL OVER SIGNATURE

SEND ORIGINAL TO:
Department of Environmental Protection
Bureau of Survey and Mapping
3900 Commonwealth Boulevard
Mail Station 105
Tallahassee, Florida 32399

D.E.P. USE ONLY

Completeness checked by: CS

Accepted and filed: 6-01-01 Date

B.L.M. - I.D. 400500

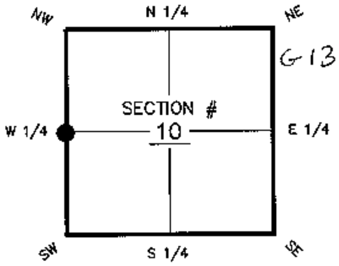
QUAD - I.D. 1064 orlando East

DOC. # 071692

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
CERTIFIED CORNER RECORD

CORNER DESCRIPTION:

Depict corner with ●



G 13

W 1/4 corner of Section 10
Twp 22 South, Rge 30 East
Tallahassee Base Meridian,
Orange County(s), Florida

MONUMENTATION DESCRIPTION (EVIDENCE FOUND OR METHOD TO SET)

SEE CERTIFIED CORNER RECORD NUMBER 0032367, 0020115

FOUND RAILROAD SPIKE WITH "X-CUT"

Comments:
The purpose of this certified corner record is to record state plane coordinate values on the previous certified corner record referericed above. No attempt was made to prove the validity of the location as shown on said previous existing certified corner.

HORIZONTAL POSITION AND HEIGHT INFORMATION (if determined):

Latitude N 28° 35' 23.33884" Longitude W 81° 18' 40.43102"

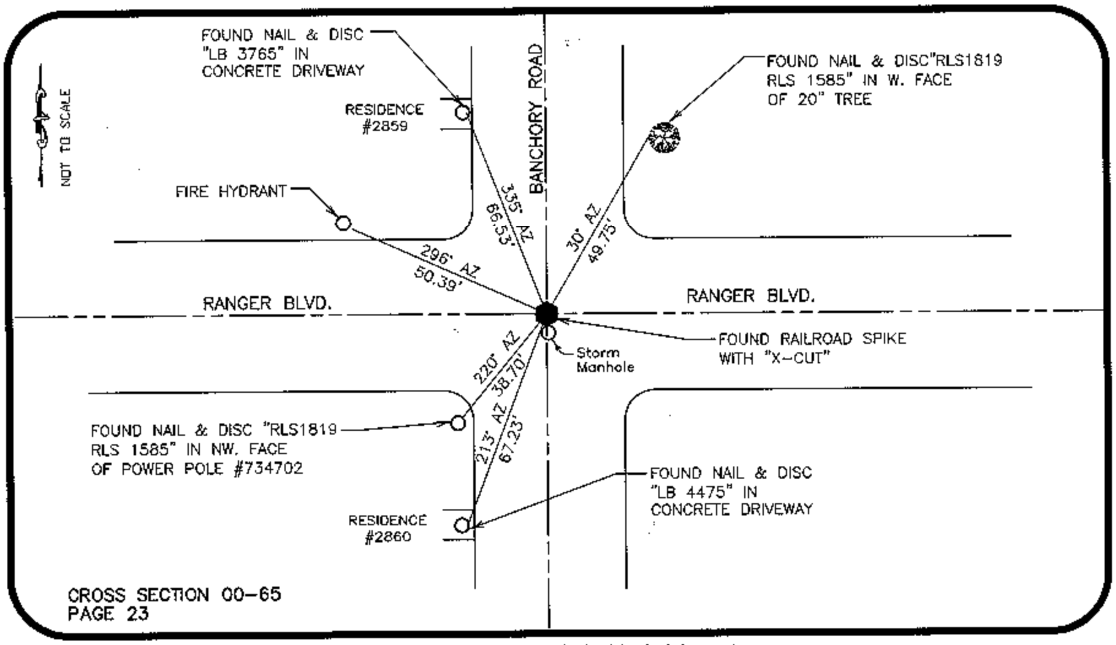
Y(NORTHING-Ft.) 1547275.9448 X(EASTING-Ft.) 556287.4946 Zone FL East

Convergence -00° 08' 56.17" Scale factor 0.9999526134

Coordinate determination (circle one): Field traverse GPS

Horizontal datum (circle one): NAD27 NAD83(1986) NAD83(1990) other (explain)

Accuracy (circle one): 1st 2nd 3rd other ______



Please complete sketch in black ink or type.

SURVEYORS CERTIFICATE:

I certify the monument and accessories indicated above were field located on DECEMBER 27, 2000

George W. Massey — SIGNATURE — 4307 PSM NO.

04-18-01 DATE

Jones, Wood & Gentry, Inc. — FIRM OR AGENCY — 1 LB NO.

136 East Robinson Street — ADDRESS

Orlando — CITY — Florida — STATE — 32801 — ZIP

EMBOSSED SEAL OVER SIGNATURE

SEND ORIGINAL TO:
Department of Environmental Protection
Bureau of Survey and Mapping
3900 Commonwealth Boulevard
Mail Station 105
Tallahassee, Florida 32399

D.E.P. USE ONLY

Completeness checked by: CS

Accepted and filed: 6 1 01 Date

B.L.M. - I.D. 400540

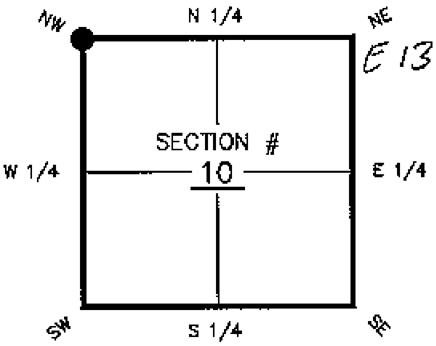
QUAD - I.D. 1064 Orlando East

DOC. # 071687

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
CERTIFIED CORNER RECORD

CORNER DESCRIPTION:

Depict corner with ●



NW corner of Section 10 Twp 22 South, Rge 30 East Tallahassee Base Meridian, Orange County(s), Florida

MONUMENTATION DESCRIPTION (EVIDENCE FOUND OR METHOD TO SET)

SEE CERTIFIED CORNER RECORD NUMBER 0028646, 0016751, 0020113, 0032363

FOUND RAILROAD SPIKE

Comments:
The purpose of this certified corner record is to record state plane coordinate values on the previous certified corner record referenced above. No attempt was made to prove the validity of the location as shown on said previous existing certified corner.

HORIZONTAL POSITION AND HEIGHT INFORMATION (if determined):

Latitude N 28° 35' 49.68581" Longitude W 81° 18' 40.98654"

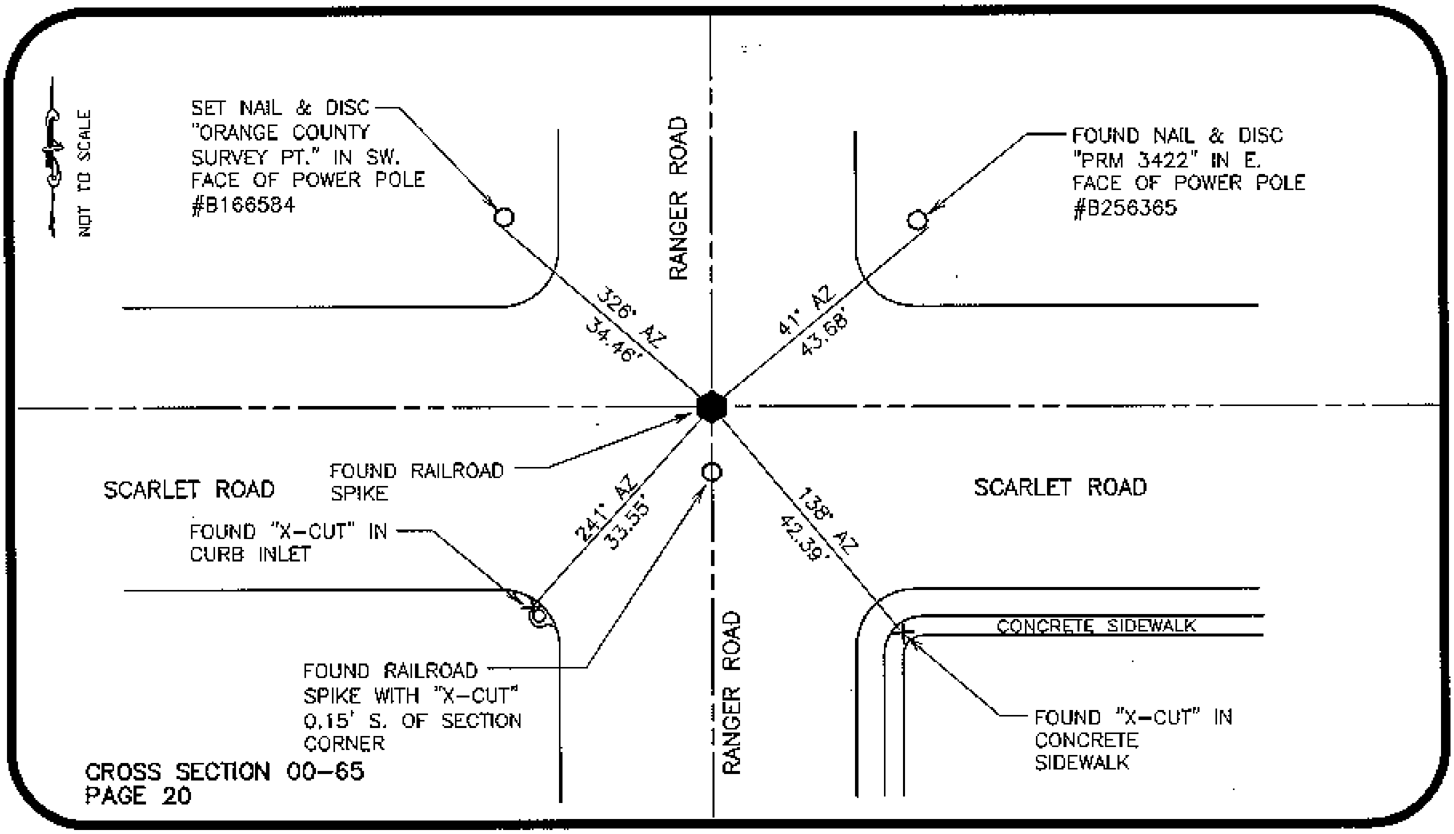
Y(NORTHING–Ft.) 1549937.0688 X(EASTING–Ft.) 556244.8940 Zone FL East

Convergence –00° 08' 56.56" Scale factor 0.9999526231

Coordinate determination (circle one): Field traverse GPS

Horizontal datum (circle one): NAD27 NAD83(1986) NAD83(1990) other (explain)

Accuracy (circle one): 1st 2nd 3rd other ______



Please complete sketch in black ink or type.

SURVEYORS CERTIFICATE:

I certify the monument and accessories indicated above were field located on DECEMBER 27, 2000

George W. Massey
SIGNATURE

4307
PSM NO.

04-18-01
DATE

Jones, Wood & Gentry, Inc.
FIRM OR AGENCY

1
LB NO.

136 East Robinson Street
ADDRESS

Orlando
CITY

Florida
STATE

32801
ZIP

EMBOSSED SEAL OVER SIGNATURE

SEND ORIGINAL TO:
Department of Environmental Protection
Bureau of Survey and Mapping
3900 Commonwealth Boulevard
Mail Station 105
Tallahassee, Florida 32399

D.E.P. USE ONLY

Completeness checked by: GS

Accepted and filed: 6-1-01
Date

B.L.M. – I.D. 400600

QUAD – I.D. 1064 Orlando East

DOC. # 071684

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
CERTIFIED CORNER RECORD

CORNER DESCRIPTION:

Depict corner with ●

NW N 1/4 NE
W 1/4 SECTION # 4 E 1/4
SW S 1/4 SE

S ¼ corner of Section 4
Twp 22 South, Rge 30 East
Tallahassee Base Meridian,
Orange County(s), Florida

MONUMENTATION DESCRIPTION (EVIDENCE FOUND OR METHOD TO SET)

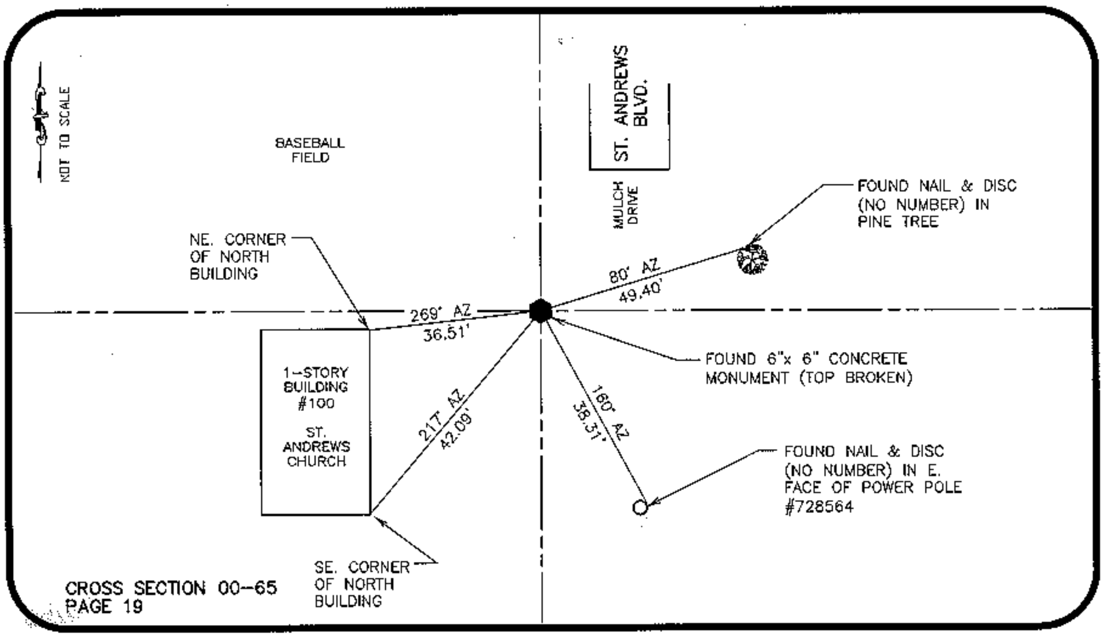
SEE CERTIFIED CORNER RECORD NUMBER 0024991
FOUND 6"x 6" CONCRETE MONUMENT (TOP BROKEN)

E 11

Comments:
The purpose of this certified corner record is to record state plane coordinate values on the previous certified corner record referenced above. No attempt was made to prove the validity of the location as shown on said previous existing certified corner.

HORIZONTAL POSITION AND HEIGHT INFORMATION (if determined):

Latitude i N 28° 35' 49.76642" Longitude W 81° 19' 10.96522"
Y(NORTHING–Ft.) 1549952.2542 X(EASTING–Ft.) 553572.6807 Zone FL East
Convergence –00° 09' 10.91" Scale factor 0.9999532434
Coordinate determination (circle one): Field traverse GPS
Horizontal datum (circle one): NAD27 NAD83(1986) NAD83(1990) other (explain)
Accuracy (circle one): 1st 2nd 3rd other ______



Please complete sketch in black ink or type.

SURVEYORS CERTIFICATE:

I certify the monument and accessories indicated above were field located on DECEMBER 27, 2000

George W. Massey — SIGNATURE
4307 — PSM NO.
04-18-01 — DATE
Jones, Wood & Gentry, Inc. — FIRM OR AGENCY
1 — LB NO.
136 East Robinson Street — ADDRESS
Orlando — CITY
Florida — STATE
32801 — ZIP

EMBOSSED SEAL OVER SIGNATURE

SEND ORIGINAL TO:
Department of Environmental Protection
Bureau of Survey and Mapping
3900 Commonwealth Boulevard
Mail Station 105
Tallahassee, Florida 32399

D.E.P. USE ONLY
Completeness checked by: GS
Accepted and filed: 6-1-01 Date
B.L.M. – I.D. 340600
QUAD – I.D. 1064 Orlando East

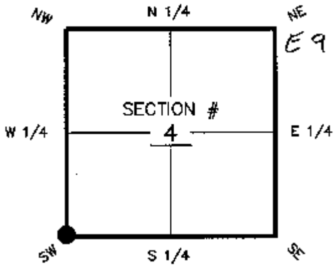
DEP 63-001(16) REV: 10/2/2000 PAGE 1 OF 1

DOC. # 071685

FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION
CERTIFIED CORNER RECORD

CORNER DESCRIPTION:

Depict corner with ●



SW corner of Section 4
Twp 22 South, Rge 30 East
Tallahassee Base Meridian,
Orange County(s), Florida

MONUMENTATION DESCRIPTION (EVIDENCE FOUND OR METHOD TO SET)

SEE CERTIFIED CORNER RECORD NUMBER 0022326

SET NAIL & DISC "ORANGE COUNTY SURVEY PT."

Comments:
The purpose of this certified corner record is to record state plane coordinate values on the previous certified corner record referenced above. No attempt was made to prove the validity of the location as shown on said previous existing certified corner.

HORIZONTAL POSITION AND HEIGHT INFORMATION (if determined):

Latitude N 28° 35' 49.67833" Longitude W 81° 19' 40.76472"

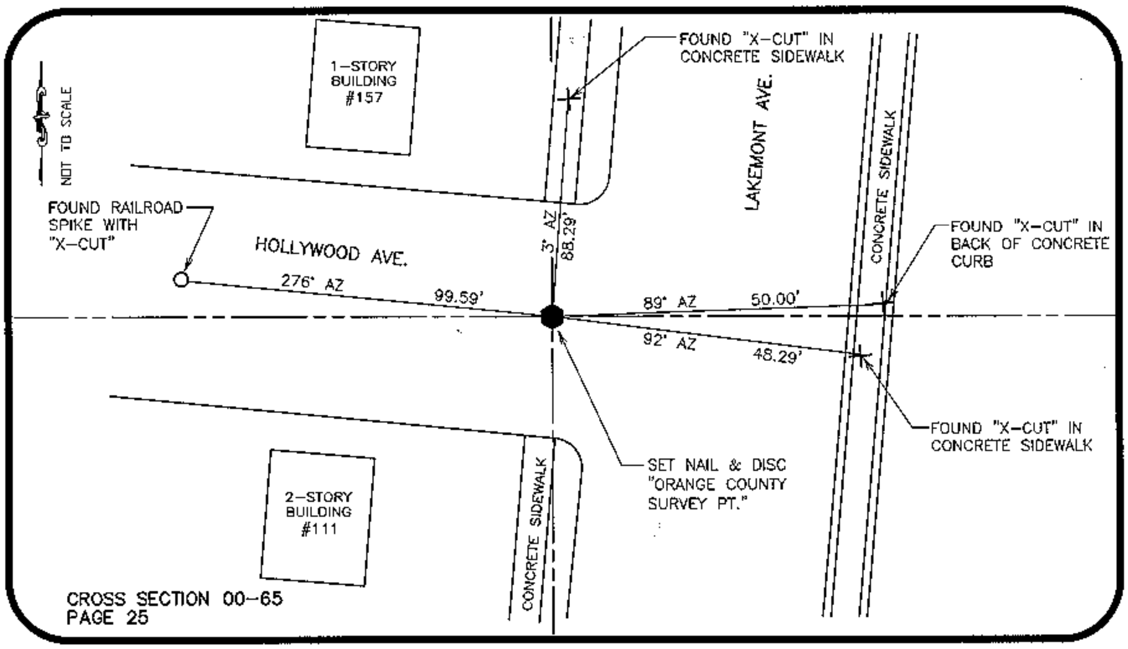
Y(NORTHING-Ft.) 1549950.5441 X(EASTING-Ft.) 550916.3923 Zone FL East

Convergence -00° 09' 25.18" Scale factor 0.9999538761

Coordinate determination (circle one): Field traverse GPS

Horizontal datum (circle one): NAD27 NAD83(1986) NAD83(1990) other (explain)

Accuracy (circle one): 1st 2nd 3rd other ________



Please complete sketch in black ink or type.

SURVEYORS CERTIFICATE:

I certify the monument and accessories indicated above were field located on DECEMBER 29, 2000

George W. Massey — SIGNATURE; 4307 — PSM NO.

04-18-01 — DATE

Jones, Wood & Gentry, Inc. — FIRM OR AGENCY; 1 — LB NO.

136 East Robinson Street — ADDRESS

Orlando — CITY; Florida — STATE; 32801 — ZIP

EMBOSSED SEAL OVER SIGNATURE

SEND ORIGINAL TO:
Department of Environmental Protection
Bureau of Survey and Mapping
3900 Commonwealth Boulevard
Mail Station 105
Tallahassee, Florida 32399

D.E.P. USE ONLY

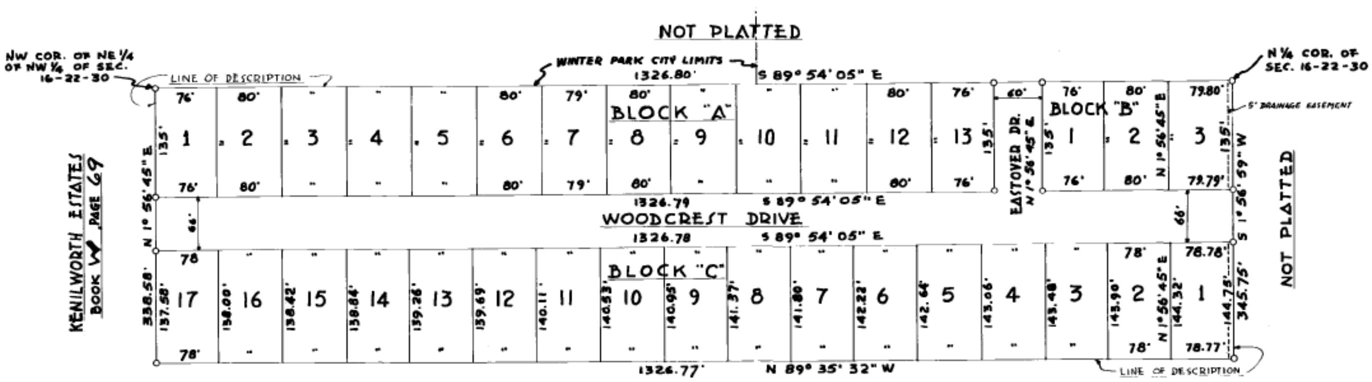
Completeness checked by: CS

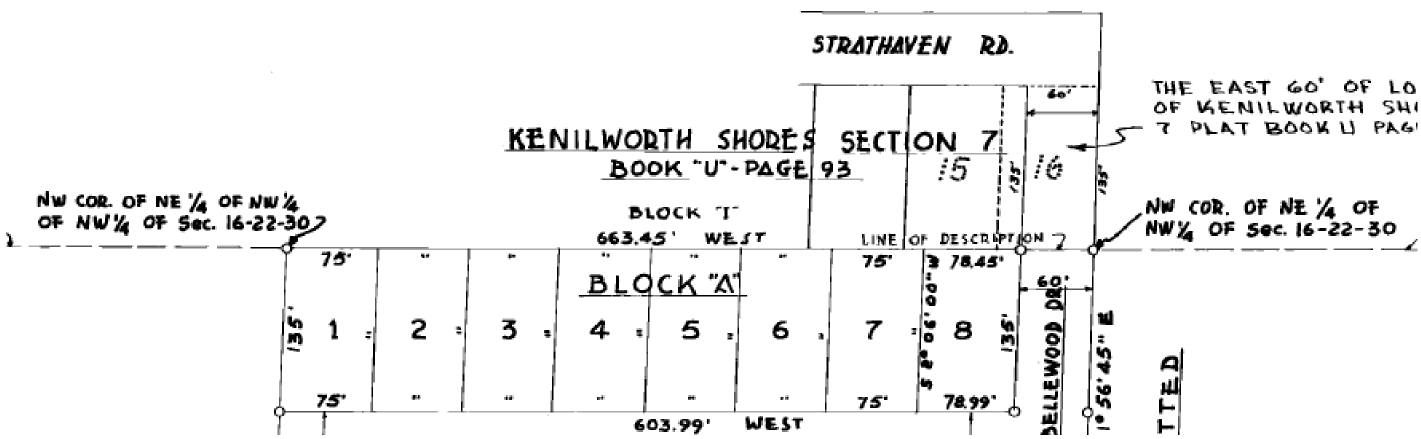
Accepted and filed: 6-1-01 Date

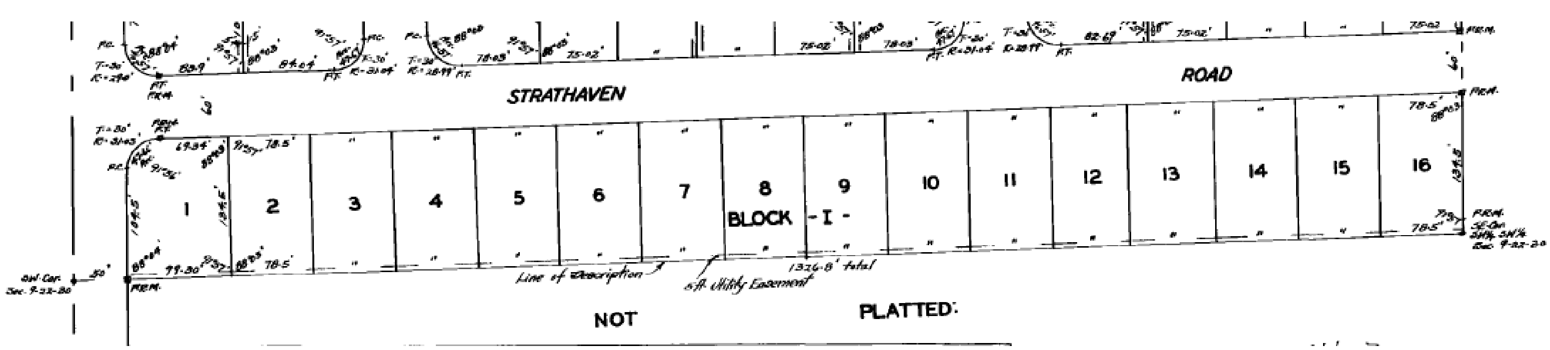
B.L.M. - I.D. 300600

QUAD - I.D. 1064 orlando East

Plats along the South Line of the Southwest Quarter:

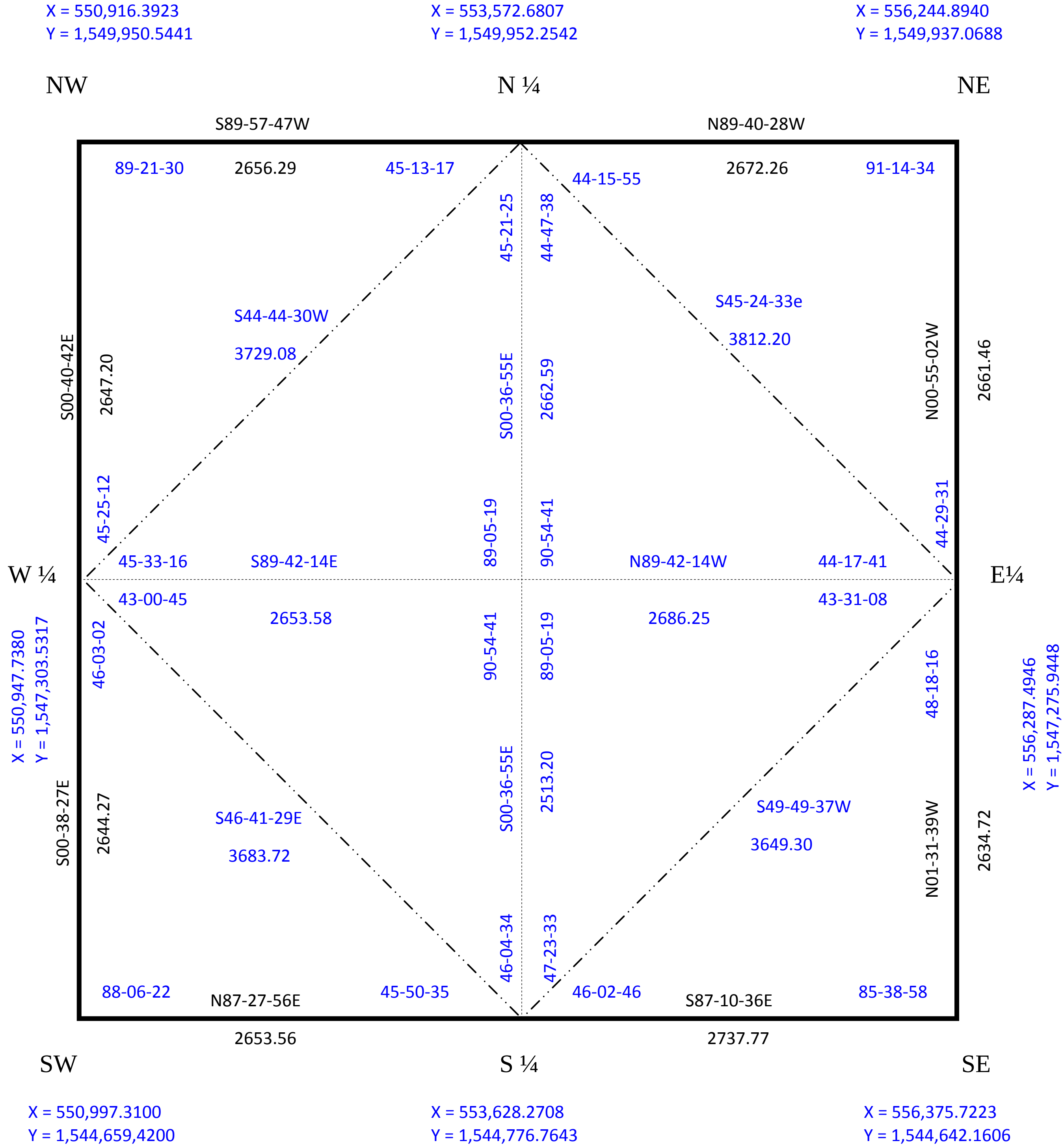






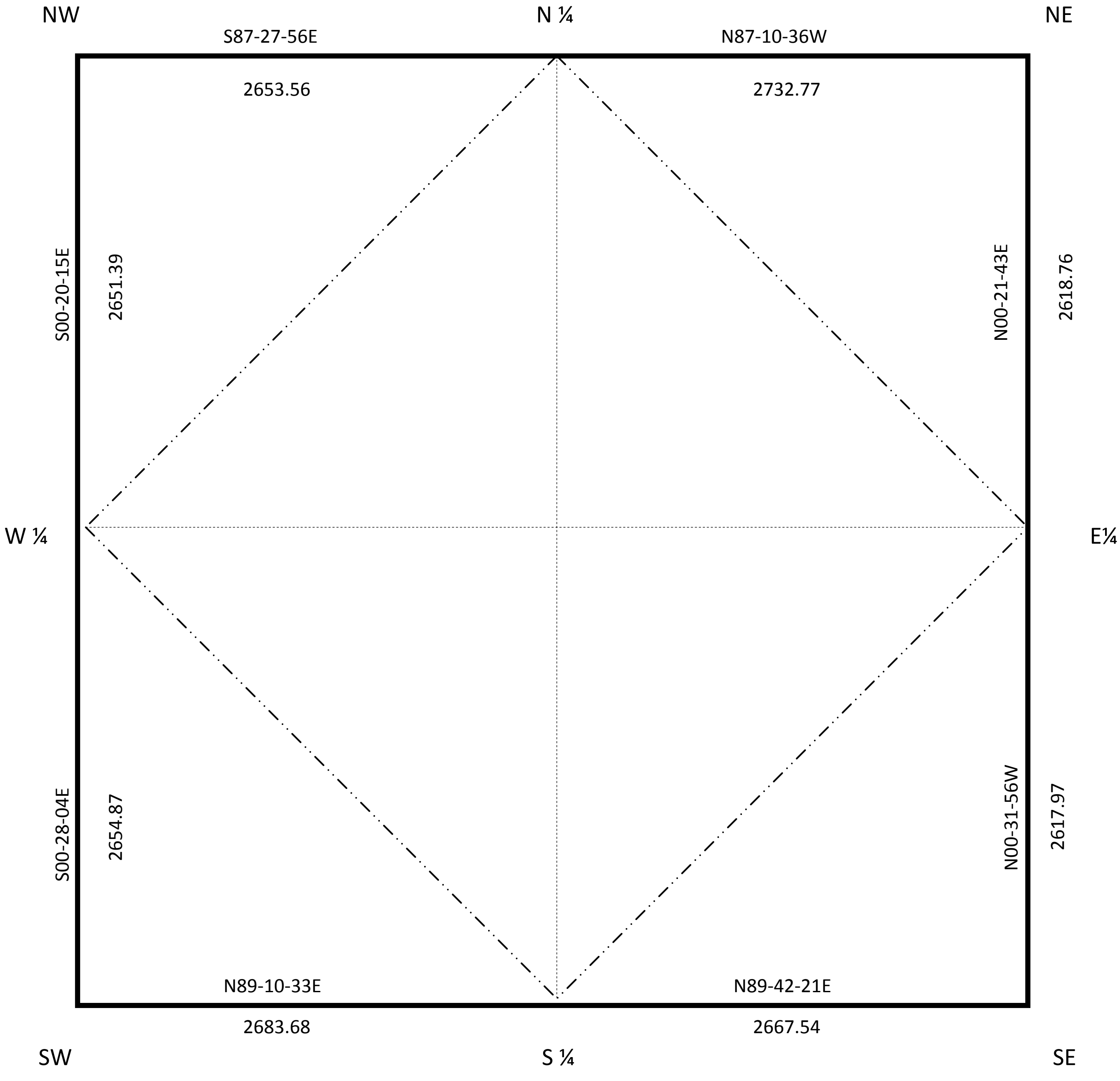
Case Study Solution

Solve for the center of the Section



Practice Problem

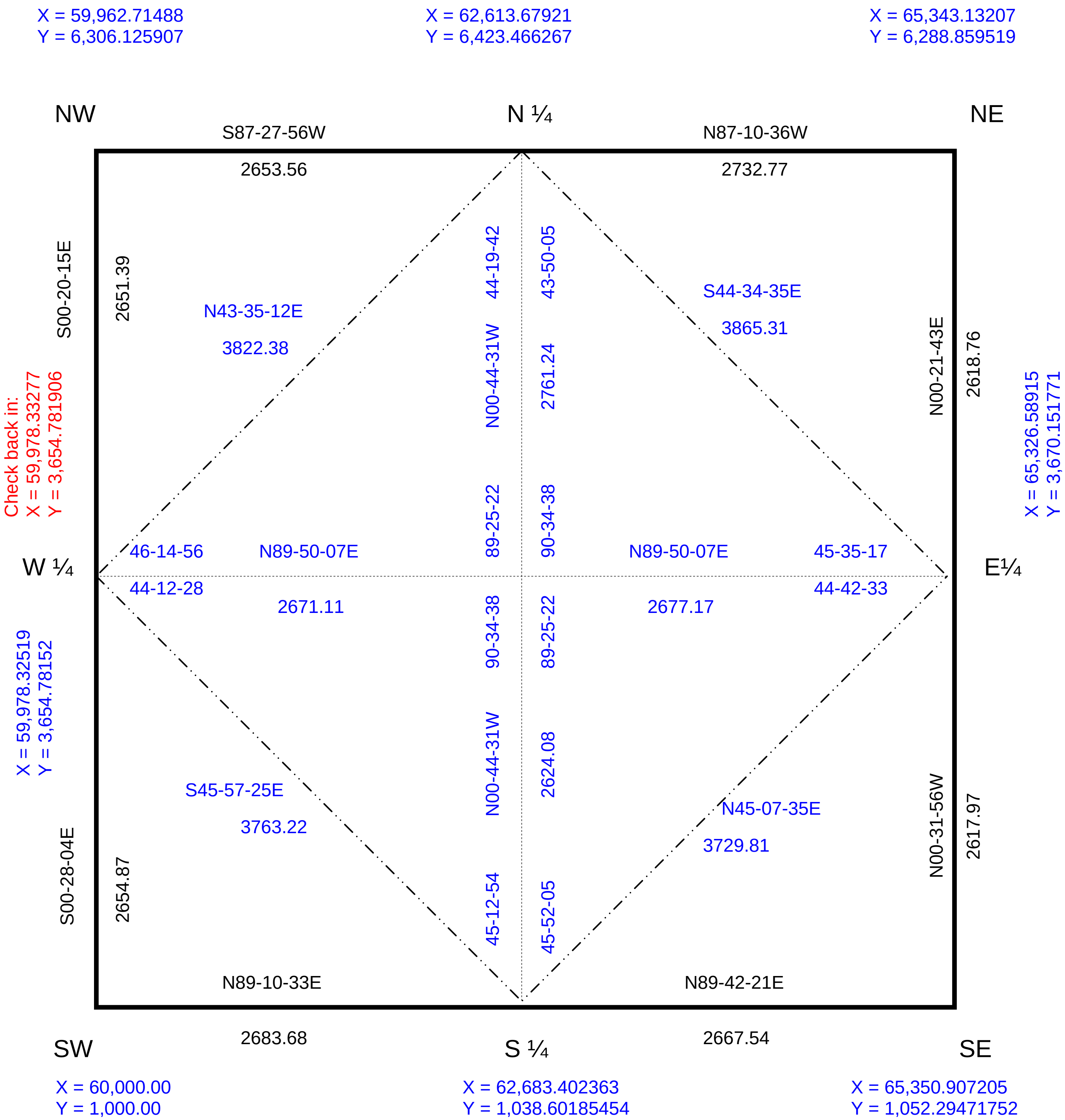
Solve for the center of the Section:



Use the following coordinate point for the SW corner: x = 60,000.00

y = 1,000.00

Solve for the center of the Section:



Use the following coordinate point for the SW corner: x = 60,000.00 y = 1,000.00

Formulas

Right Triangles

Pythagorean Theorem

$a^2 + b^2 = c^2$

$c^2 - a^2 = b^2$

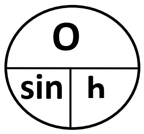
$c^2 - b^2 = a^2$

Solve for hypotenuse:
$c = \sqrt{(a^2 + b^2)}$

Solve for leg:
$a = \sqrt{(c^2 - b^2)}$

Sine

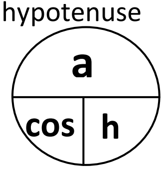
Sine =
opposite side ÷ hypotenuse



sine functions:
sine of an angle =
opposite side ÷ hypotenuse
opp. side = hypotenuse x sine of opp. angle
hypotenuse = opp. side ÷ sine of opp. angle

Cosine

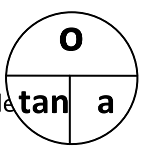
Cosine = adjacent side ÷ hypotenuse



cosine functions:
cosine of an angle =
adjacent side ÷ hypotenuse
adj. side = hypotenuse x cosine of adj. angle
hypotenuse = adj. side ÷ cosine of adj.angle

Tangent

Tangent = opposite side ÷ adjacent side



tangent functions:
tangent of an angle =
opposite side ÷ adjacent side
opposite side =
adjacent side x tangent of an angle
adjacent side =
opposite side ÷ tangent of an angle

Coordinate System

Bearing formula:

$(x_1 - x_2) \div (y_1 - y_2) = \tan \theta$ (**tan theta**)

Distance formula:

$(x_1 - x_2)^2 + (y_1 - y_2)^2 = d^2$

Areas

Trapezoid:
Area = ½ ($base_1 + base_2$) x height

Triangle:
Area = ½ (b x h)

Law of Sines

$$\frac{a}{\text{Sin } A} = \frac{b}{\text{Sin } B} = \frac{c}{\text{Sin } C}$$

$$\mathbf{a} = b \times \frac{\text{Sin } A}{\text{Sin } B} \qquad \mathbf{a} = c \times \frac{\text{Sin } A}{\text{Sin } C}$$

$$\mathbf{b} = a \times \frac{\text{Sin } B}{\text{Sin } A} \qquad \mathbf{b} = c \times \frac{\text{Sin } B}{\text{Sin } C}$$

$$\mathbf{c} = a \times \frac{\text{Sin } C}{\text{Sin } A} \qquad \mathbf{c} = b \times \frac{\text{Sin } C}{\text{Sin } B}$$

$$\textbf{Sin A} = \frac{a \times \text{Sin } B}{b} \qquad \textbf{Sin A} = \frac{a \times \text{Sin } C}{c}$$

$$\textbf{Sin B} = \frac{b \times \text{Sin } A}{a} \qquad \textbf{Sin B} = \frac{b \times \text{Sin } C}{c}$$

$$\textbf{Sin C} = \frac{c \times \text{Sin } A}{a} \qquad \textbf{Sin C} = \frac{c \times \text{Sin } B}{b}$$

Law of Cosines

$$c^2 = a^2 + b^2 - (2ab \text{ Cos } C)$$
$$b^2 = a^2 + c^2 - (2ac \text{ Cos } B)$$
$$a^2 = b^2 + c^2 - (2bc \text{ Cos } A)$$

$$\text{Cos } A = \frac{(b^2 + c^2) - a^2}{2bc}$$

$$\text{Cos } B = \frac{(a^2 + c^2) - b^2}{2ac}$$

$$\text{Cos } C = \frac{(a^2 + b^2) - c^2}{2ab}$$

Curves

Radius

$$R = \frac{T\text{(angent length)}}{\tan(\frac{1}{2}\text{ Delta}\Delta)} = \frac{180 \times \text{ArcL}}{\pi \times \text{Delta}\Delta}$$

Degree of Curve

$$D_c = \frac{5729.58}{R} \text{ (Hwy)} \qquad D_c = \frac{5729.65}{R} \text{ (RR)}$$

Arc

$$\text{Arc} = \frac{100 \times \text{Delta}\Delta}{D_c}$$

Arc = 100 x (DeltaΔ ÷ Dc)

Chord

chord = 2R x (sin ½ DeltaΔ)

Delta or Central Angle Δ

$$\text{delta}\Delta = \frac{\text{ArcL}}{R} \times 5729.58$$

Tangent Length

tangent = R x (tan ½ Δ)

Deflection Angle

Deflection angle = ½ DeltaΔ

Sector Area

Sector area = $(\pi R^2) * (\Delta \div 360)$

Segment Area

Segment area =
$$\text{sector area} - \frac{R^2}{2} * \sin \Delta$$

Fillet

Fillet = R x T – $(\pi R^2) * (\Delta \div 360)$

Fillet = R x T – sector

PC Station =
PI station – tangent length

PT Station =
PC station + arc length