Missouri GLO

Missouri Society of Professional Surveyors

Lodge of the Four Seasons

Lake Ozark, Missouri

May 6-7, 2011

Speakers

- Robert Ross, PLS

  Chief of the Cadastral Section at the State Land Surveyor's Office in Rolla, Missouri.

  Attended Missouri State University (formerly SMSU) in Springfield, Missouri, and received a Bachelor of Science

  degree in Cartographic Sciences, with an emphasis in Land Surveying. As Section Chief he oversees program

  staff, performs survey investigations and dependent resurveys, administers boundary project contracts and the

  Private and County Surveyor Cooperative remonumentation programs.

Speakers

- Ralph Riggs, PLS, CFedS

  President of Riggs & Associates, Inc., West Plains, Missouri and Managing Member of Ruble, Riggs & Shotts LLC. He is currently the Howell County Surveyor and is licensed in Missouri, Kansas, Arkansas, and Louisiana and is a Certified Federal Surveyor. He is a past president of MSPS and is a currently member of MSPS, MACS (Past President), NSPS, Arkansas ASPS. He has also been a member of and past chairman of the Land Survey Advisory Committee and is the recipient of the MSPS Surveyor of the Year in 2010.

Speakers

- Robert Shotts, PLS, ASLA, CFedS, CFM

  President of Robert S. Shotts, Inc., Lebanon, Missouri and Managing Member of Ruble, Riggs & Shotts LLC. He is currently the Laclede and Wright County Surveyor and is a Certified Floodplain Manager. He is licensed in Missouri, Kansas, Arkansas, Colorado, Illinois and is a Certified Federal Surveyor. He is also licensed as a Landscape Architect in Missouri, Kansas and Arkansas. He holds a BS in Forestry from the University of Missouri-Columbia and has graduate work in Landscape Architecture from Kansas State University. He is a past president of MSPS and is a currently member of MSPS, NSPS, MACS, MALA, ACSM, ASLA and the Association of State Floodplain Managers. He is a recipient of the MSPS Surveyor of the Year award and the Robert E. Myers Service award.

The System of Rectangular Surveys

- General Concept and Evolution
- Subdivision of Sections
  - The Role of the Plat
- Fifth Principal Meridian

General Concept and Evolution

- Land Ordinance of 1785
  - 36 Lots per Township
  - Each Lot was to be 1 Mile Square
  - Townships to be 6 Miles Square
  - Lot lines would not be surveyed by the government
  - The purchaser would survey his lot line after purchase
  - Five lots reserved
    - Lots 8, 11 & 26 were reserved to the government
    - Lot 16 to schools
    - Lot 29 to “religion”
  - Under the direction of Geographer, Thomas Hutchins

Township Scheme

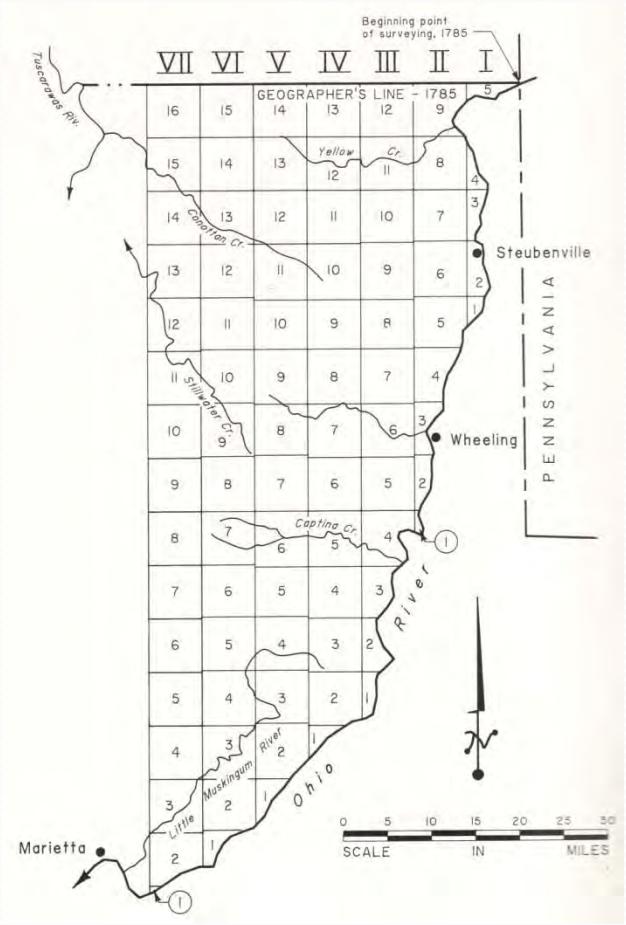
LAND ORDINANCE–1785

36	30	24	18	12	6
35	29 Reserved to Religion	23	17	11 Reserved to U.S.	5
34	28	22	16 School Reserve	10	4
33	27	21	15	9	3
32	26 Reserved to U.S.	20	14	8 Reserved to U.S.	2
31	25	19	13	7	1

General Concept and Evolution (Continued)

- Seven Ranges surveyed from 1785-1787
- Problems began immediately
  - Numbering became a problem
  - The township exteriors were poorly surveyed
  - Individual lots were poorly surveyed
  - Conflicts between lots were common
    - Gores
    - Overlaps

Boundary of the 7 Ranges



General Concept and Evolution (Continued)

- Congress contracted with the Ohio Company to sell one million acres west of the Seven Ranges
- Ohio company had to survey the townships and lots
- The Company surveyor was Rufus Putnam who contracted with private surveyors to conduct the work
- Greenville Treaty of August 3, 1795 after General Mad Anthony Wayne defeated the Indians at Fallen Timbers

General Concept and Evolution (Continued)

- The Act of May 18, 1796
  - The office of the Surveyor General was created by this Act, Rufus Putnam appointed to this position
  - He contracted with Deputy Surveyors who were paid by the mile
  - Lots became Sections
  - Current township scheme was created, Section 1 in the NE corner of the township
  - 2-pole chain is to be used
  - Corner descriptions are to be recorded in a field book

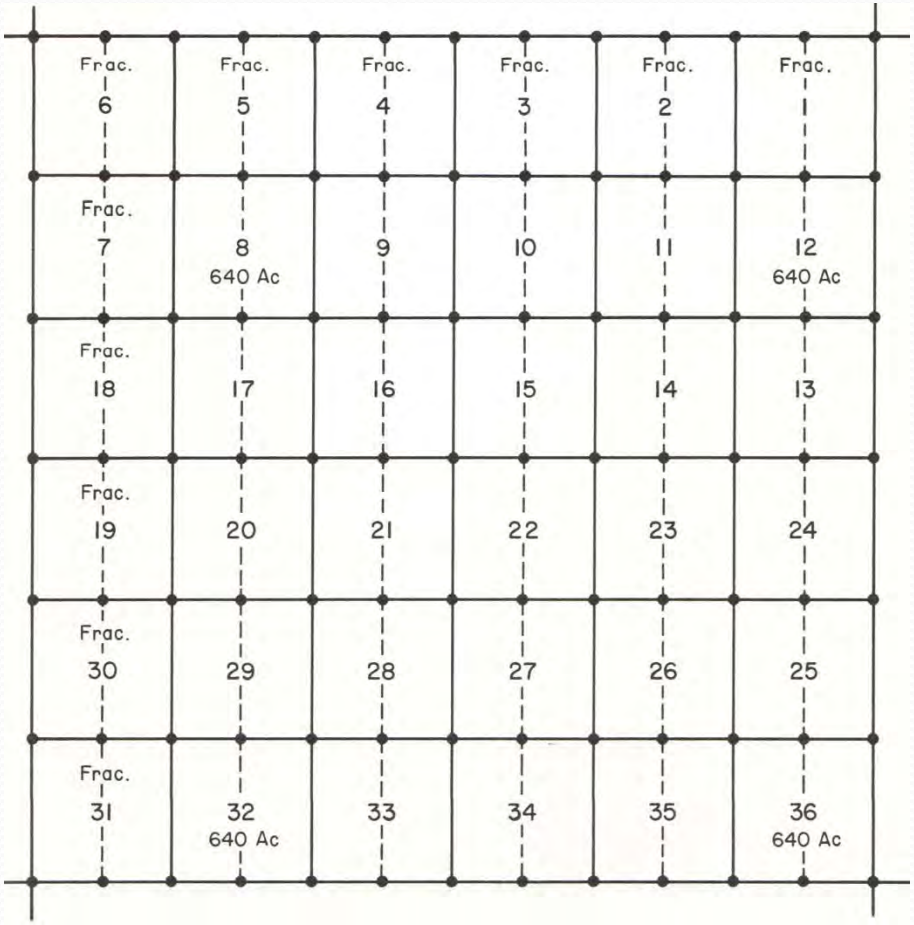
General Concept and Evolution (Continued)

- Reference to navigable rivers as public highways
- Every other unsold township was to be divided into nine four-mile square blocks

General Concept and Evolution (Continued)

- The Act of May 10, 1800
  - Townships were to be divided into sections and half sections
  - Corners to be set at one mile intervals
  - Half mile corners were to be fixed on the E-W lines only
  - Allowed the sale of ½ sections (320 acres)
  - Established local land offices

Act of 1800 Monumentation



General Concept and Evolution (Continued)

- The Act of March 26, 1804
  - Provided for the sale of ¼ sections

General Concept and Evolution (Continued)

- The Act of February 11, 1805
  - Original corners control
  - The boundaries as run and marked cannot be changed
  - Measurements and quantities returned are held to be true (Proportionate measure basis)
  - Aliquot parts of the sections are defined
  - Statutory rules for the subdivision of sections are defined
  - Rules for the subdivision of fractional townships and sections

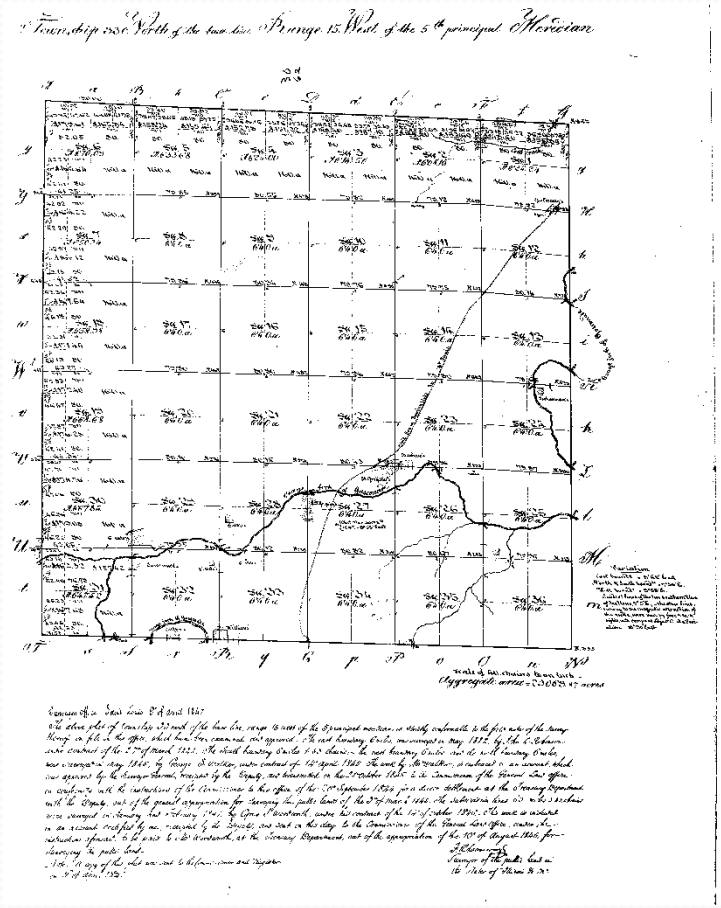
General Concept and Evolution (Continued)

- The Act of April 24, 1820
  - The sale of ½ quarter sections (80 acres)
  - The N-S lines through the quarter sections to be in accordance with the Act of 1805

General Concept and Evolution (Continued)

- The Act of April 5, 1832
  - The sale of quarter-quarter sections (40 acres)
  - The E-W lines through the quarter section to be in accordance with the Act of 1805

Subdivision of Sections
Role of the Plat



Subdivision of Sections
Role of the Plat

- **BLM:**
- **Survey plats** are part of the official record of a cadastral survey. Surveying is the art and science of measuring the land to locate the limits of an owner's interest thereon. A cadastral survey is a survey which creates, marks, defines, retraces or re-establishes the boundaries and subdivisions of Federal Lands of the United States. The survey plat is the graphic drawing of the boundaries involved with a particular survey project, and contains the official acreage to be used in the legal description.

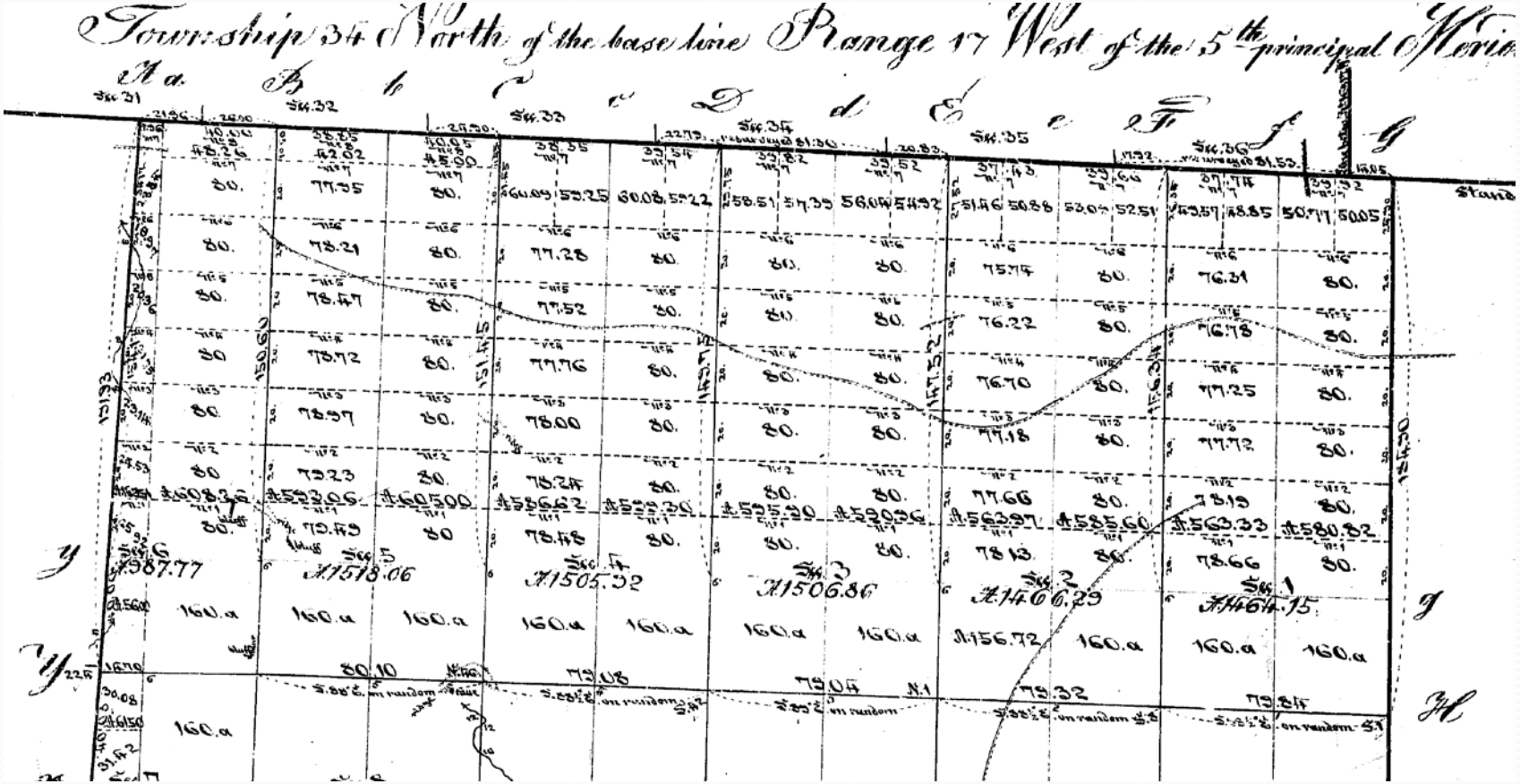
Subdivision of Sections
Role of the Plat

- Functions of the GLO Plat
  - The returns of the lines and areas
  - Sections are not subdivided in the field
  - Certain of the subdivision-of-the-section lines are protracted on the official plat
  - Subdivision-of-the-section corners are not marked in the field
  - Tracts having senior rights are shown on the plat
    - Grant, Lease, Order, Proclamation, reservation, & etc.

Subdivision of Sections
Role of the Plat

- Scrivener (Draftsperson)
  - Plat each section in accordance with the field notes
  - Subdivide each section:
    - In conformity with the uniform plan
    - Connecting by straight lines between opposite corresponding corners
    - Excess or deficiency against the township boundary (N & W)
    - As many aliquot parts as possible
    - Follow lotting principals

Subdivision of Sections
Role of the Plat



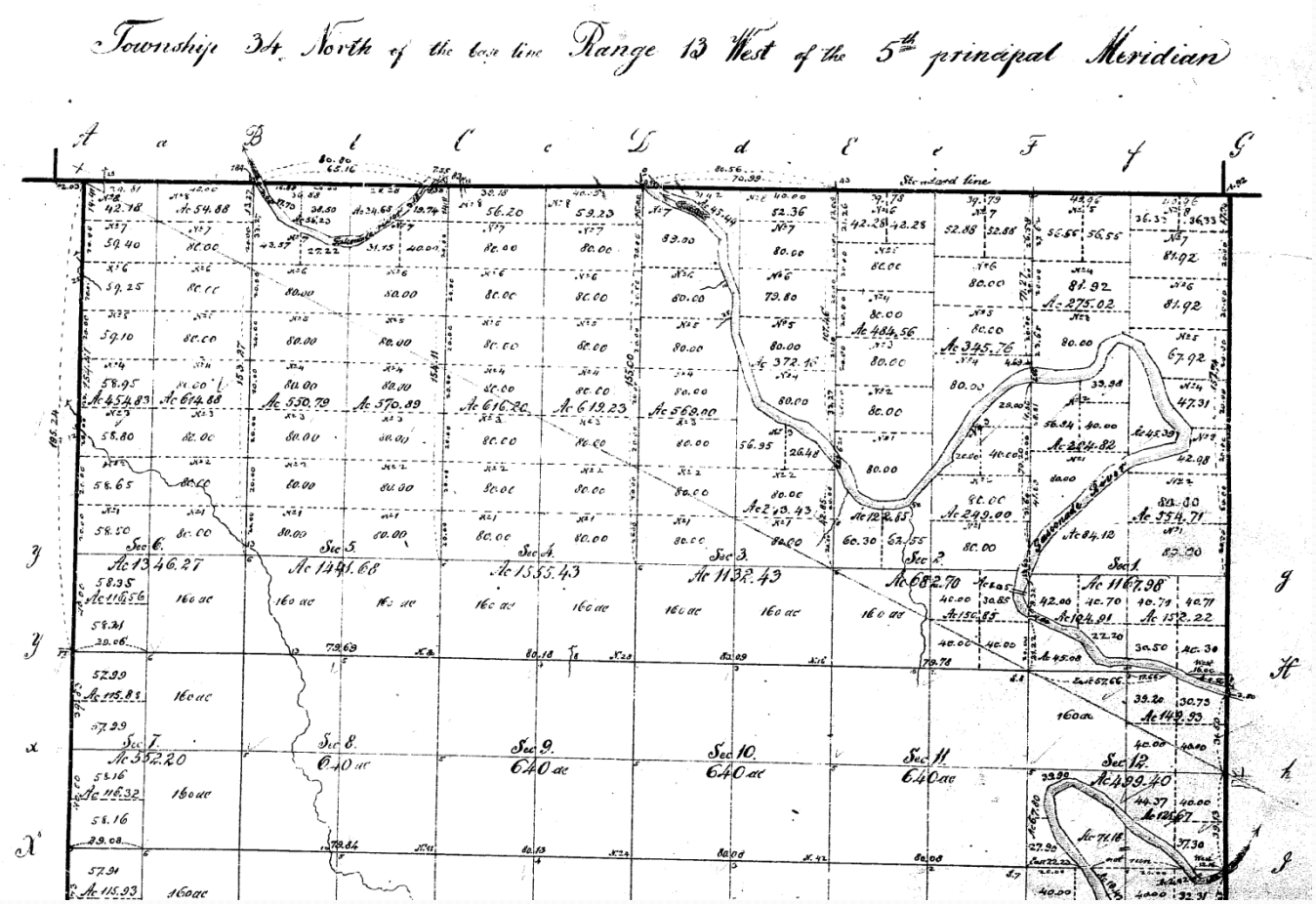
Subdivision of Sections Role of the Plat

- General Rules of Subdivision, Regular Sections
  - Quarter-quarter sections are aliquot parts of the quarter sections-lines not indicated on plat
  - Sections subdivided to include as many aliquot parts as possible
  - Sections invaded by meanderable water bodies and approved claims divided into as many aliquot parts as possible then lots as necessary

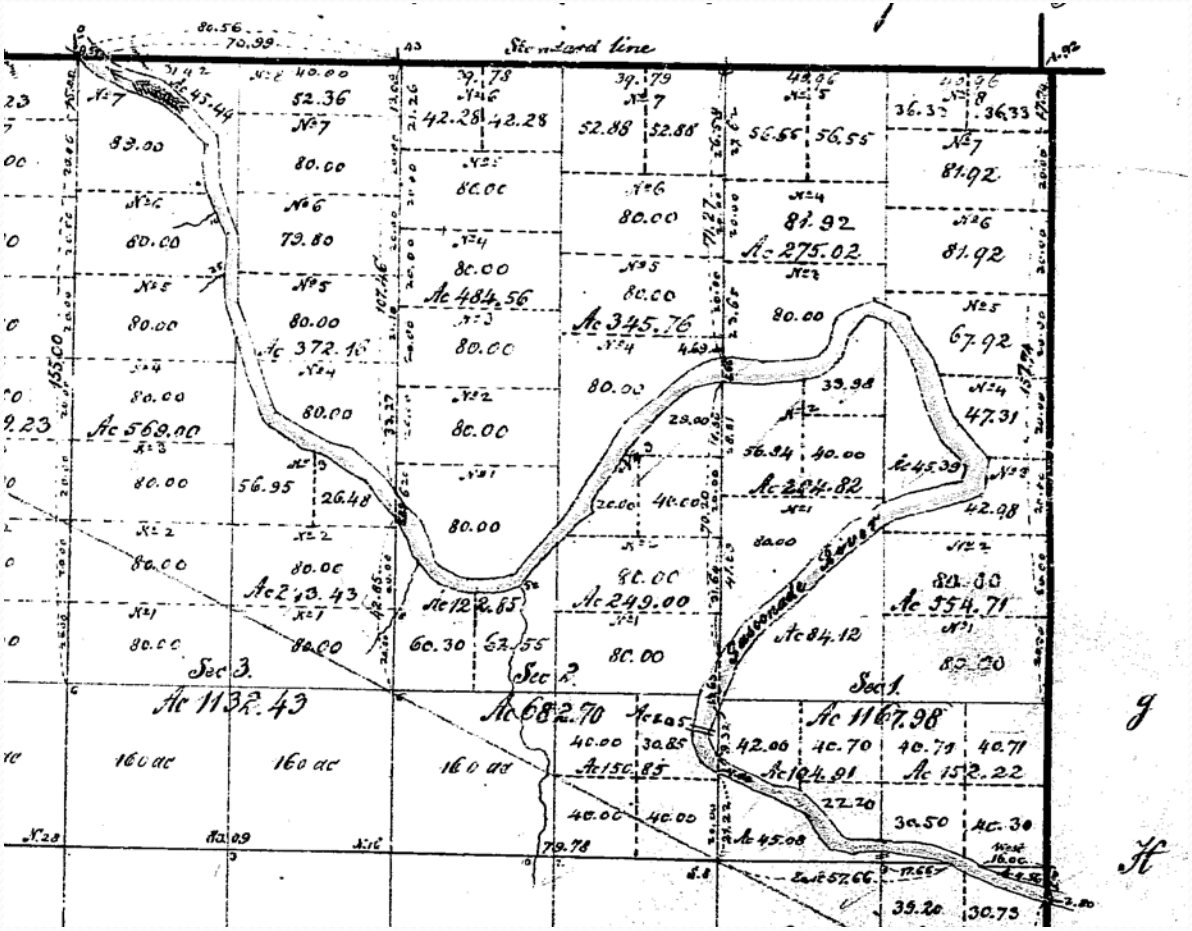
Subdivision of Sections
Role of the Plat

- General Rules of Subdivision, Fractional Sections
  - First, subdivision by protraction in accordance with field notes
  - Second, subdivision by protraction as near as possible with uniform plan for fractional sections
  - Subdivision-of-section lines are terminated at the meander line or claim line

Subdivision of Sections
Role of the Plat

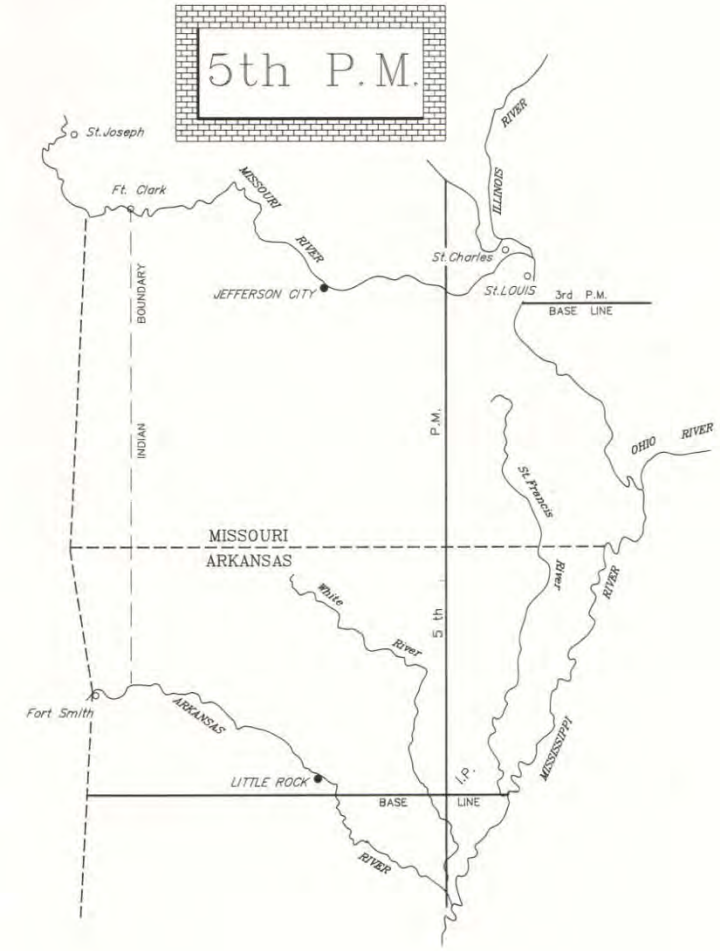


Subdivision of Sections
Role of the Plat



Fifth Principal Meridian

Fifth Principal Meridian



Fifth Principal Meridian

The Baseline

Joseph C. Brown began the survey of the base line on October 27th 1815 the same day P. K. Robbins began his survey of the 5th Principal Meridian.

Brown arrived at the initial point on November 2, but was unaware of this until later.

Chs. West on the base line, commencing at a post on the south bank of the St. Francis river at its mouth, from which a Hickory 2 feet diam. Bears S31E 61 links and a Hickory 1 ½ feet diam bears N87W 2 chs. 6 links – The Mississippi here is 50 chs. -- links wide and bears S. 12 E.

Fifth Principal Meridian

The Baseline (Cont.)

4.86 river St. Francis, running from S25W –
10 chs. 50 lks. Wide –
19.24 left St. Francis R.
23.36 an Elm 20 ins diam
40.00 Set ½ mile post
50.25 aCypress 5 feet dia
80.00 Set mile post – (1 MP)
Land low and sandy, covered with
cane Sweet Gum etc. –would be good were it
not subject to inundation -- Thence

Fifth Principal Meridian

The Baseline (Cont.)

80.00	Set Mile post	M.P. 26
	This mostly very cold wet land	
	Oak, Hickory, Dogwood and a little Pine	
West	on the base line	
8.70	a White oak 2 feet dia	
20.00	Cypress swamp	
29.82	base line intersects the meridian	

Fifth Principal Meridian

The Initial Point

Prospect Robbins begins his survey of the 5th P. M. Eastern States Office of the BLM. Copies of the 1840 notes.

October 27, 1815:

Set a post at the extremity of the point of Land formed by the Junction of the Mississippi & Arkansas Rivers at which commenced the 5th principal meridian as follows:

North on the 5th Principal Meridian

3.30 Arkansas River 1225 Lks over C SW Navigable for Boats current gentle

Fifth Principal Meridian

The Initial Point (Cont.)

59.19 Left Arkansas to the left hand

72.60 Sycamore 40 in dia

80.00 Set tpy mile post

Over level Timb C wood

Sycamore Hackberry & C-UG

Cane. H water mk 8 feet up

the trees Soil good…

October 27th 1815

80.00 Set tpy Mile post M.P. 57

North on 5th Principal Meridian

Fifth Principal Meridian

The Initial Point (Cont.)

30.25 W.O. 12 in dia

40.00 Set temp ½ M post in South-
ern edge of a Cypress Swamp

60.50 Intersected the Base line 26 miles
& 30 Chains West of the
Mississippi where set a
Post corner of Sects. 1.6.31 &
36 & Townships 1 & 1 N of the Ranges
1 E & 1 West from which a
Gum 18 in dia bears N61E dist

Fifth Principal Meridian

The Initial Point (Cont.)

44 lks & a do 18 in dia brs S70W dist

10 L-

S1/2 M over level 2nd land-

T. W & BO – U.g. Same-

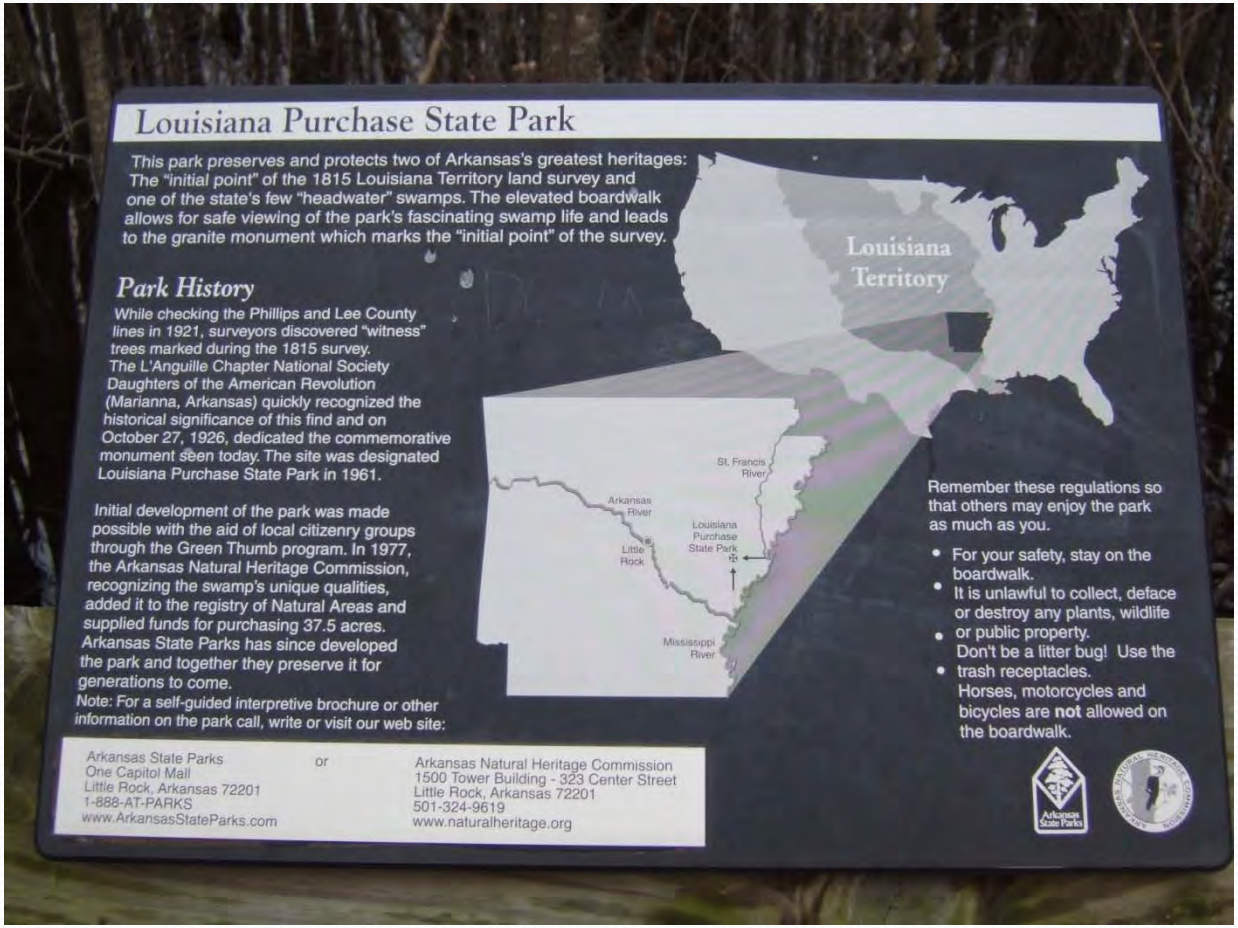
bkn low & wet – TS Cypress

Nov 10th…

Fifth Principal Meridian

Fifth Principal Meridian

Fifth Principal Meridian



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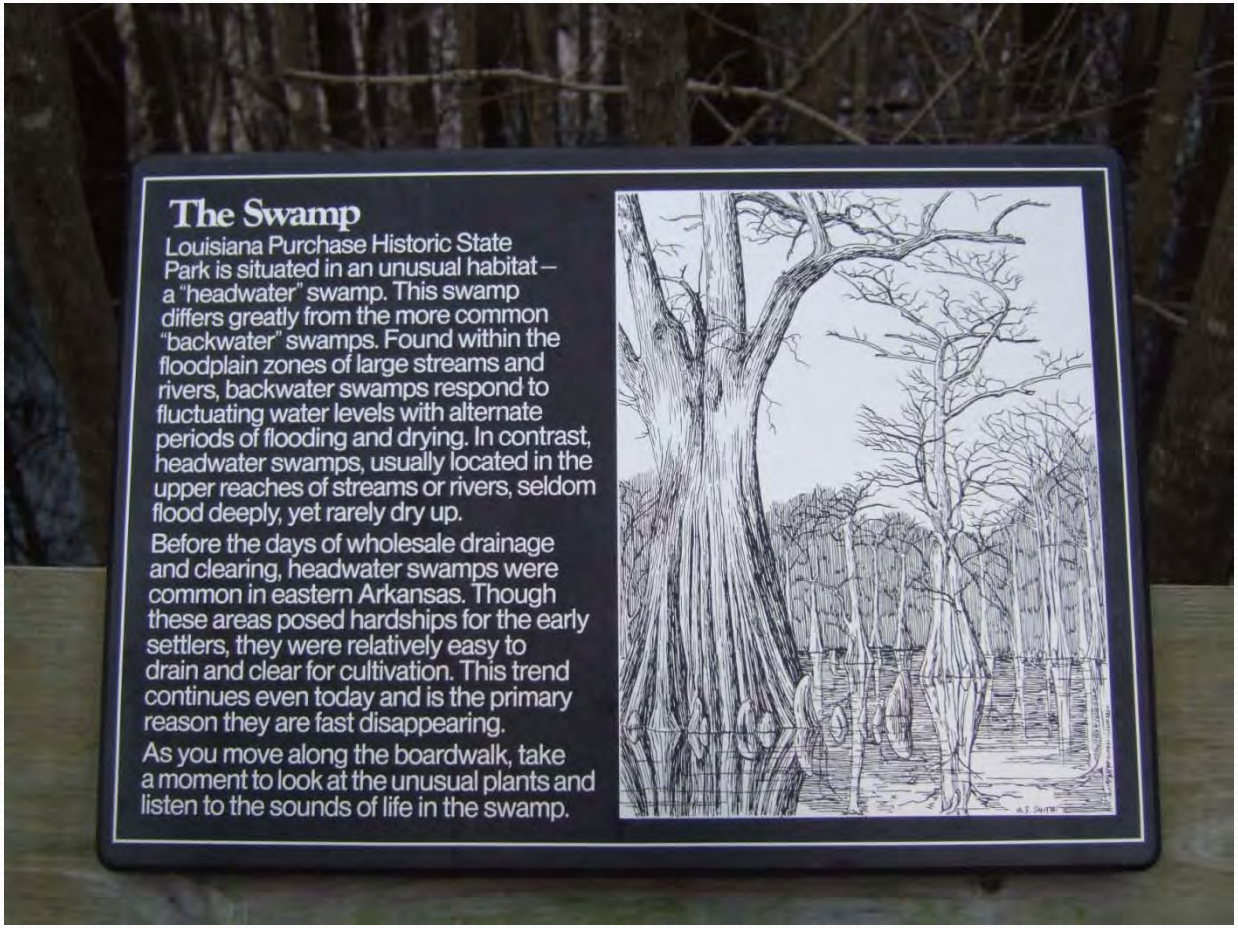

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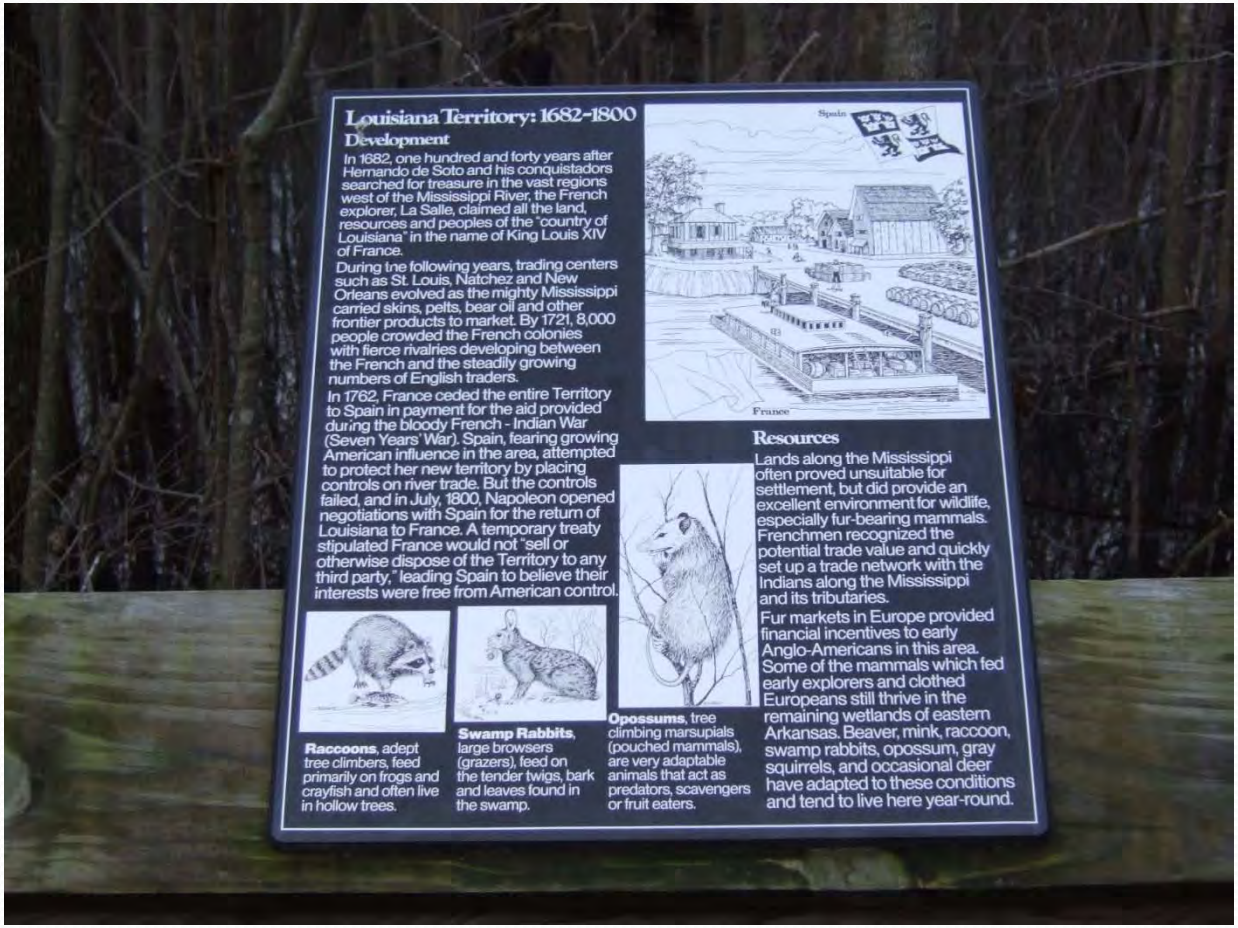

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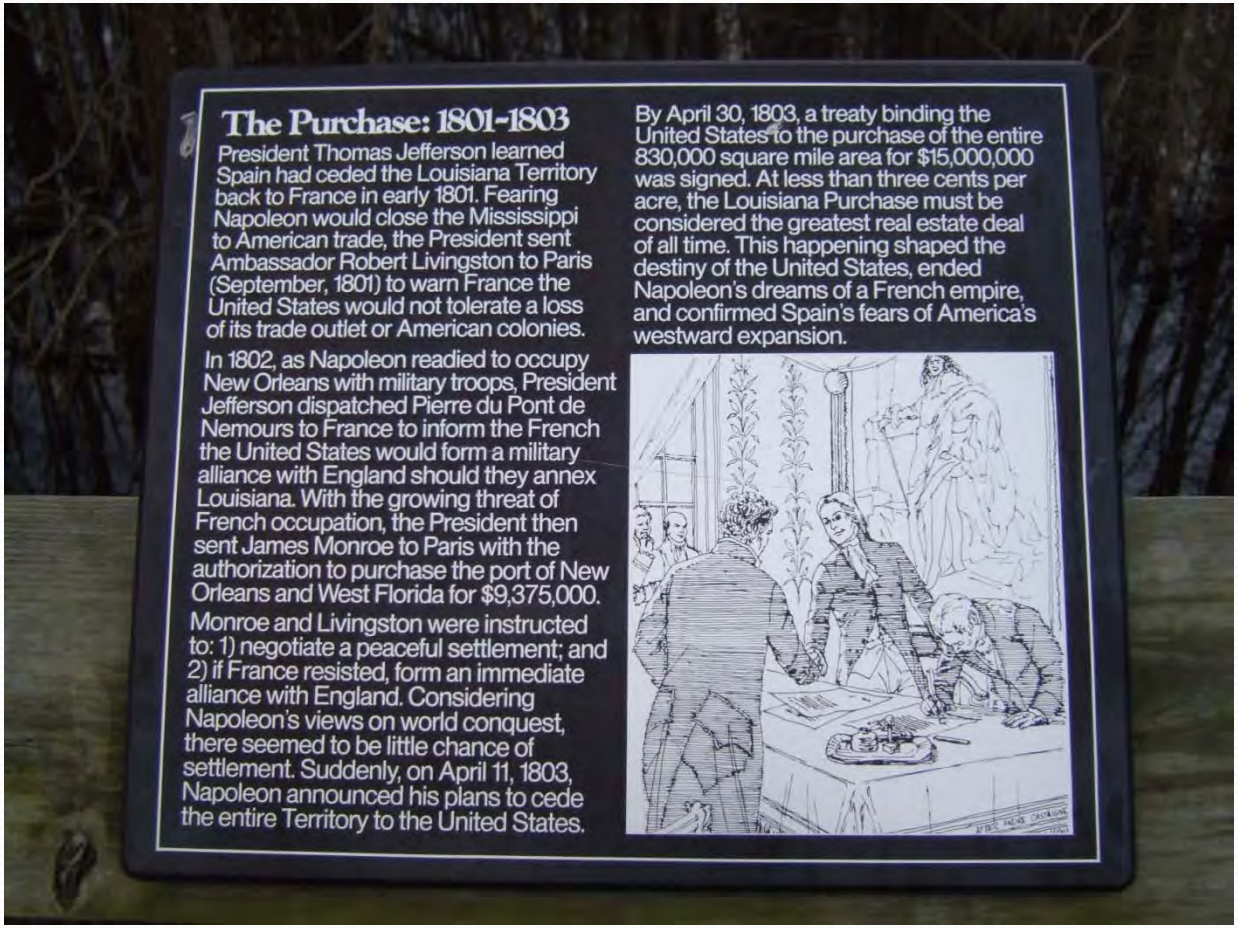

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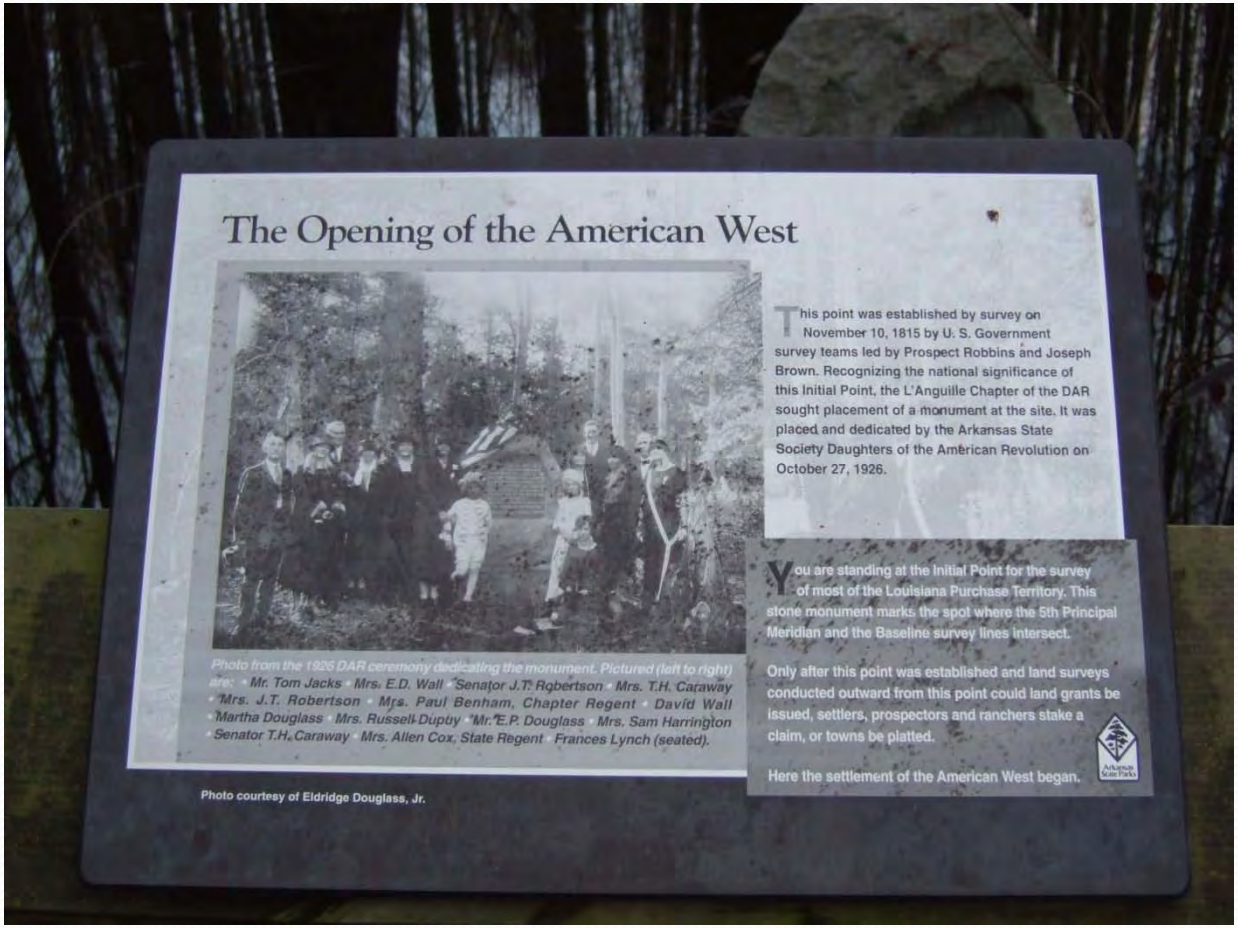

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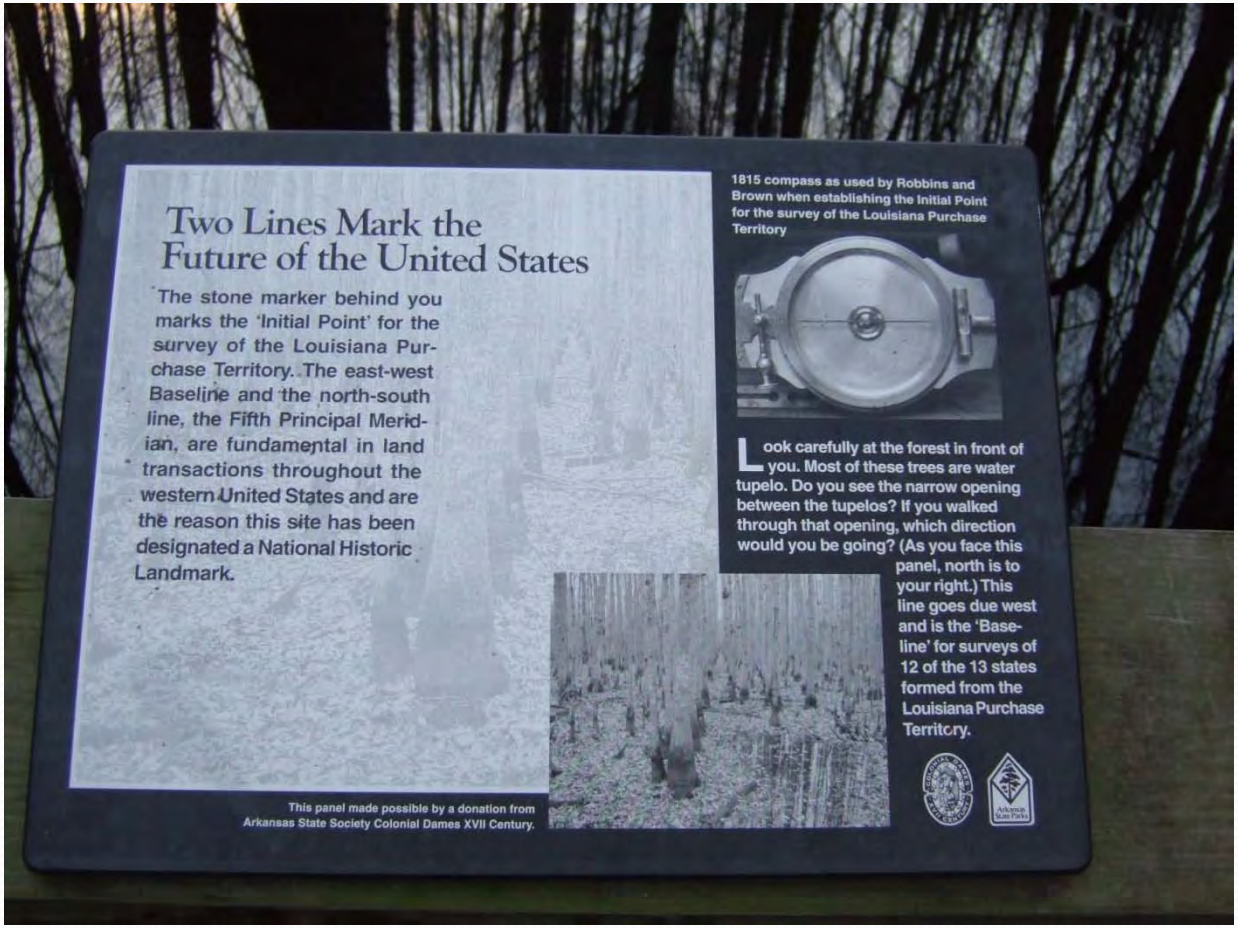


Fifth Principal Meridian

Fifth Principal Meridian

Methods of Survey Geodesy of Cadastral Surveys

- Convergence of meridians
- Rhumb lines or parallels of latitude
- Line of constant bearing vs. line of sight
- Apparent misclosure
- Grid coordinate systems

Convergence of Meridians

- Land Ordinance of 1785
- "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 circumstances 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."

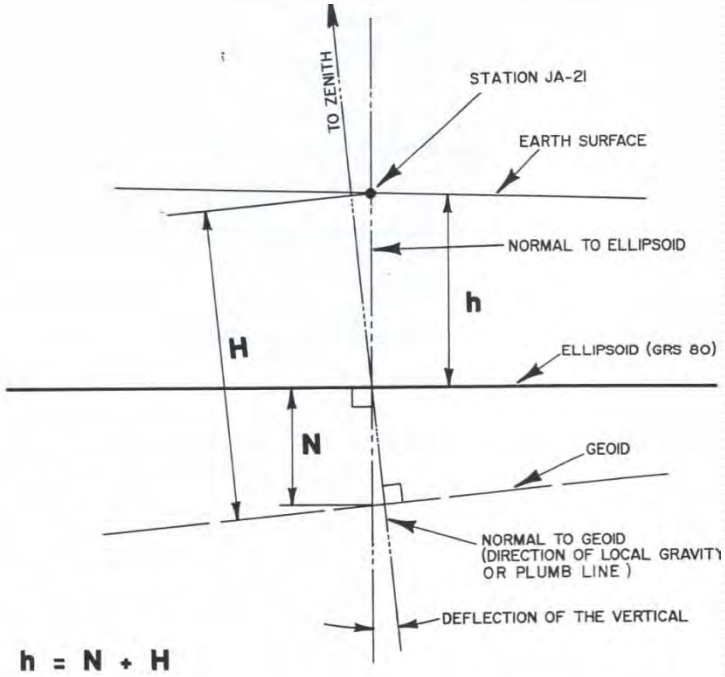
Convergence of Meridians

- True Meridian
- Public Land Survey directions determined with reference to the true meridian as defined by the axis of the earth's rotation.
- The true meridian is a line along a meridian of longitude.
- Historically the determination of a true meridian has been based on an astronomic observation at the point of record.
- There is an angular difference between the astronomic and geodetic direction.

Convergence of Meridians

- True Meridian (cont.)
- This angle (the Laplace correction or deflection of the vertical) is caused by difference in the direction of local gravity as compared with the normal to the reference ellipsoid.
- This value has been difficult to determine in the past.
- Historically the determination of a true meridian has been based on an astronomic observation at the point of record.
- Publication of the NAD 83 allowed the calculation of the Laplace correction to be made

Convergence of Meridians



$h = N + H$

H = ORTHOMETRIC HEIGHT OR ELEVATION
(DISTANCE FROM GEOID TO EARTH SURFACE)

h = ELLIPSOIDAL HEIGHT OR GEODETIC HEIGHT
(DISTANCE FROM ELLIPSOID TO EARTH SURFACE)

N = GEOID SEPARATION OR GEOID HEIGHT
(DISTANCE FROM ELLIPSOID TO GEOID)

Figure 6. Surfaces at Station JA-21

Convergence of Meridians

- True Meridian (cont.)
- In most conventional surveys the application of this correction is not necessary
- The application of the Laplace correction may be necessary on large-scale surveys where geodetic and astronomic observations are mixed.

Rhumb Lines - Parallels of Latitude

- Rhumb line

  A rhumb is a course on the Earth of constant bearing. For example, to travel from New York to London a voyager could head at a constant bearing 73° east of north.

  Loxodrome is a Latin synonym for rhumb, and has come to be used more as a geometric term—the course is a rhumb, the curve is a loxodrome. On a surface of revolution, *meridians are copies of the revolved curve; on the earth, they are north-south lines of* constant longitude. A loxodrome intersects all the meridians at the same angle. A circle of constant latitude is a loxodrome (perpendicular to meridians).

Rhumb Lines - Parallels of Latitude

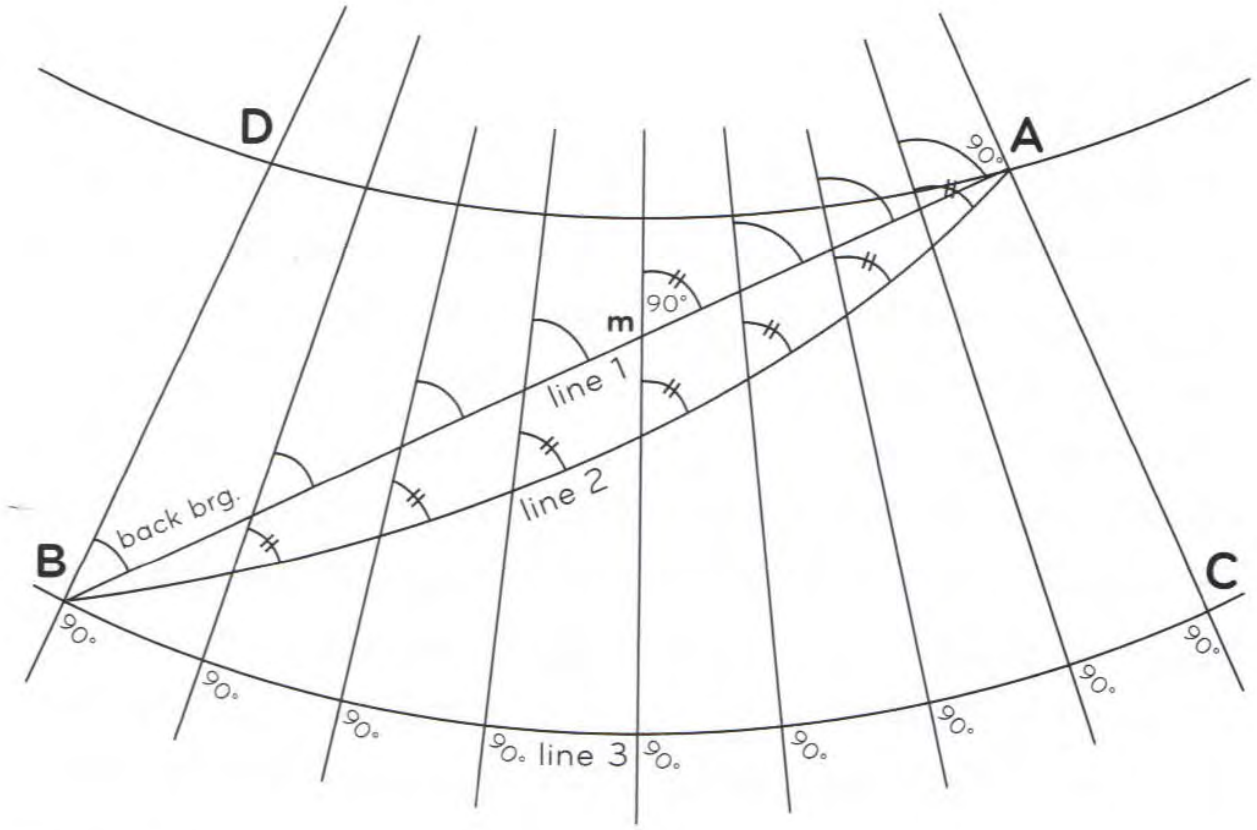
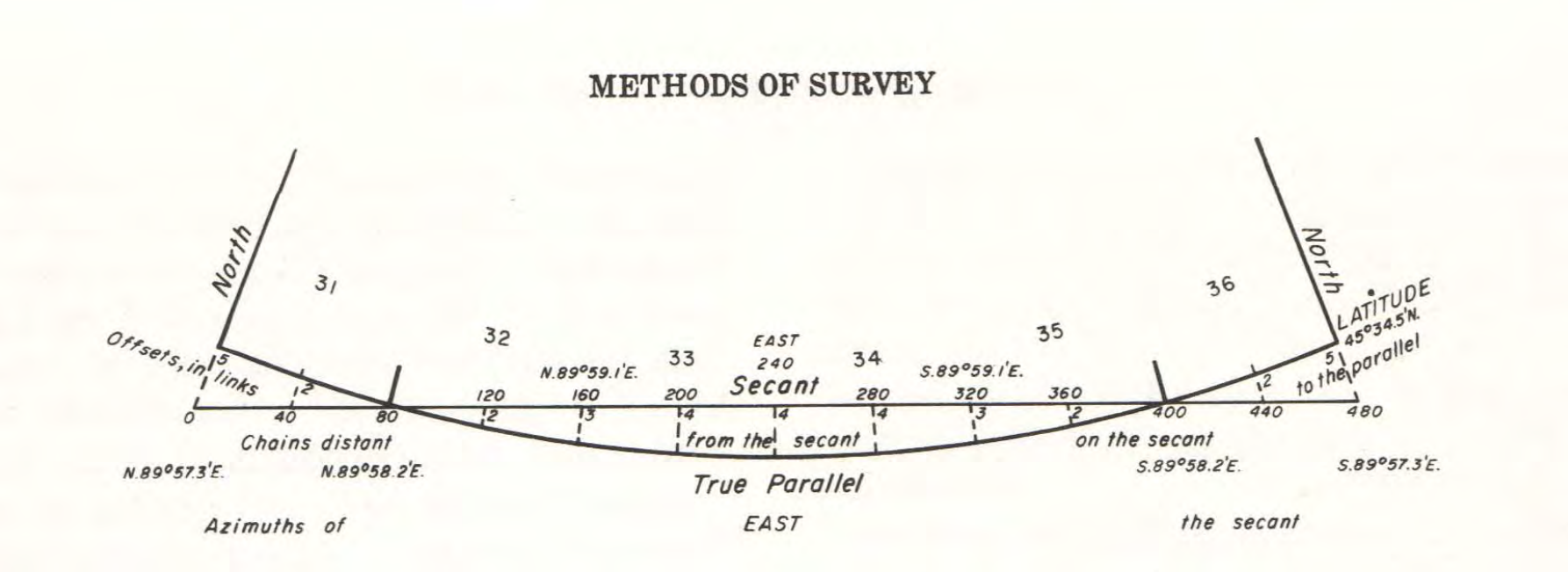
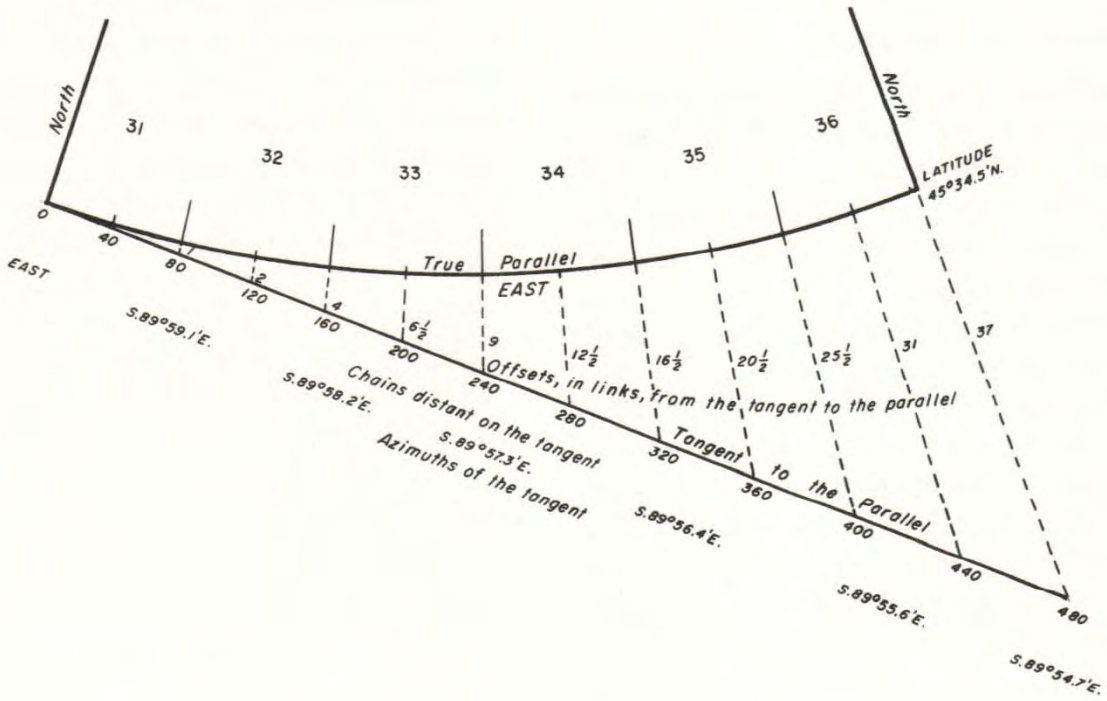


Figure 2-1. Lines on exaggerated converging meridians.

Rhumb Lines - Parallels of Latitude



Rhumb Lines - Parallels of Latitude



$$\text{Offset (in chains)} = \frac{1}{R_p} \cdot \frac{(m\phi)^2}{2} \cdot \sin b, \text{ where}$$

$\frac{1}{R_p}$ is taken from the table in section 2–79 for the latitude of the beginning point

$m\phi$ = distance from the beginning point in chains

b = forward bearing at the beginning point

Line of Constant Bearing
Straight line

Act of February 11, 1805

… to be subdivided into sections, by running straight lines from the mile corners thus marked, to the opposite corresponding corners…

Tiffin's Instructions, 1815

Great care must be taken that the north and south lines be run according to the true meridian as required by law, and east and west lines be run at right angles to them as far as practicable…

Line of Constant Bearing Straight line

Lines of Constant Bearing

Most lines in the PLSS are intended to be surveyed as lines of constant bearing. This is a direct result of the requirement that the lines be run "according to the true meridian" thereby crossing each meridian at the same angle.

Examples of lines of constant bearing:

- Base lines
- Standard Parallels
- Random latitudinal township boundary lines

Line of Constant Bearing Straight line

Lines of Constant Bearing (cont.)

Grant lines

Reservation lines

Lines of constant bearing can be defined as a forward bearing, a reverse bearing and a mean bearing in a rectangular system. This line is from the beginning point to the ending point, and follows the rhumb line.

The rate of departure of a line of sight from a true parallel is a function of the latitude on the earth's surface.

Rhumb Lines - Parallels of Latitude

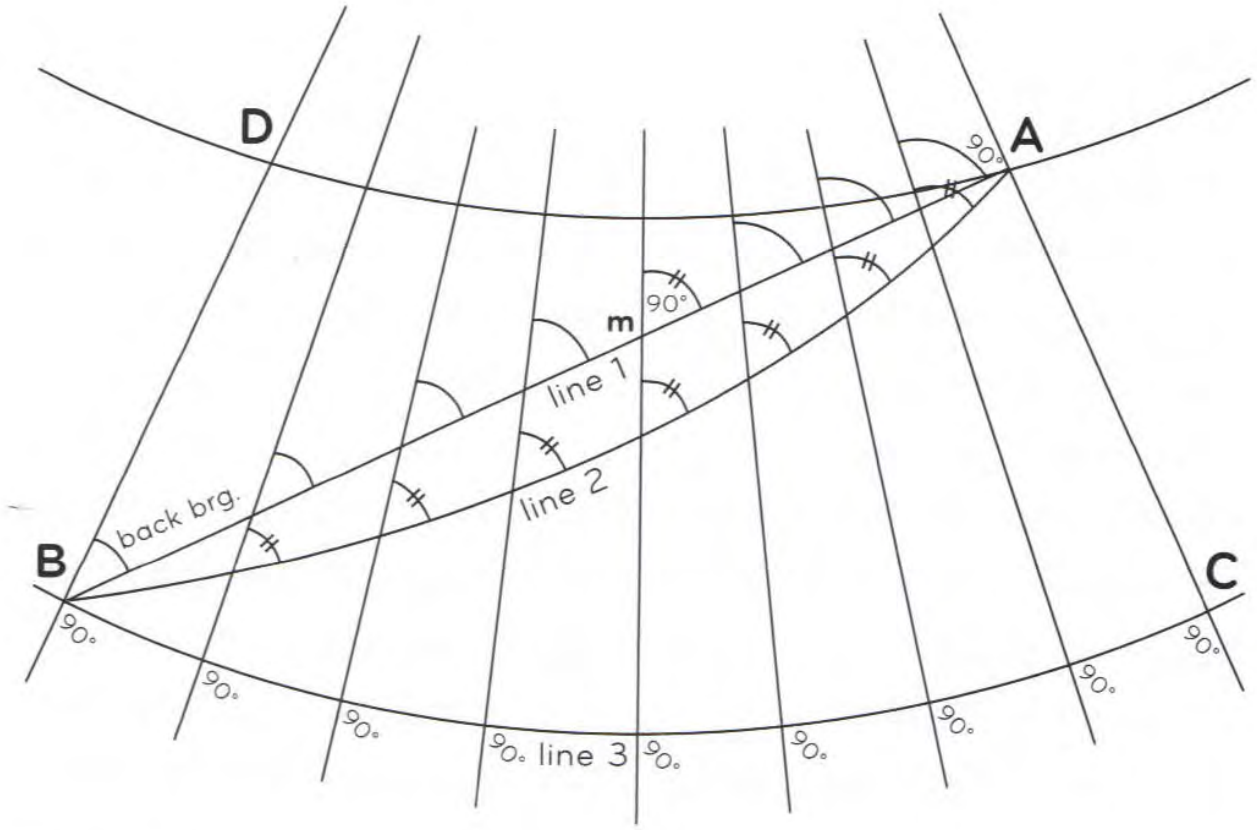


Figure 2-1. Lines on exaggerated converging meridians.

Line of Sight

The line of sight is defined as the shortest distance between two points. Conventional surveying instruments make measurements along the line of sight. This line is a line of constantly changing bearing.

A line of sight passes each meridian at a different angle.

In the PLSS line of sight lines have a different bearing at each corner point on the line.

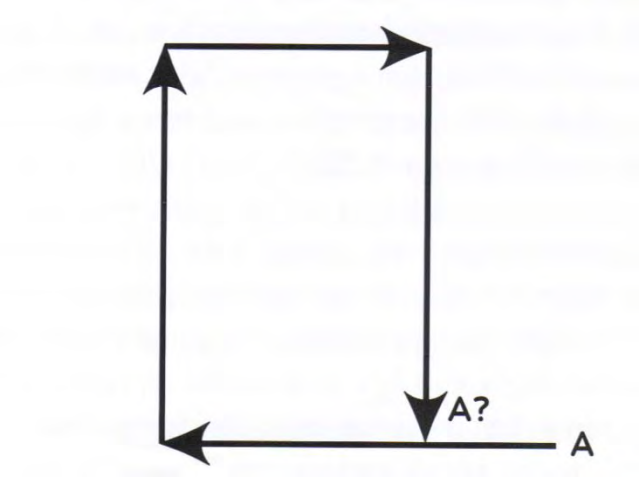
The line along a meridian is also a line of sight.

Apparent Misclosure

The basis of bearing of the PLSS is not rectangular. Using plane computational methods on the PLSS datum will result in a geometric effect called the apparent misclosure due to meridional convergence. In the PLSS datum, even if all measurements are perfect, there will be an apparent misclosure when using a plane coordinate system. This effect will increase with an increase in latitude. The apparent misclosure is also a function of the area of the figure.

Apparent Misclosure

A “cardinal square” having sides that are cardinal north, west, south and east by true mean bearings such as a section having 80.00 chains on a side at 40°N latitude will be shorter by 1.69 links (1.15 feet) on the north line. At 70°N latitude the same figure will be 5.53 links (3.53 feet) shorter.



Grid Coordinate Systems

State plane systems allow surveyors to work in a plane coordinate system over limited areas without significant angular or distance distortions.

The Missouri coordinate system of 1983 is based on the Transverse Mercator projection. Arkansas and Kansas both use the Lambert Conformal Conical projections for their state plane coordinate systems. In Missouri there are three state plane zones:

Eastern Zone	CM = 90°30’
Central Zone	CM = 92°30’
Western Zone	CM = 94°30’

Grid Coordinate Systems

Grid Factor

The grid factor is the conversion for ground distances to grid distances. This is used to place the measured distances on the ground surface onto the grid surface to calculate grid distances and grid coordinates.

The grid factor is related to two major components:

Elevation Factor

Scale Factor

The elevation factor is related to the difference in elevation of the ellipsoid, the geoid and the ground.

Grid Coordinate Systems

The grid factor is not as sensitive to errors in elevation as it is to errors in the scale factor.

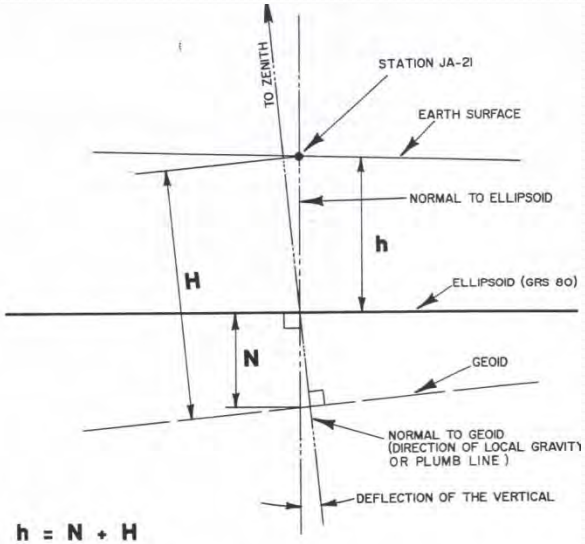


Figure 6. Surfaces at Station JA-21

Grid Coordinate Systems

CHAPTER 5
GRID DISTANCES, GRID BEARINGS, AND THEIR COMPUTATION
MEASUREMENT OF DISTANCES

ELEVATION FACTOR

The surveyor measures all his distances on the earth's surface; therefore, the first step in using state plane coordinates is the reduction of these measurements to distances on the reference ellipsoid (fig. 15).

The general concept is to multiply the ground distance by a factor (table 1) which is dependent upon the mean elevation of the line being measured.

$$S = Sm \left(\frac{R}{R+H}\right)\left(1 - \frac{N}{R}\right)$$

S = Sm times elevation factor

$$\text{Elevation factor} = \left(\frac{R}{R+H}\right)\left(1 - \frac{N}{R}\right)$$

Where S = Ellipsoid distance

Sm = Measured ground distance

R = Ellipsoid radius in feet

N = Geoid separation in feet

H = Mean elevation of measurements in feet

For Missouri Coordinate System 1983: *(H in feet)*

$$\text{Elevation factor} = \left(\frac{20{,}909{,}689}{20{,}909{,}689 + H}\right)(1.00000479)$$

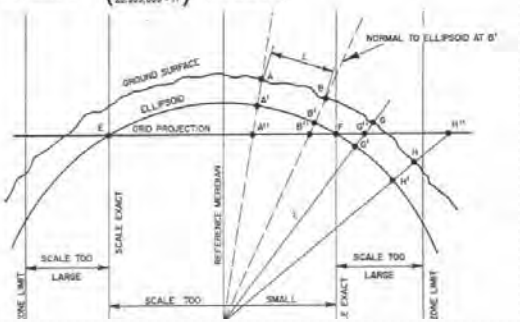


Figure 15. Section of Earth

Grid Coordinate Systems

The scale factor is another component of the grid factor and in the transverse Mercator projection varies with distance from the central meridian for each of the three zones.

The grid factor is determined by the multiplying the elevation factor and the scale factor.

It is important to understand the use of state plane coordinate systems even though the use of GPS has in some cases simplified the conversion.

Grid Coordinate Systems

Measurement of Directions

The basis of direction in the state plane coordinate system is coordinate grid lines. In the transverse Mercator projection grid north and geodetic north are the same along the central meridian. All grid lines in the plane system are parallel or perpendicular to the central meridian. The true meridians converge and therefore the grid and true meridian only coincide at the central meridian for the zone. The amount that grid north differs from geodetic north is called grid convergence.

Grid Coordinate Systems

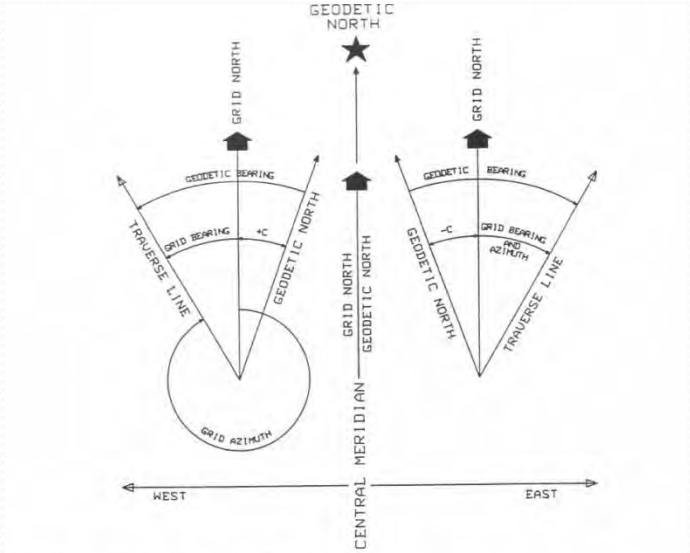


Figure 16. Grid Azimuth and Geodetic North

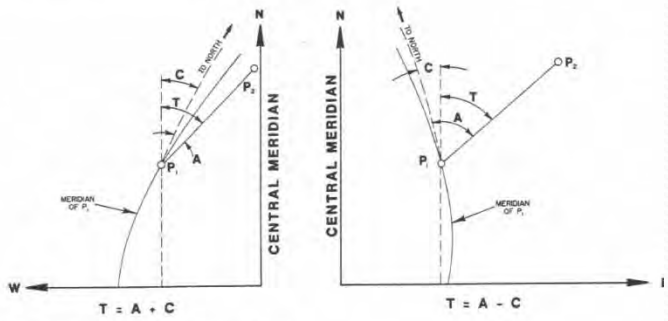


Figure 17. Grid Bearing and Geodetic North

Grid Coordinate Systems

Adjustment date

The date of adjustment of the control stations makes a difference in the value of the state plane coordinates. It is also important to understand what adjustment is being used when using RTK GPS even with OPUS and MoDOT VRS.

MONUMENTATION

From the GLO Surveys to Present

MONUMENTATION

- Survey monumentation has evolved along what I would call a bell curve

  Non-durable Large durable small durable

- We will discuss the range of monumentation from the original GLO surveys through the ages to our current monumentation standards with an interjection of odd and unusual monumentation.

ORIGINAL INSTRUCTIONS

- 1815 – Instructions for Deputy Surveyors
- 1831 – Circular from GLO to Surveyor General
- 1832 – Haywoods Instructions canceling fingerboards and irons
- 1834 – Instructions to Deputy Surveyors, Illinois & Missouri
- 1855 – Instructions to Surveyor General of Public Lands
- 1864 – Instructions to the Surveyor General
- 1871 – Instructions to the Surveyor General
- 1881 – Instructions to the Surveyor General

1815 – Edward Tiffin

1766-1829

1812 - Appointed by President Madison as Commissioner of General Land Office

"The posts must be erected at the distance of every mile, and half mile from where the town or sectional line commenced (except a tree may be so situated as to supply the place of a post, which post must be at least three inches diameter and rise not less than three feet..."

...notched on south and east the number of miles from SE corner of twp.

...no marks on 1/2 mile posts

...two bearing trees in opposite directions

...WT's at section corners marked from bottom to top...SEC, TXX, RXX

...WT's at quarter corners marked 1/4S

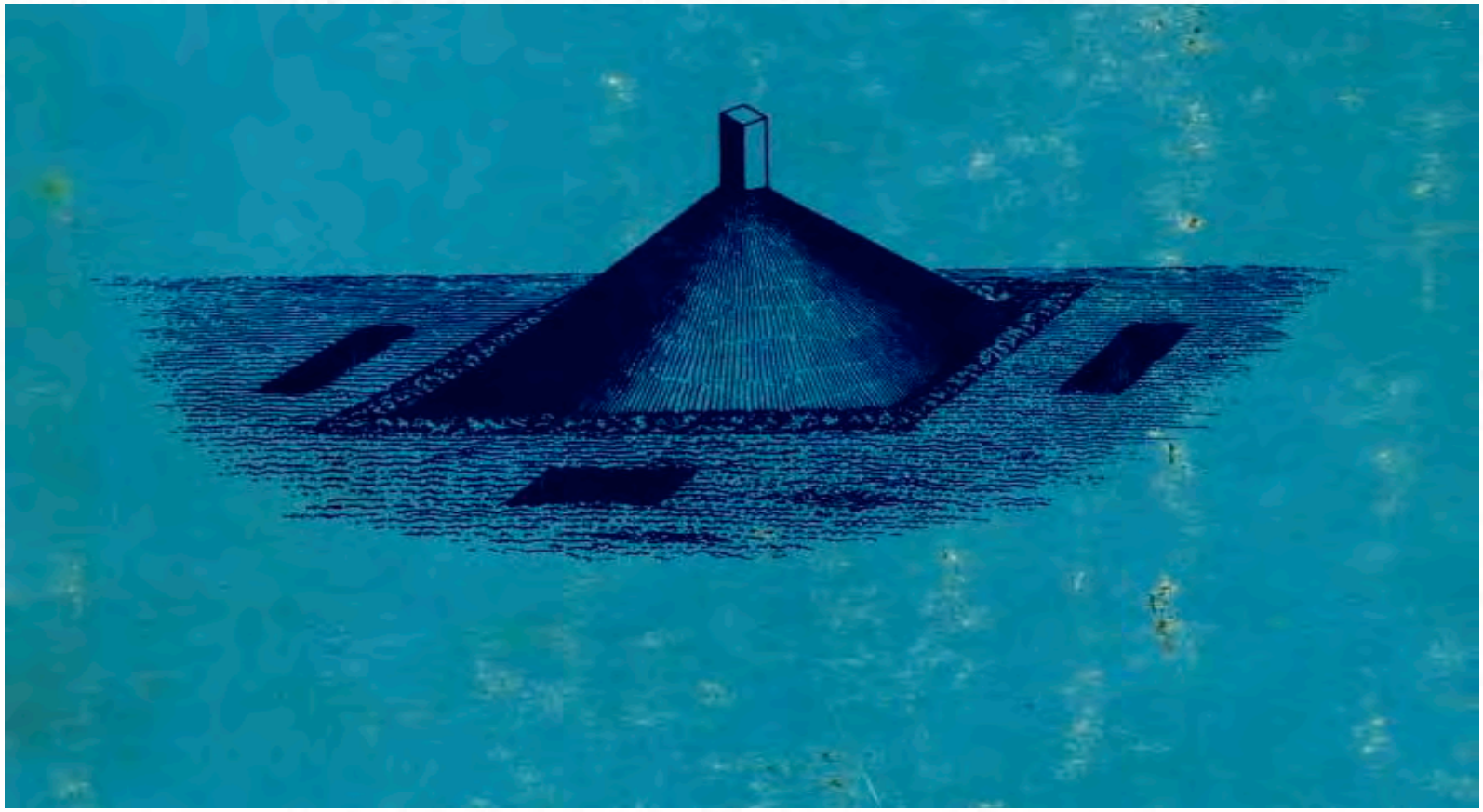
1/4S Scribing

WOOD POSTS - SUBSEQUENT

Circular from GENERAL LAND OFFICE to SURVEYOR GENERAL – 1831: Elizah Haywood

- Posts made of the most durable wood and set in the earth to depth of two feet and very securely rammed in with earth and stone.
- Sides to be numbered to correspond with number of section it faces
- In prairie counties mounds covered with sod to be erected, recommended that stone be planted in center of mound with a few handfulls of charcoal to be enclosed therein and at each corner of the squares enclosing the mound and conform to cardinal points be planted a chestnut, hickory nut, walnut or acorn.
- stake, fingerboard in black oil paint (cancelled in 1832)
- approved 'red' paint traced in groove cut by marking irons
- The perpetuation of the corners of the Public Surveys is a subject of ***primary importance***

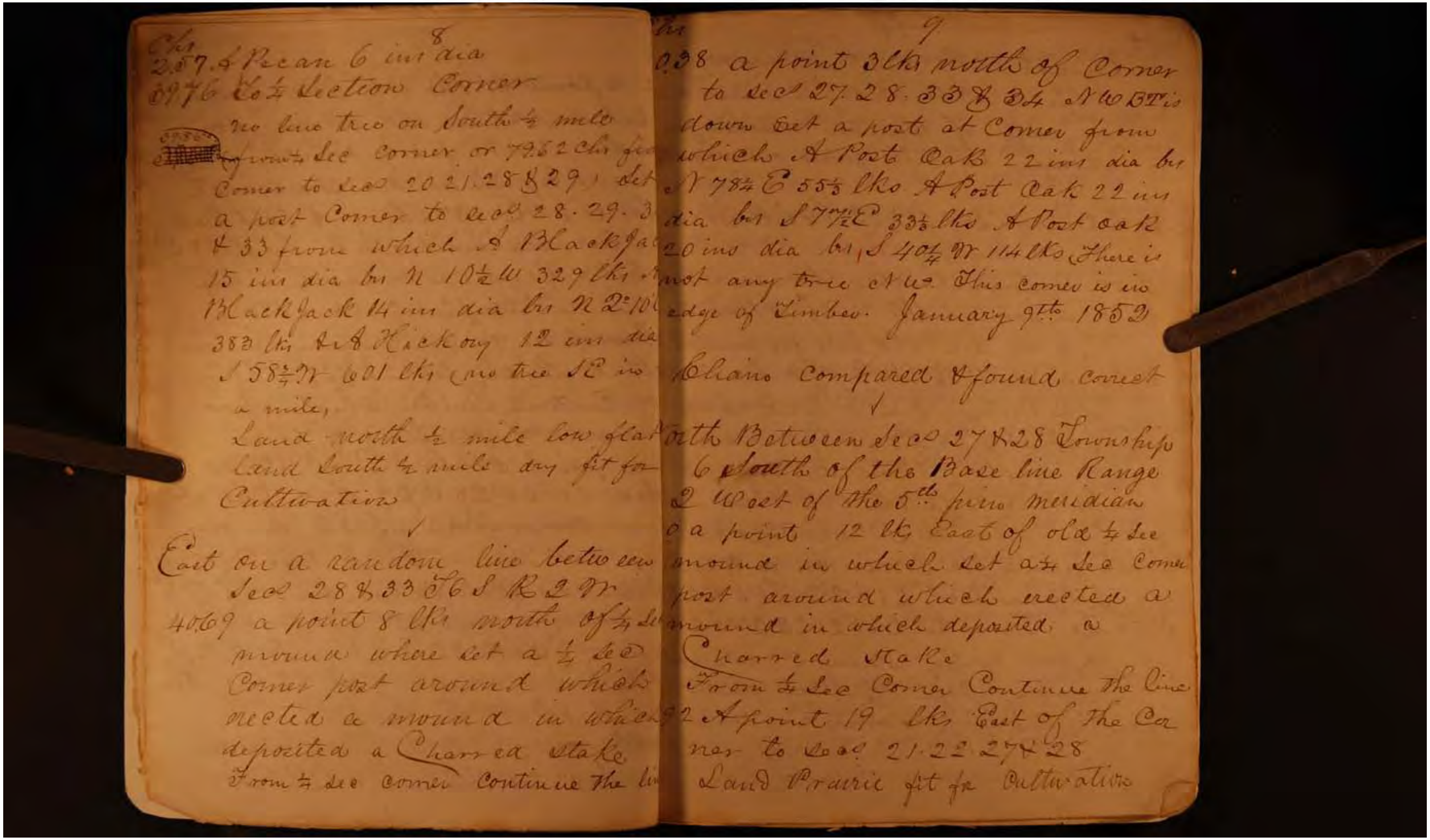
Pits & Mound



General Instructions (1834) to Deputy Surveyors in Illinois and Missouri

- Plant a post of the most durable wood that can be had in the vicinity
- Digging a hole to admit them *two feet deep* and rammed with earth
- Township corner posts at least 5”, section and fractional section 4” diameter, they must be *neatly squared off* at top and placed so, that the corners will correspond to the cardinal points.
- Shall be notched in miles from the SE corner of the township.
- Posts at township corners will have 6 notches on each of the four corners, or in lieu of posts, you may insert endways into the ground to a depth of 7 or 8 inches, a stone which shall be not less than 12”W x 14”L x 3”Thick.
- Mounds: At Township Corners, 3' H x 5' Sq. x 2' Sq. at the top
  At Section Corners, 2' 6” H x 4' Sq. x 2' Sq. at the top
  At Quarter Corners, 2' H x 3' 6” Sq. x 1' 6” Sq. at the top

GLO Notes - Mound


Chs 8
2.57 A Pecan 6 ins dia
39.76 To ¼ Section Corner
no line tree on South ½ mile
from ¼ Sec corner or 79.62 Chs from
Corner to Secs 20 21.28 & 29, set
a post Corner to Secs 28.29.3
& 33 from which A Black Jack
15 ins dia bs N 10½ W 329 lks A
Black Jack 14 ins dia bs N 2° 10
383 lks & A Hickory 12 ins dia
S 58¾ W 601 lks (no tree SE in
a mile,)
Land north ½ mile low flat
Land South ½ mile dry fit for
Cultivation

East on a random line between
Secs 28 & 33 T 6 S R 2 W
40.69 a point 8 lks north of ¼ Sec
mound where set a ¼ Sec
Corner post around which
erected a mound in which
deposited a Charred Stake
From ¼ sec corner Continue the line

Chs 9
0.38 a point 3 lks north of Corner
to Secs 27.28.33 & 34 N W B T is
down Set a post at Corner from
which A Post Oak 22 ins dia bs
N 78¼ E 55½ lks A Post Oak 22 ins
dia bs S 7½ E 33½ lks A Post oak
20 ins dia bs S 40¼ W 114 lks There is
not any tree N W. This corner is in
edge of Timber. January 9th 1852

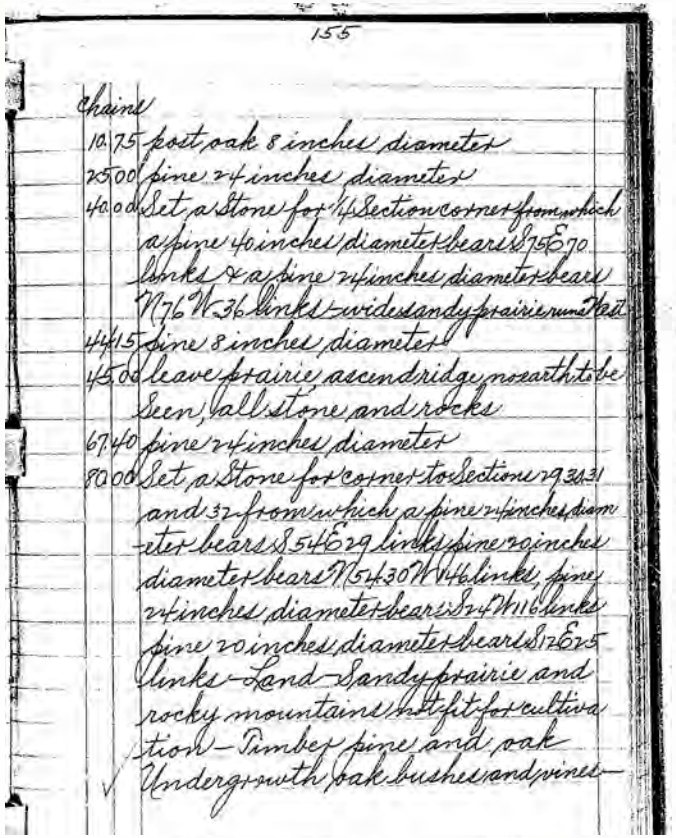
Chains compared & found correct

North Between Secs 27 & 28 Township
6 South of the Base line Range
2 West of the 5th prin meridian
0 a point 12 lks East of old ¼ Sec
mound in which set a ¼ Sec Corner
post around which erected a
mound in which deposited a
Charred Stake
From ¼ Sec Corner Continue the line
2 A point 19 lks East of the Cor-
ner to Secs 21.22.27 & 28
Land Prairie fit for Cultivation

General Instructions (1834) to Deputy Surveyors in Illinois and Missouri

- or...deposit at the place of the corner, three stones, not less than five inches square by three inches thick – the top of the uppermost stone to be 3” below the natural surface of the ground....over said stones erect a mound.
- or...in lieu of charcoal or stone...insert endways into the ground, and to a depth of 7 or 8 inches, a stone, which shall not be less than 12” wide, 14” long, and 3” thick; over which no mound need be erected...the kind of stone used with its shape and dimensions and the manner in which it is set, must be particularly described in your field notes.
- Quarter Section posts (of durable wood) 3” diameter, placed in the ground and marked 1/4S...with two witness trees.

General Instructions (1834) to Deputy Surveyors in Illinois and Missouri - cont.



155

Chains

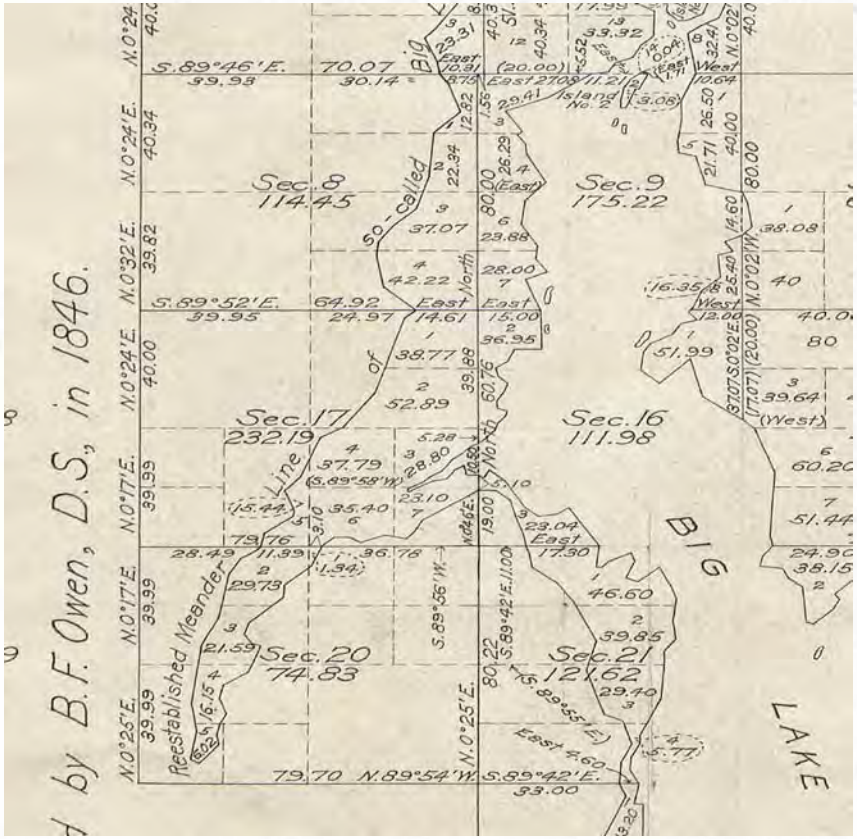
10.75 post oak 8 inches diameter
25.00 pine 24 inches diameter
40.00 Set a Stone for 1/4 Section corner from which a pine 40 inches diameter bears S 75 E 70 links & a pine 24 inches diameter bears N 76 W 36 links wide sandy prairie runs N & S
44.15 pine 8 inches diameter
45.00 leave prairie, ascend ridge, no earth to be Seen, all stone and rocks
67.40 pine 24 inches diameter
80.00 Set a Stone for corner to Sections 29 30 31 and 32 from which a pine 24 inches diameter bears S 54 E 29 links, pine 20 inches diameter bears N 54 W 46 links, pine 24 inches diameter bears S 24 W 116 links pine 20 inches diameter bears S 12 E 75 links — Land — Sandy prairie and rocky mountains not fit for cultivation — Timber pine and oak Undergrowth oak bushes and vines

- In some townships the requirement of stone type and sizing was ignored.
- T27N R4W
  Charles DeWard - 1840

THE $$$$$ ORIGINAL STONE

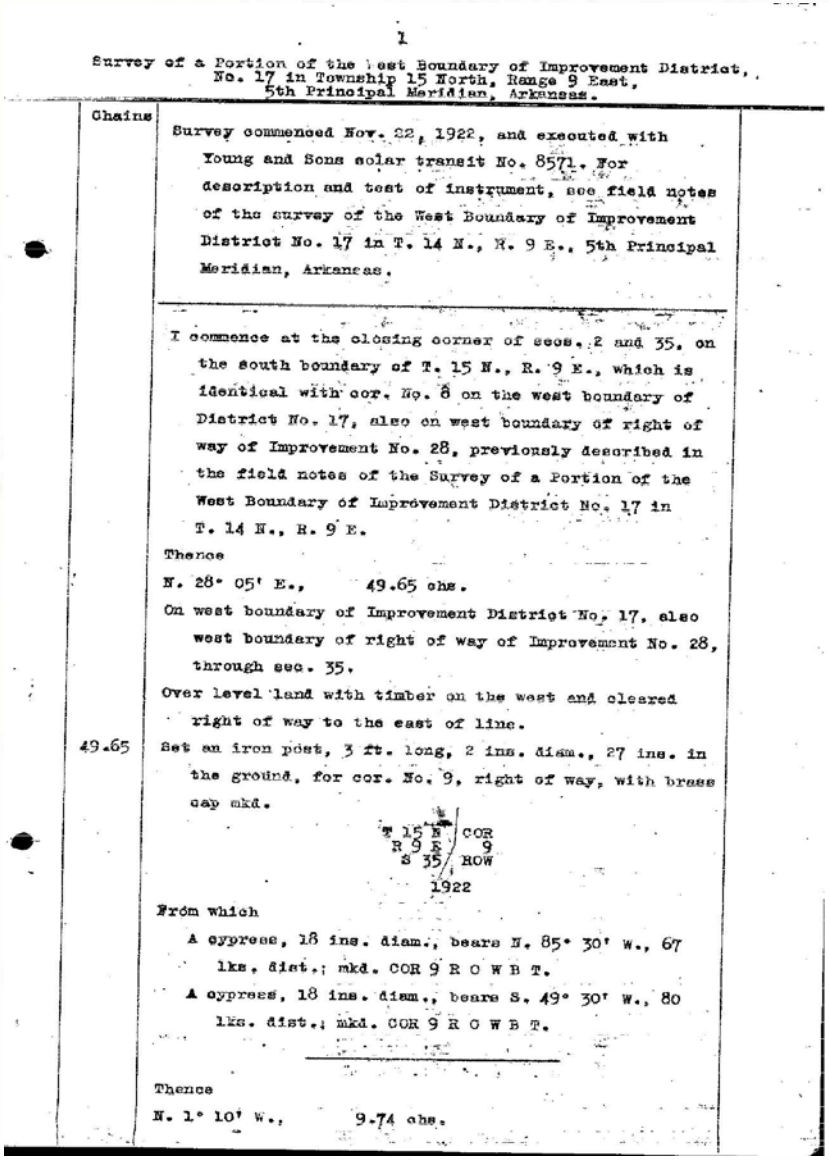
- Original stone recovered at the 11,12,13,14 Section Corner T27N R3W
- Original notes 1840 “set a stone”
- Position originally proportioned
- Stone recovered: Sandstone 26”x11”x6” with notches
- 1838 scribed on stone

Retracement & Extension Survey



- 1848 – Original Survey
- 1922 – Retracement and Extension surveys

Extension Survey – 15N 9E



1

Survey of a Portion of the West Boundary of Improvement District, No. 17 in Township 15 North, Range 9 East, 5th Principal Meridian, Arkansas.

Chains

Survey commenced Nov. 22, 1922, and executed with Young and Sons solar transit No. 8571. For description and test of instrument, see field notes of the survey of the West Boundary of Improvement District No. 17 in T. 14 N., R. 9 E., 5th Principal Meridian, Arkansas.

I commence at the closing corner of secs. 2 and 35, on the south boundary of T. 15 N., R. 9 E., which is identical with cor. No. 8 on the west boundary of District No. 17, also on west boundary of right of way of Improvement No. 28, previously described in the field notes of the Survey of a Portion of the West Boundary of Improvement District No. 17 in T. 14 N., R. 9 E.

Thence

N. 28° 05' E., 49.65 chs.

On west boundary of Improvement District No. 17, also west boundary of right of way of Improvement No. 28, through sec. 35.

Over level land with timber on the west and cleared right of way to the east of line.

49.65 Set an iron post, 3 ft. long, 2 ins. diam., 27 ins. in the ground, for cor. No. 9, right of way, with brass cap mkd.

T 15 N
R 9 E
S 35
COR
9
ROW
1922

From which

A cypress, 18 ins. diam., bears N. 85° 30' W., 67 lks. dist.; mkd. COR 9 R O W B T.

A cypress, 18 ins. diam., bears S. 49° 30' W., 80 lks. dist.; mkd. COR 9 R O W B T.

Thence

N. 1° 10' W., 9.74 chs.

- Monumented with iron post, 3 ft. long, 2 ins. diam., 27 ins. in the ground with brass cap mkd....

COUNTY SURVEYORS

- Late 1800's – Early 1900's.....Stone Age
- 1930's – 1960's.....Whatever was laying around the farm
- 1964 – Current....Minimum Standards.....rebars, pipes, iron rods

STONE AGE

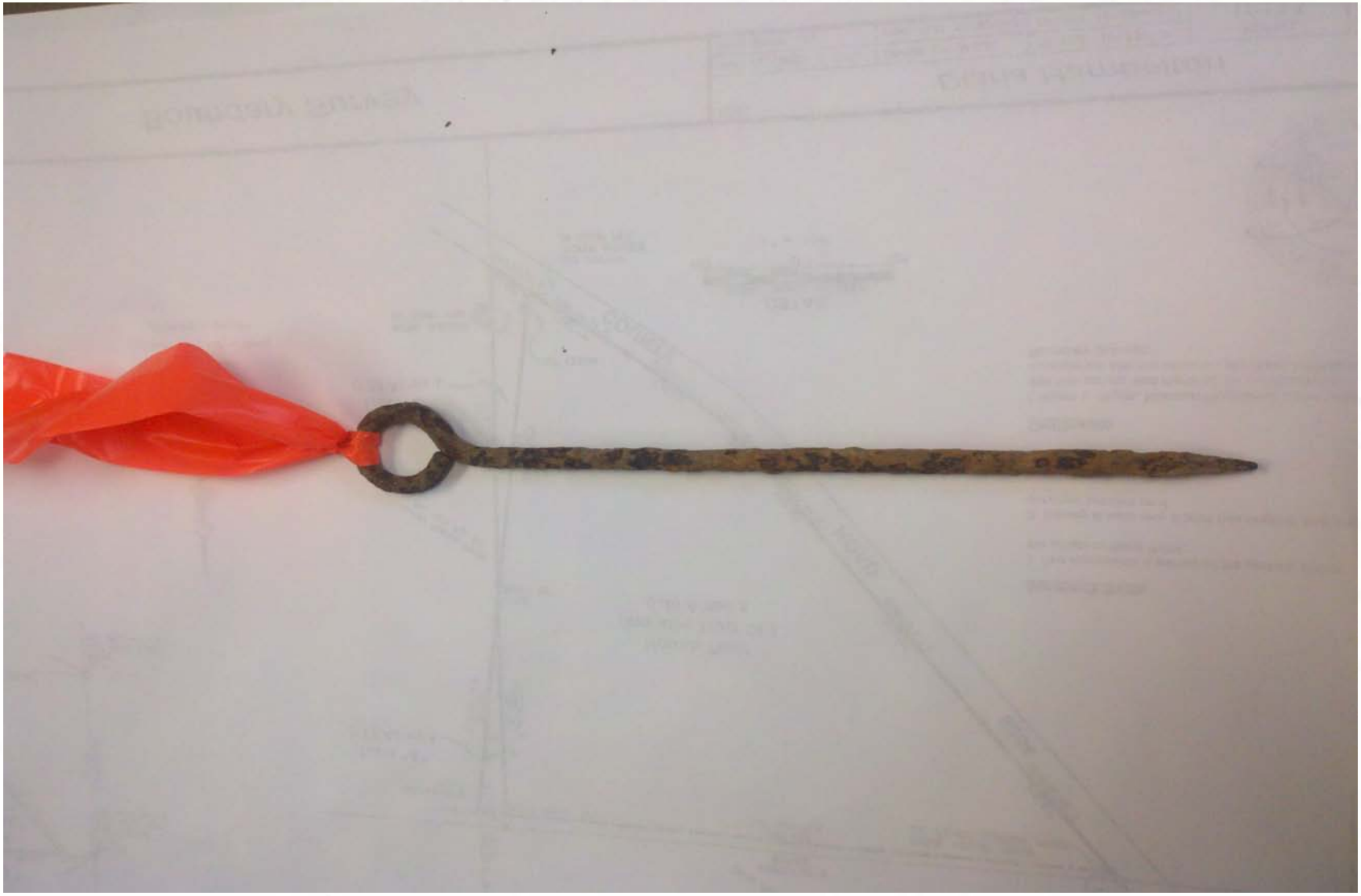
- Set a stone.....no dimensions & dimensioned
- Mound of stones
- “X” or marks on Boulders
- Unique Stones
- County Surveyors had unique traits.....

STONE AGE

JUNK IRON AGE

- Wagon tire irons, wagon irons, wagon thimbles, plowshares
- sucker rods, axles, washing machine wringers
- rifle barrels, musket barrels, chaining pins?
- Model A engine...

Chaining Pin



Broken Glass, Charcoal Under Stones

JUNK IRON

- A collection of iron removed at corners perpetuated with DNR Co-Op Monumentation

STANDARDIZED ERA

- First Minimum Standards – Advisory only, November 1964
- First promulgated by authority – 1973
- Current Minimum Standards - 2003

CURRENT MONUMENTATION STANDARDS

- PERMANENT MONUMENTS
- Concrete Monuments at least 4” square, no less than 24” long with stamped brass or aluminum cap.
- Commercial cast iron or aluminum markers no less than 24” long nonferrous markers shall have magnets attached
- Steel rods not less than 5/8” X 24” with cap, iron pipe markers not less than 3/4” inside diameter with cap.
- Brass or aluminum disk not less than 2” diameter countersunk and cemented in drill hole.

CURRENT MONUMENTATION STANDARDS

- SEMI-PERMANENT MONUMENTS
- Iron pipe markers not less than 3/4” *outside* diameter, not less than 18” long
- Steel rod markers not less than 1/2” x 18” with plastic or alum. cap
- Cross-cut or drill hole
- In asphalt, RR spikes, cotton picker spindles CPS and other metal devices. PK and concrete nails not to be used

CONCLUSION

- Monumentation standards and requirement have transformed from less durable objects such as wooden posts and mounds to large durable objects such as stones, rock mounds, etc. to our current standards of ferrous metals.
- Main objective is to establish or perpetuate the corners of the Public Land Survey System to a degree that is the most permanent to be easily recovered by those who *follow our footsteps.*

BONA FIDE RIGHTS

- BONA FIDE - made, done, presented, etc., in good faith; without deception or fraud

BONA FIDE RIGHTS

1973

Resurvey of Public Lands. The Act of March 3, 1909 (35 Stat. 845) as amended June 25, 1910 (36 Stat. 884; 43 U.S.C. 772), provides that: "The Secretary of the Interior may, as of March 3, 1909, in his discretion, cause to be made, as he may deem wise under the rectangular system on that date provided by law, such resurveys or retracements of the surveys of public lands as, after full investigation, he may deem essential to properly mark the boundaries of the public lands remaining undisposed of: *Provided,* that no such resurvey or retracement shall be so executed as to impair the bona fide rights or claims of any claimant, entryman, or owner of lands affected by such resurvey or retracement, ..."

2009

Chapter 6-50
Describes conditions that warrant protection of bona fide rights as to location due to:

1) gross errors in original survey

2) inadequate original evidence

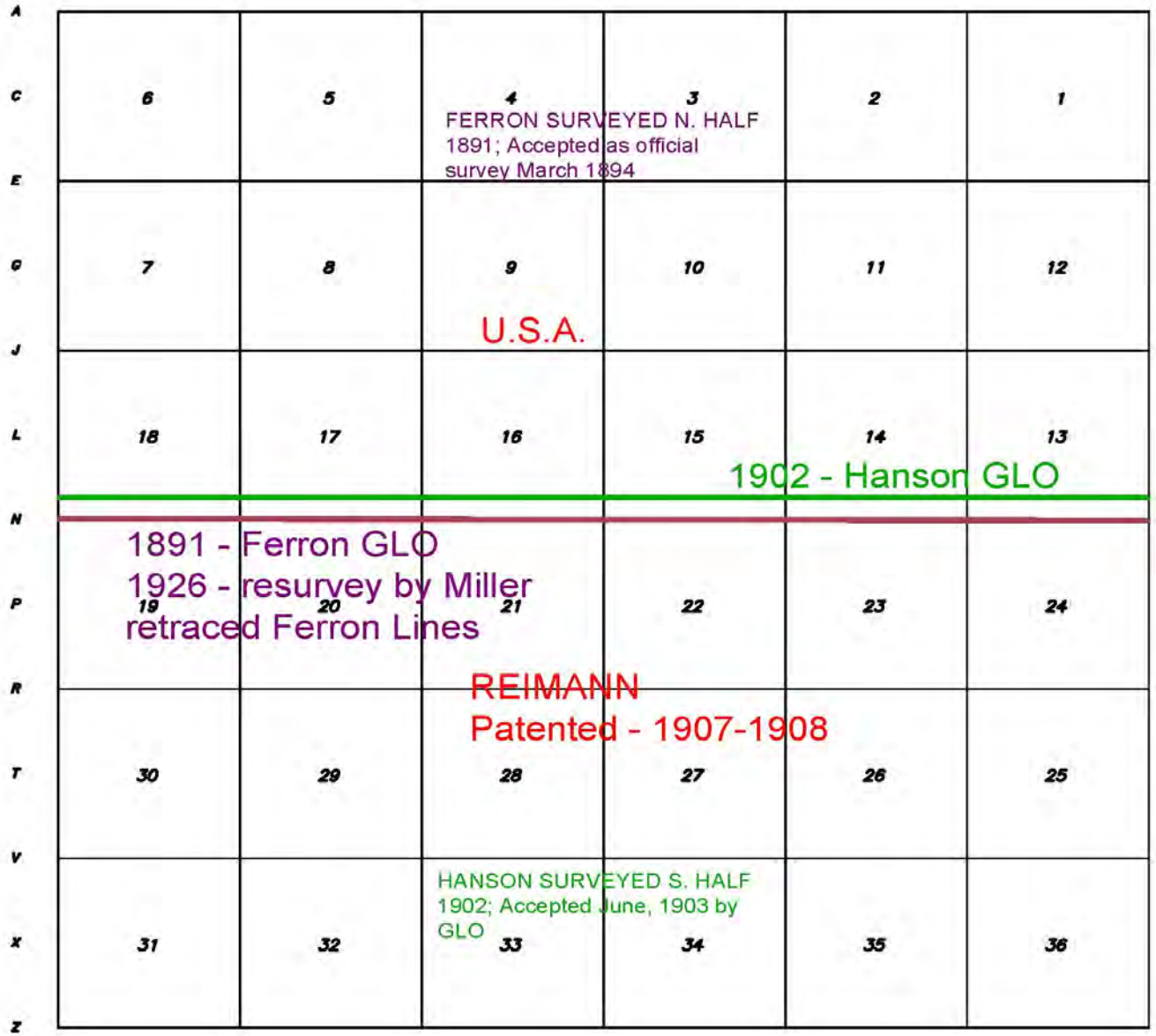
3) complicated conditions, double corners, other conflicting evidence

Chapter 6-53
may also vest to local surveys that rely on original evidence

United States v. Reimann
504 F.2d 135

"It would be inequitable to permit the government...to accept a survey,...recording it with knowledge that it would be relied upon by patentees, and then grant the government the right to alter correct its error, ex parte, to the detriment of those who did in fact, and in good faith, rely upon it."

U.S.A v. Reimann
U.S. Court of Appeals; 504 F.2d 135



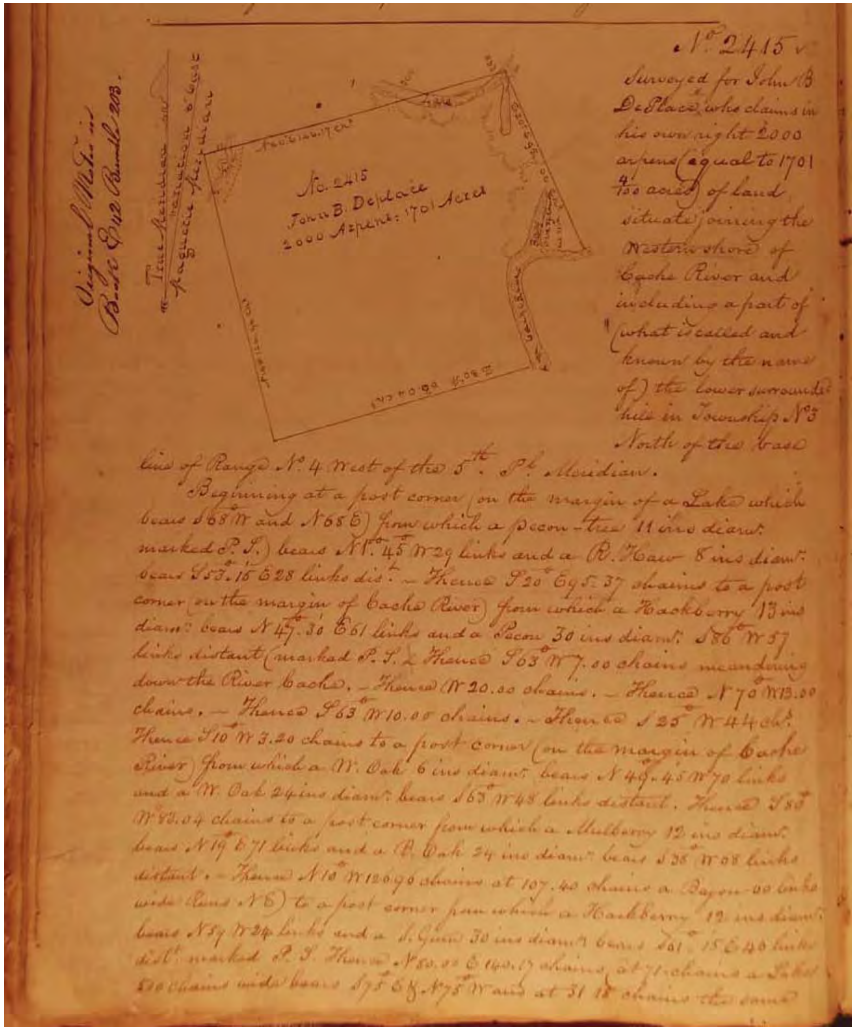
Spanish Land Grants

- Represent some of earliest land transactions and establishment of title....from late 1600's to 1803.
- 1805 – Congress passed legislation establishing rules and procedures for titles to be confirmed or unconfirmed by appointed land commissioners.
- Claims established after October 1, 1800 were not recognized

GLO NOTES - 1842 - OOPS!

Chains	
50.00	left upland entered overflow of 8 feet
64.70	To Cache River runs SW Thence I travel down to Mr Lewis's about ½ a mile SW to cross the river & learn that I was mistaken about crossing Cache on the line East of Section 24 the water course that I crossed on that line was a Sloo running from White River into Cache River Thence I travel to the corner to Townships 2 & 3 North Ranges 3 & 4 West & continue the Random line no further
North	along the East side of Section 36 T 3 N R 4 W
16.97	a sweet Gum 16 inches dia
23.50	left cane
40.00	Set a ¼ Section corner post from which a Hackberry 14 inches dia Bears N 41 W 21½ links and a sweet Gum 24 inches dia Bears S 21½ W 36 links
55.41	a sweet Gum 32 inches dia
71.50	Entered cane

Grant Survey - 1819


Original Notes in Book E 42 Bundle 203.

True Meridian

Magnetic Meridian

No. 2415
John B. DePlace
2000 Arpens = 1701 Acres

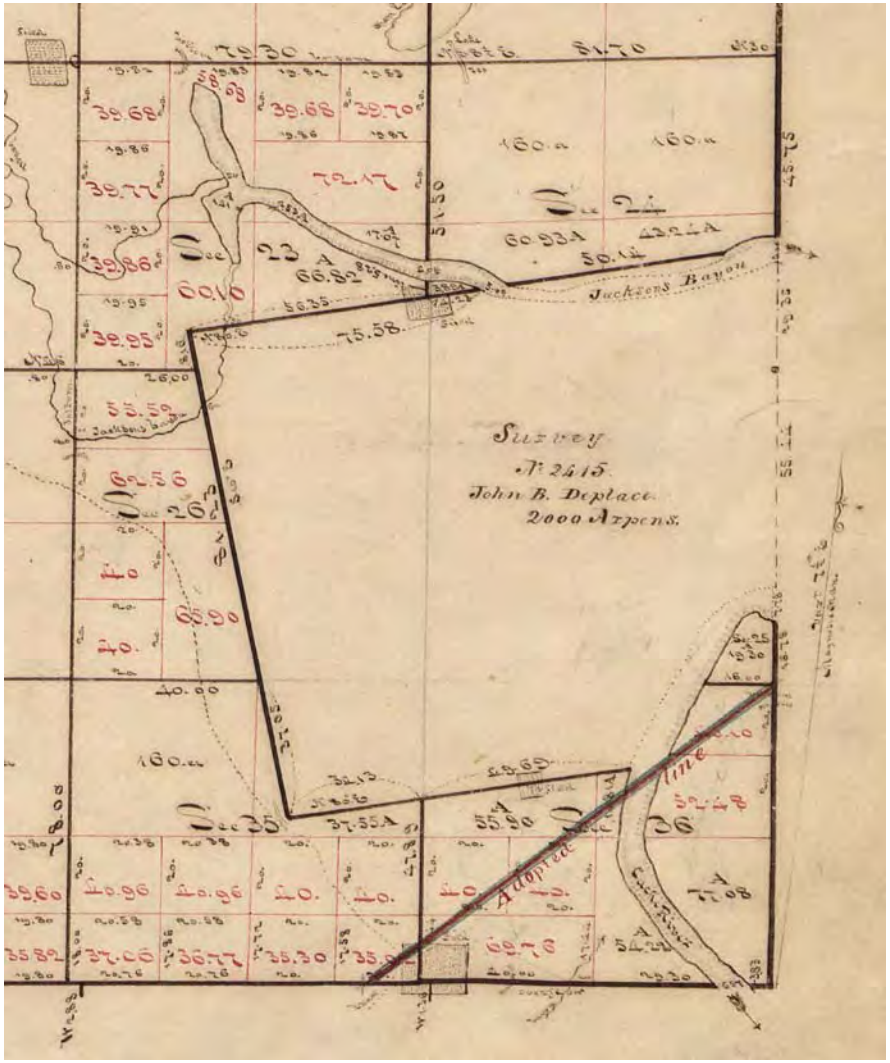
No. 2415

Surveyed for John B DePlace who claims in his own right 2000 arpens (equal to 1701 4/100 acres) of land situate joining the Western shore of Cache River and including a part of (what is called and known by the name of) the lower surrounded hill in Township No 3 North of the base line of Range No. 4 West of the 5th. Pl. Meridian.

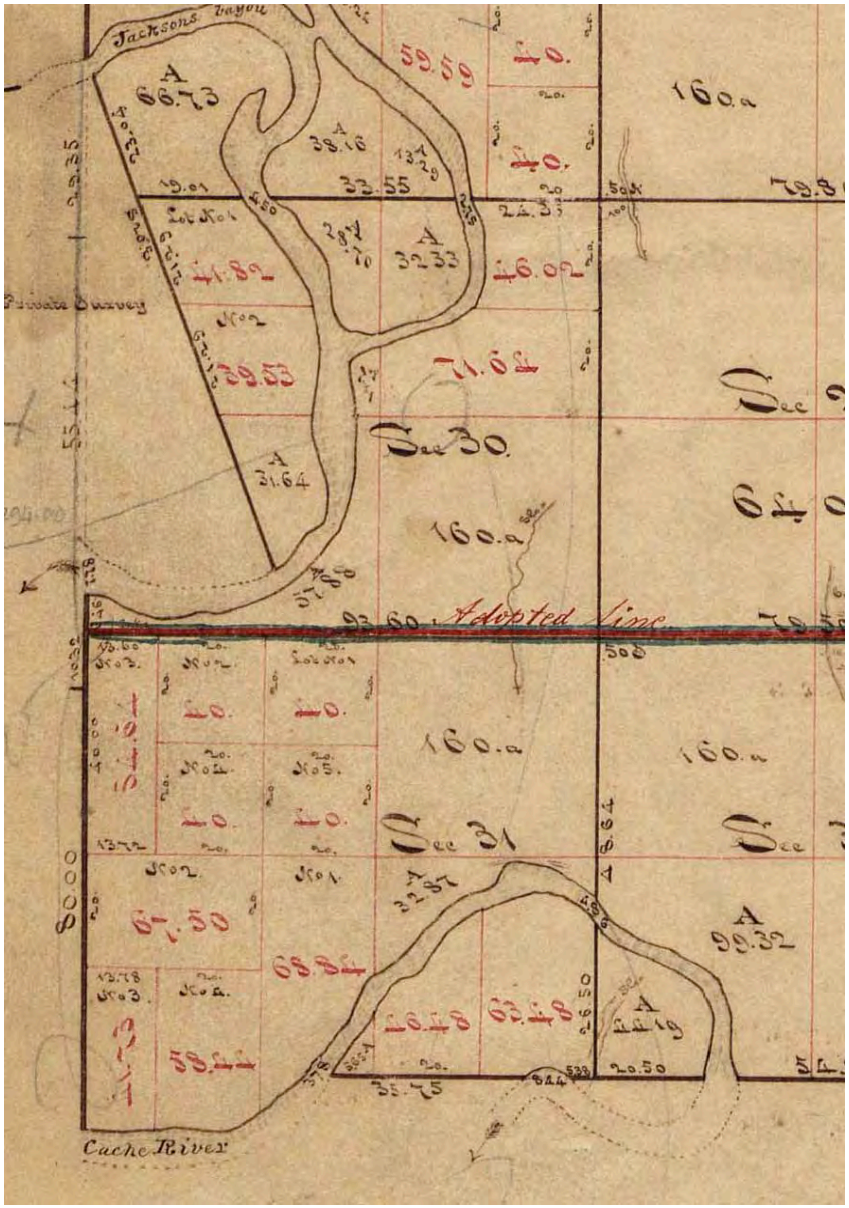
Beginning at a post corner (on the margin of a Lake which bears S 68° W and N 65 E) from which a Pecon tree 11 ins diamt. marked P. S.) bears N 1°.45 W 29 links and a R. Haw 8 ins diamt. bears S 53°.15 E 28 links dist. — Thence S 20° E 95.37 chains to a post corner (on the margin of Cache River) from which a Hackberry 13 ins diamt. bears N 47°.30 E 61 links and a Pecon 30 ins diamt. S 86° W 57 links distant (marked P. S.) Thence S 63° W 7.00 chains meandering down the River Cache. — Thence W 20.00 chains. — Thence N 70° W 13.00 chains. — Thence S 63° W 10.00 chains. — Thence S 25° W 44 chs. Thence S 10° W 3.20 chains to a post corner (on the margin of Cache River) from which a W. Oak 6 ins diamt. bears N 49°.45 W 70 links and a W. Oak 24 ins diamt. bears S 65° W 48 links distant. Thence S 80° W 82.04 chains to a post corner from which a Mulberry 12 ins diamt. bears N 19° E 71 links and a B. Oak 24 ins diamt. bears S 38° W 08 links distant. — Thence N 10° W 126.96 chains at 107.40 chains a Bayou 00 links wide (runs N E) to a post corner from which a Hackberry 12 ins diamt. bears N 57 W 24 links and a S. Gum 30 ins diamt. bears S 61°.15 E 40 links dist. marked P. S. Thence N 80.00 E 140.17 chains, at 71 chains a Lake 10 chains wide bears S 75 E & N 75 W and at 31 [illegible] chains the same

- Grant survey of 2000 arpens
- “No. 2415, surveyed for John B. DePlace, who claims in his own right 2000 arpens, equal to 1701 4/100 acres.

1840 – GLO Plat



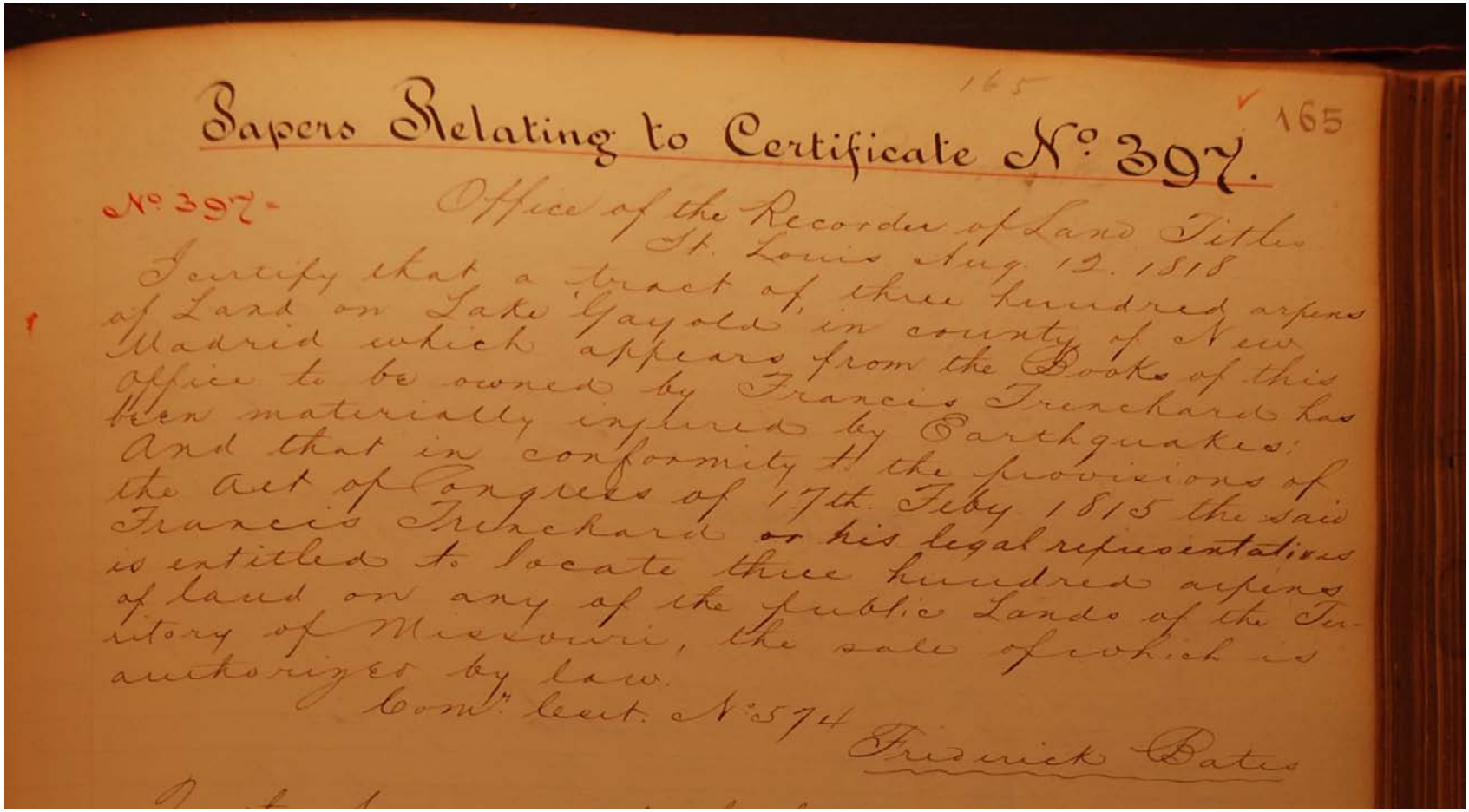
1840 – GLO PLAT



New Madrid Claims

- Established by Act of Congress in February of 1815
- Direct result of New Madrid earthquake of 1812
- Those “materially injured” could relocate to other unclaimed land in territory free of charge.
- Could not claim greater than what they previously owned
- Not to exceed 640 acres
- Those that owned less than 160 acres could claim up to 160 ac.

New Madrid Claim



Papers Relating to Certificate No. 397.

165

165

No 397.

Office of the Recorder of Land Titles
St. Louis Aug. 12. 1818

I certify that a tract of three hundred arpens of Land on Lake Gayoso in county of New Madrid which appears from the Books of this Office to be owned by Francis Trenchard has been materially injured by Earthquakes: And that in conformity to the provisions of the Act of Congress of 17th. Feby. 1815 the said Francis Trenchard or his legal representatives is entitled to locate three hundred arpens of land on any of the public Lands of the Territory of Missouri, the sale of which is authorized by law.

Comt. Cert. No 574

Frisnick Bates

Bona Fide Rights - conculsion

- Protecting....that which was made, done, presented, etc., in good faith; without deception or fraud
- *Knight v.United States Land Association, 142 US 161,181 (1891)*
  "It is obvious...that in the administration of such large and varied interests as are intrusted to the Land Department, matters not foreseen, equities not anticipated, and which are, therefore, not provided for by express statute, may sometimes arise, and, therefore, that the Secretary of the Interior is given that...power which will enable him, in the face of these unexpected contingencies, to do justice..." (2009 BLM Manual)

Resurveys

- Dependent Resurveys
- Retracements
- Extension or Completion Surveys
- Independent Resurveys

Dependent Resurvey

- 1973 – Chapter 6-4
  designed to restore the original conditions of the official survey according to the *record.*

- 2009 – Chapter 5-10
  ...is a retracement and reestablishment of the lines of the original survey or of a prior resurvey in their true original positions according to the best available evidence of the original corners...In legal contemplation and in fact, the lands contained in a certain section of the original survey and the lands contained in the corresponding section of the dependent resurvey *are identical.*

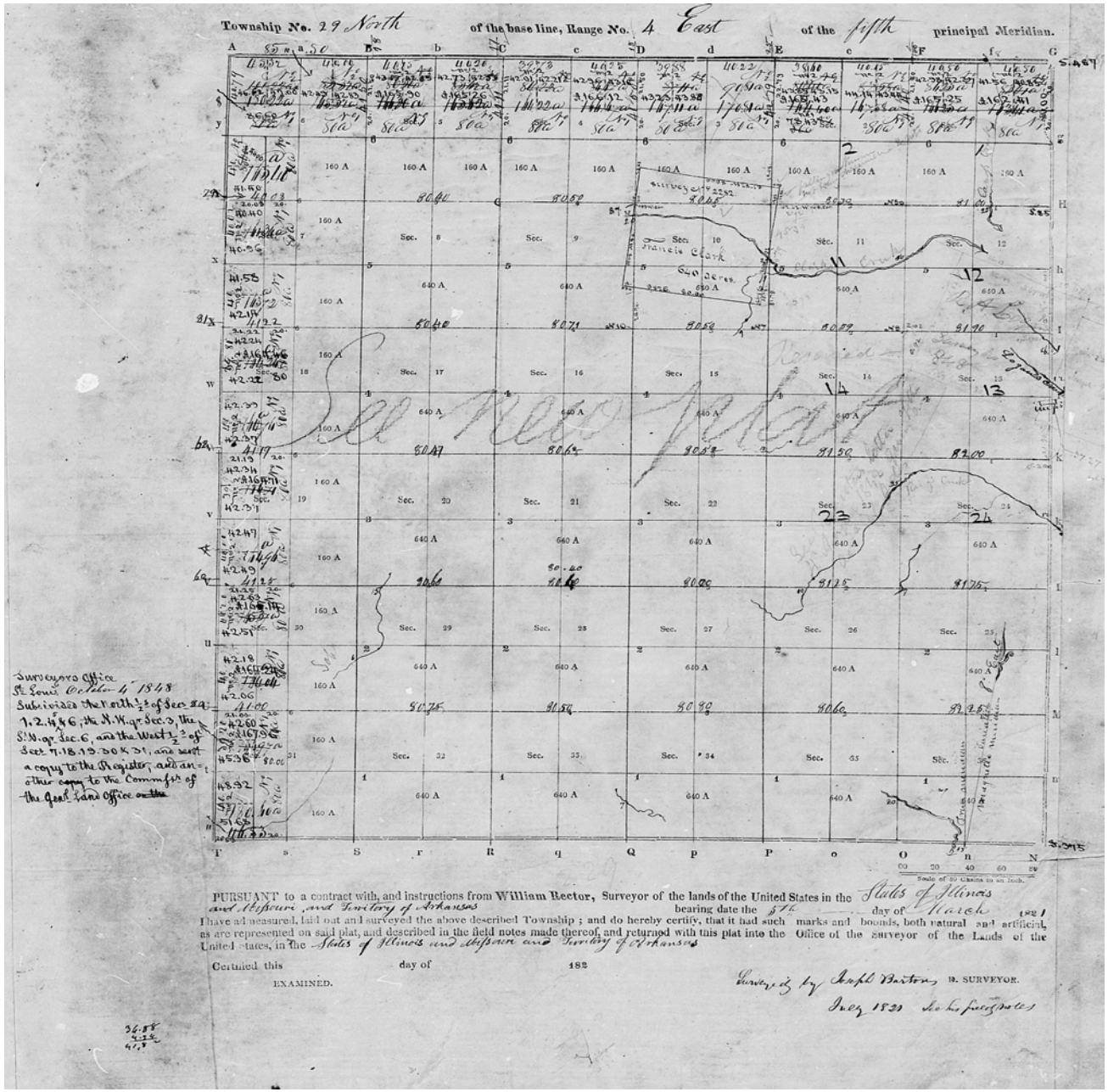
Dependent Resurvey

- Not fixing (repairing)
- Not moving
- Not shifting
- Is a reconstruction of the prior original survey (or resurvey)
- Original GLO corners are the true corners
- Congressional Act of 1805...”GLO corners are true corners and the distances on the plat are the true lengths of the lines.”

Dependent Resurvey based upon:

- Identified and found original corners
- Other acceptable points of control including “obliterated corners”
- Restored “lost corners” by proportionate measurement in harmony with the record of the original survey.
- Flexibility allowed in applying rules of proportionate measurement and subdivision of sections in order to protect the bona fide rights of claimants
- Particularly so in cases where no objection is found adopting a point acceptably located under the *good faith location rule.*

Original Survey – T29N R4E



Dependent Resurvey T29N R4E

GOOD FAITH LOCATION

- 2009 BLM Manual, Chapter 6-35
- “It may be held generally that the claimant, entryman, or owner of lands has located his or her lands by the good faith location rule if such care was used in determining the boundaries as might be expected by the exercise of *ordinary intelligence* under existing conditions”
- A good faith location is a satisfactory location of a claim or of a local point. It is one in which it is evident that claimant's interpretation of the original survey...is indicative of such a degree of care and diligence upon their part, or that of *their surveyor*...in the ascertainment of their boundaries as might be expected for that time and place”

GOOD FAITH LOCATION

- The surveyor should neither rigidly apply the rules for restoration of lost corners ...without regard to effect on location of improvements....nor accept the position of improvements without question regardless of their relation or irrelation to existing evidence of the original survey...
- Between these extremes will be found the basis for determination.
- No definite specific set of rules can be laid down in advance. The solution to the problem must be found on the ground by the surveyor.
- The responsibility to resolve the question of good faith as to location rests primarily upon the surveyor's judgement...

LOCAL POINTS OF CONTROL

- Once a local point of control is accepted in an official survey it has all the authority and significance of an original corner.
- Surveyor cannot abandon the record of the original survey in favor of an indiscriminate adoption of points …
- Local evidence: recorded monuments established by local surveyors and duly agreed upon by interested property owners, including boundary fences.
- Public roads, drainage ditches, timber cutting lines.
- If a point qualifies for acceptance...the presumption is strong that its position bears satisfactory relation to the original survey and the burden of proof to the contrary must be borne by the party claiming differently...

RETRACEMENT SURVEYS

- Made to ascertain direction and length of lines and identify monuments and other marks of an established prior survey
- If no intervening corners are reestablished, the direct connection between the two corners is reported as a tie.
- Made to afford new evidence of the character and condition of the previous survey.
- Recovered corners are rehabilitated “refurbished” but does not include restoration of lost corners.
- The retracement is sometimes complete in itself, but usually is made as an early part of a resurvey.

EXTENSION or COMPLETION SURVEYS
Federal

- Only parts of townships or sections were surveyed originally
- Mainly due to unusable lands
- New townships constructed with *protracted as surveyed* sections (has been abandoned as unsatisfactory...)
- *Protracted as surveyed* done in Alaska to accommodate Alaska Native Claims Settlement Act...dashed lines on plat indicate which lines not run and marked
- Tract “A” townships in Alaska – minimum 2 mile monumentation

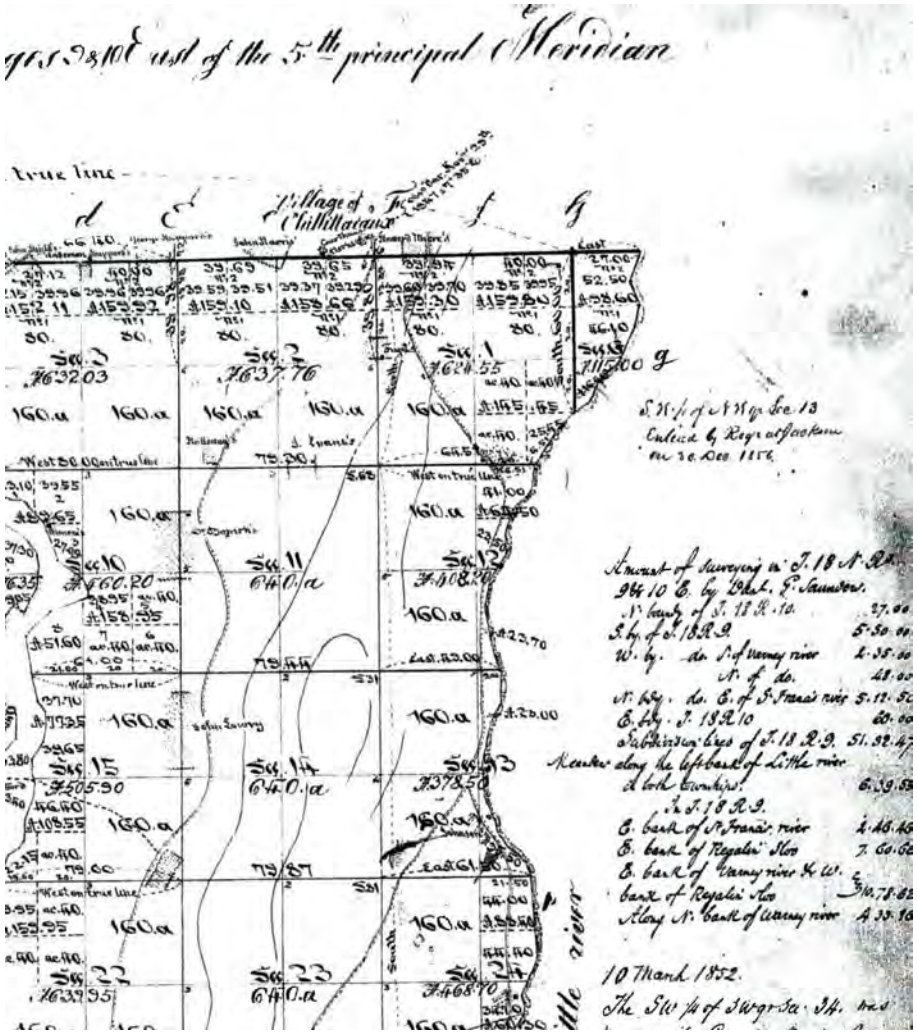
Extension Surveys - Missouri

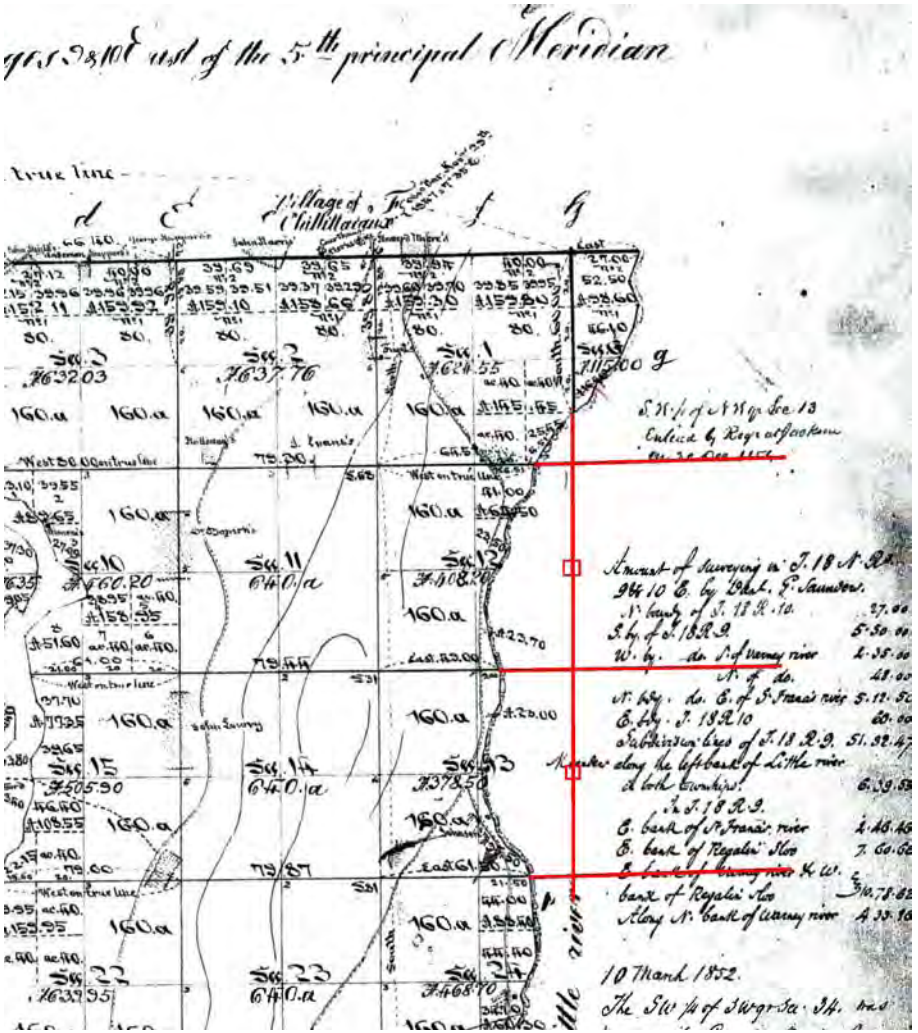
- Chapter 241 RSMO, Swamplands, Islands and Abandoned Riverbeds
- Occurred mainly along bodies of water, Missouri River, etc.
- Authority by Swamp Land Act of Sept. 28, 1850
- Lands donated to County where situated
- Secretary of State to supply County Clerks with approved list of swamplands in each county.
- Patents issued from State of Missouri to Counties
- County commissions have full power to sell and dispose of

Extension Surveys - Missouri

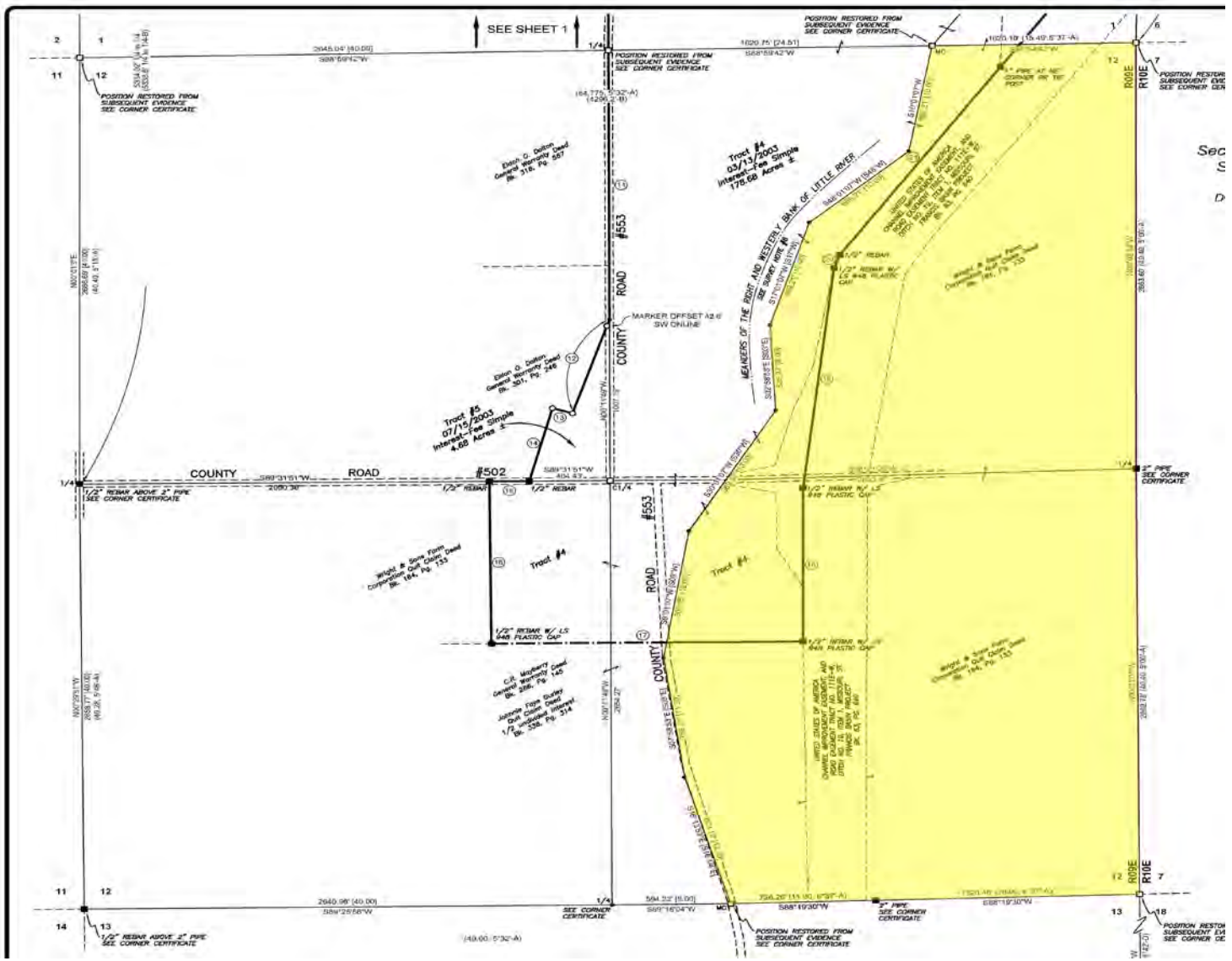
- County commission issues patent to purchaser...net proceeds of sale to the county school fund.
- Land to be surveyed how...
  Surveyor shall connect the survey with some established section, quarter section, meander or other US survey corner near or adjacent.
- Shall subdivide land into sections and quarter sections by producing and extending the lines of the US surveys.

Extension Surveys - Examples



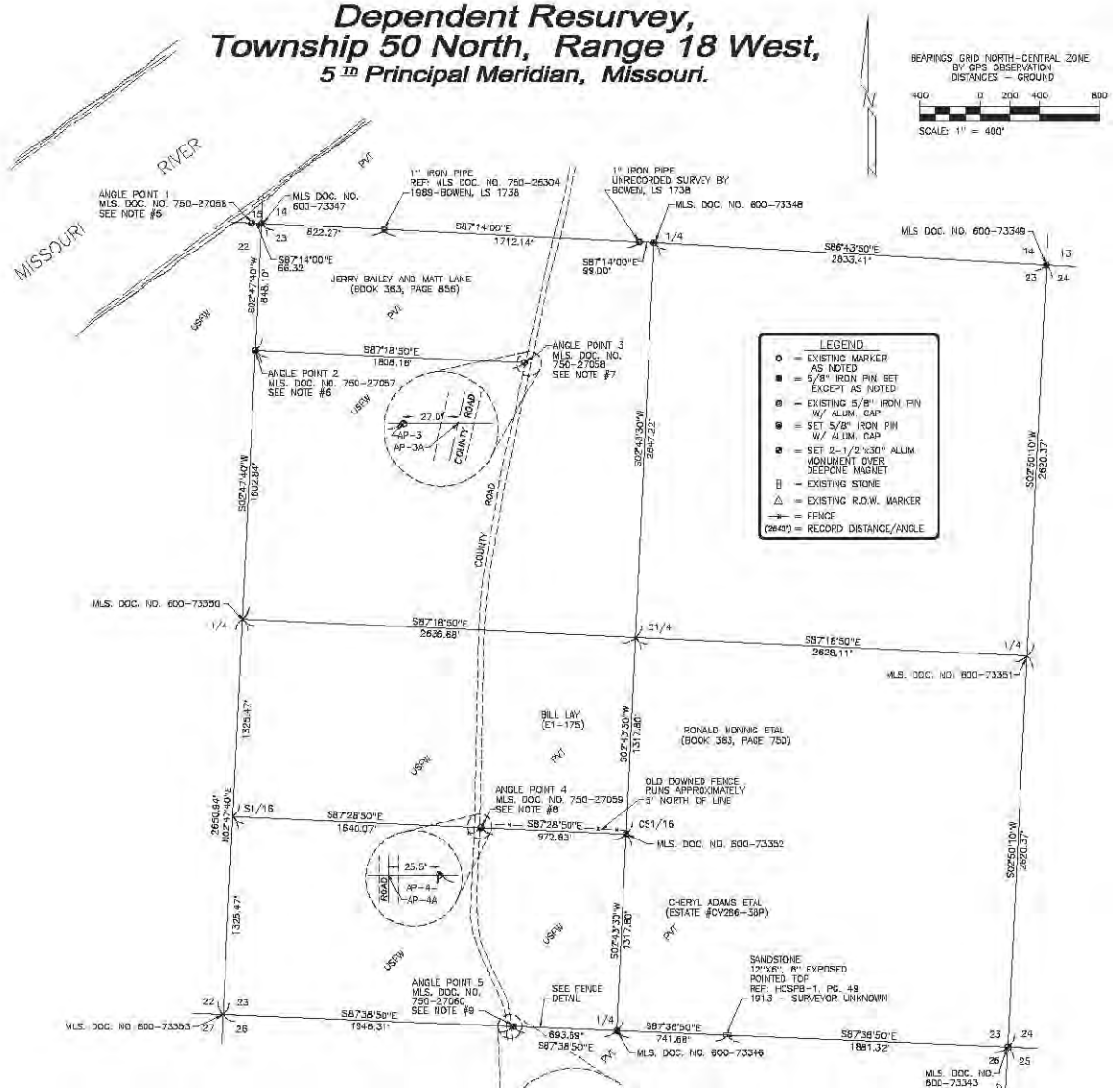


Retracement of Extension Survey



GLO – T50N R18W Howard County, MO

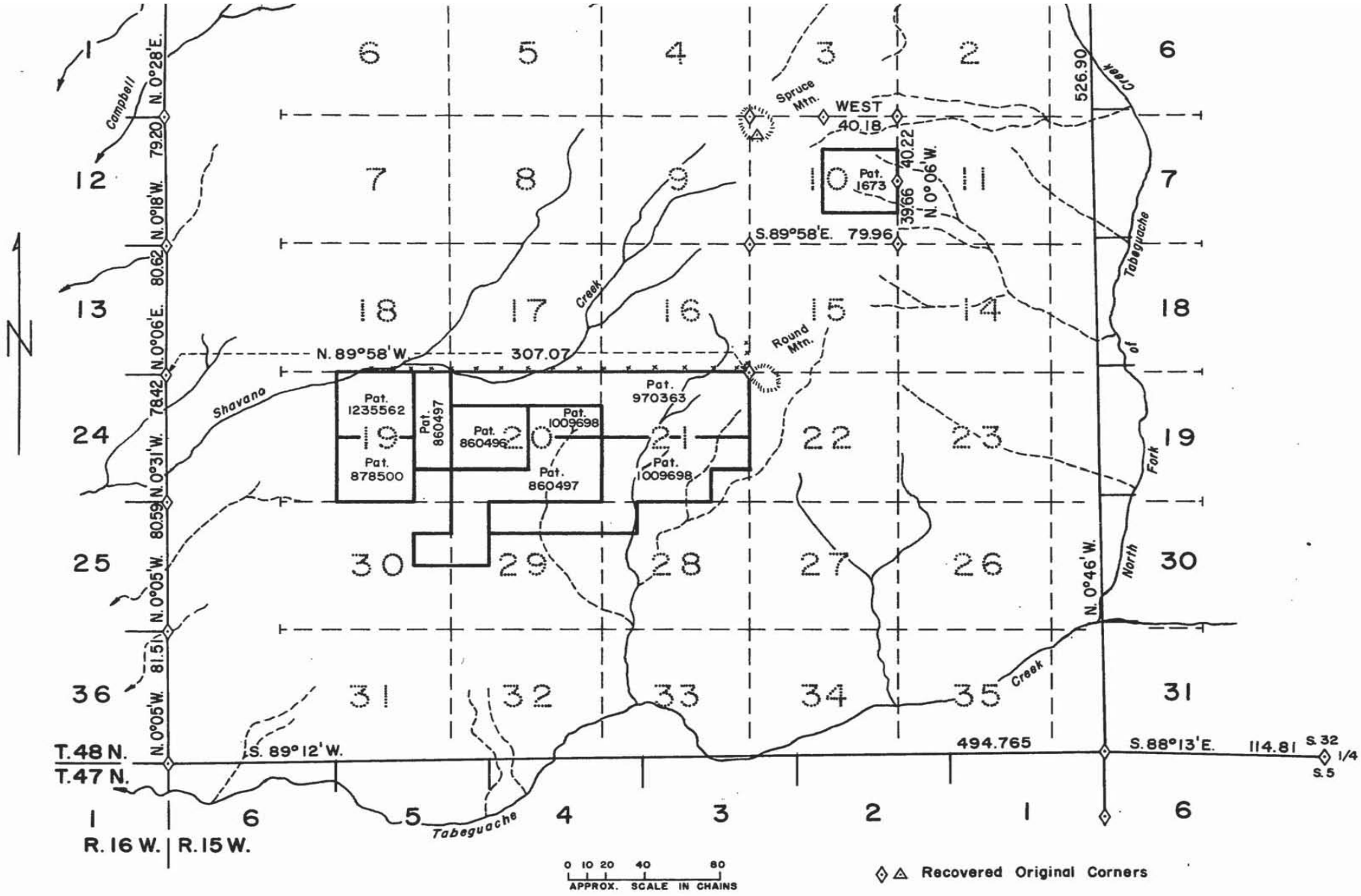
Dependent Resurvey – T50N R18W



INDEPENDENT RESURVEYS
2009 Manual – Chapter 5-12

- Retracement and reestablishment in reliance on evidence of the original survey in order to give official recognition and respect to all alienated lands with its scope...
- Includes establishment of new section lines, township lines...independent of and without reference to the corners of the original survey.
- ...necessary to preserve the boundaries of those lands previously alienated by legal subdivision of the sections in the original survey.
- this is done by surveying them as tracts, or conforming the alienated lands to the subdivision of the resurvey...if suitable.

THE ORIGINAL SURVEY – SHOWING PATENTS



THE INDEPENDENT RESURVEY

Resurveys - conclusion

- Dependent Resurvey
  -Relies on original survey throughout
  -Majority of what we do today
- Retracement Survey
  -Shows ties between existing corners
  -No corners reestablished...only rehabilitated
- Completion or Extension Surveys
  -Relies on original survey for origin
  -Creates additional lands in sections or entirely new sections
- Independent Resurveys
  -Relies on original survey for exterior bounds
  -Protects prior patents and bona fide rights

Evidence

Existent, Obliterated and Lost Corners

Topographic Calls

Line Trees

Collateral evidence

Evidence

Existent, Obliterated and Lost Corners

Existent Corners

An existent corner is one whose original position can be identified by *substantial evidence of the monument* or *its accessories* by *reference to the description in the field notes*, or located by an *acceptable supplemental survey record*, *some physical evidence*, or *reliable testimony*.

2009 BLM manual:

Substantial evidence is more than a scintilla of evidence but less than a preponderance of the evidence.

Evidence

Existent, Obliterated and Lost Corners

Existent Corners (cont.)

The evidence should be looked in light of:

(1) The charter and dimensions of the monument in evidence should not be widely different from the record.

(2) The markings in evidence should not be inconsistent with the record.

(3) The nature of the accessories in evidence, including size, position and markings, should not be greatly at variance with the record.

Keep in mind:

(1) Allowance for ordinary discrepancies

(2) Look for patterns of discrepancies.

Evidence

Existent, Obliterated and Lost Corners

Existent Corners (cont.)

(3) Evidence of less than workmanlike care in the original survey in compiling the record.

- Erroneously recorded dimensions
- Transposed or interchangeable directions or distances
- Misidentified tree species or monument type
- Inconsistencies in reporting topographical features

No set rules can be set down as to what is sufficient evidence.

All means should be exhausted in regard to restoring the corner.

Evidence

Existent, Obliterated and Lost Corners

Obliterated Corner

An obliterated corner is an existent corner where at the corner's original position, there are no remaining traces of the monument or accessories, but at whose position has been perpetuated, or the point for which may be recovered, by substantial evidence from the acts or reliable testimony of the interested landowners, competent surveyors, other qualified local authorities, or witnesses, or by some acceptable record evidence.

An obliterated corner position can be proven by substantial direct or collateral evidence. When there is both direct and collateral evidence the direct evidence will be given more weight.

Evidence

Existent, Obliterated and Lost Corners

Lost Corner

Only when every means of identifying the original position of a corner has been exhausted shall a corner be considered to be lost. A lost corenr is one whose original position cannot be determined by substantial evidence, either from traces of the original marks or from acceptable evidence or reliable testimony that bears upon the original position and whose location can be restored only by reference to one or more independent corners.

If substantial evidence of the position of the original corner exists, it is an existent or obliterated corner. If the corner is truly lost then it must be properly reestablished.

Evidence

Topographic Calls

Topographic Calls

The proper use of topographic calls of the original field notes may assist in recovering the locus of the original corner. This evidence my merely disprove other questionable features of be a valuable guide in arriving at the immediate vicinity of a line or corner. At best a topographic call or calls can verify or disprove questionable evidence of the original monument or its accessories. In rare cases, they may serve as substantial evidence to fix the position of a point, line or corner.

Topographic calls may be poorly recorded or fabricated.

Evidence

Line Trees

Line Trees

Under the law (federal and Missouri), a definitely identified line tree with the distinguishing marks is a monument of the original survey. It is properly used as a control point in the reestablishment of lost corners by the appropriate method of proportionate measurement and treated as a recovered corner. It becomes an angle point on the true line.

Problems can arise where line trees were improperly established on a random line and recorded in the field notes rather than on the true line. Having said this, the most probable location of the true line is on a straight line between the corners.

Evidence

Collateral Evidence

Collateral Evidence

It is generally held that the claimant, entryman, of owner of lands has located his or her lands by the good faith location rule if such care was used in determining the boundaries as might be expected by the exercise of ordinary intelligence under existing conditions. Local monuments must be analyzed for good faith location. Lack of good faith is not necessarily chargeable if the entryman has not located himself according to a rigid application of the rules laid down for the restoration of lost corners where:

Complicated conditions involve a double set of corners, both of which may be regarded as authentic.

There are no existing corners in one or more directions for an extensive distance.

Evidence

Collateral Evidence

Collateral Evidence (cont.)

Existing marks are improperly related to an extraordinary degree.

All evidence of the original survey or prior resurvey that have been adopted by the entryman as a basis for his or her location have been lost before the resurvey is undertaken.

Acceptance of a local point by neighboring claimants used for the control of the location of claims very often carries with it the necessity for a consideration of its influence in the matter of the acceptability of such locations under the good faith rule.