# Appendix B

# Metes And Bounds Surveying System.

# Appendix B

## Metes & Bounds:

Introduction:

This appendix has been written for those persons that do not understand why the Metes & Bounds Surveying System that is used in some states to survey rural lands, and to survey city lots throughout the U.S. The Metes & Bounds system was first used in the first 13 American colonies.

Bearings will be briefly covered; the surveyor's tools; property description of farm land recorded in a land deeds; & recording of city lots on deeds or sometimes in wills.

This appendix is not intended to cover all aspects of surveying, but to introduce some basic ideas how to understand Metes & Bounds property description in land deeds. A surveyor must have a good knowledge about higher mathematics; have a basic knowledge about the field of Astronomy; & plus know all aspects about surveying.

Bearings:

The bearing represents one system of designating direction of a line. A bearing of a line is the acute horizontal angle between a reference meridian which is usually a North or South and the property line. The angle is measured from either North or South towards the East or West, to read on the surveyor's compass that is less than 90 degrees. The proper quadrant is shown by N or S preceding the angle, and E or W following the angle. See Table No. 1 and Figure No 1.

In Table No. 1 compare the bearing angle 0-A 70 degrees with Figure No. 1. In column No. 4 shows how the bearing of the property line is recorded on a land deed.

Methods To Obtain A Bearing:

1. By the True (Geographic) Meridian which is measured from a established local geographic meridian.

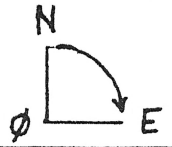
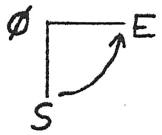
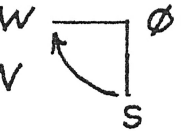
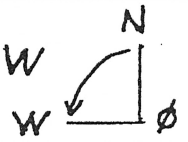
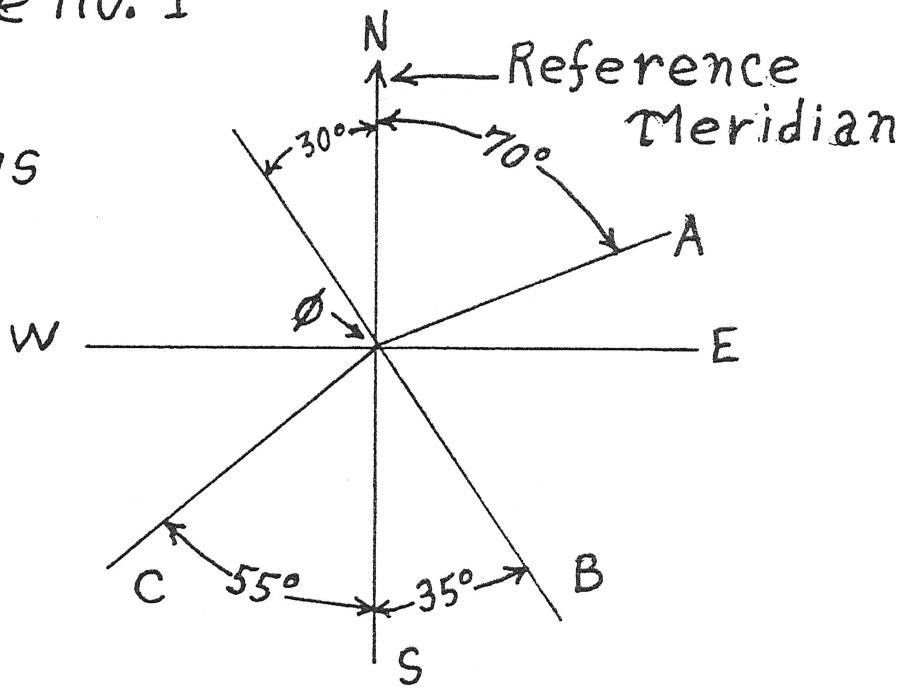
| Quadrant | Direction from meridian | Bearing of angle | Bearing record in a deed |
|---|---|---|---|
| N-ϕ-E   | CW | ϕ-A 70° | N 70° E |
| S-ϕ-E   | CCW | ϕ-B 35° | S 35° E |
| S-ϕ-W   | CW | ϕ-C 55° | S 55° W |
| N-ϕ-W   | CCW | ϕ-D 30° | N 30° W |

Table No. 1

Figure No. 1

Bearings



2. By the Magnetic Bearing taken from a established local magnetic meridian. Magnetic declination of the angle of variation between true geographic meridian and the magnetic meridian needs to be found because of the declination changes throughout the year.

3. Assumed Meridian may be selected and a true or a magnetic line can be ascertained later.

4. By a Grid Bearing from an appropriate established grid meridian.

Magnetic Bearings:

Magnetic bearings can be obtained in the field by observing a magnetic needle in a compass box or surveyor's compass. The surveyor must calculate the angle of variation between magnetic north and true north. The U.S. Geological Survey of the Federal government publishes a map that shows the magnetic lines of declination from true north which can aid the surveyor in the calculating the direction of true North. The surveyor must determine where true north lies before any surveying is completed in most cases.

In Figure No. 2 assume the compass is set up to true North at points A, B, & C bearings. Bearings A ----> B & B ----> C are called Forward Bearings. Bearings C ----> B & B ----> A are called Back Bearings, but are marked with opposite letters of direction. Forward bearing has the same numerical direction as the back bearing, but they are marked with opposite letters of direction. If the bearing of A ----> B is N 72 degrees E, then the bearing of B ----> A is S 72 degrees W.

Surveyor's Tools Used In Metes & Bounds System:

1. Surveyor's Compass shown in Figure No. 2a and 2b. George Washington and thousands of surveyors who followed him used this type of instrument to determine land boundary lines of property holdings. This instrument helps the surveyor find the bearing when surveying property lines.

   The compass consists of a metal base plate "1" in Figure No. 2a with vertical sight vanes "2" at each end of the metal base plate. At the center is round compass box "3". See Figure No. 2a & 2b. Two small level vial "4" are mounted on the base plate. The whole surveyor's compass is mounted on a wooden tripod. The sight vanes are strips of metal with vertical slits to define the line of sight. The compass box in Figure No. 2b has a cone shaped point at its center to support the needle,

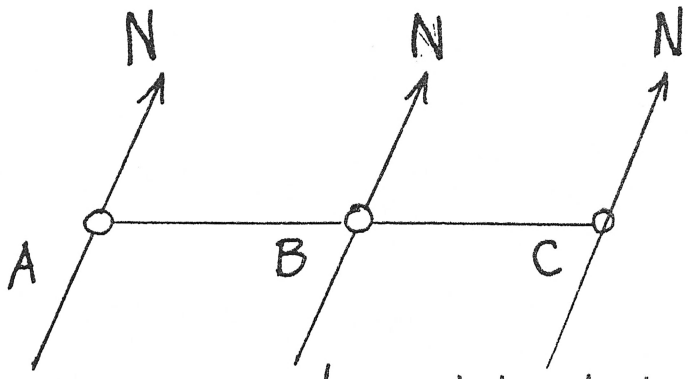



Figure no. 2 forward and back bearings.

and a glass cover to protect it. A circular scale at the outer rim of the box is graduated in degrees or half degrees. The zero marks are at the north and south points are in line with the line of sight - vane slits. Graduations are numbered in multiplies of 10 degrees clock wise and counterclockwise from 0 degrees at North & South to 90 degrees at East and West. As the sight vanes and compass boxes are rotated around at the center or the axis and the needle shows the bearing of line observed.

The letter E and W on the compass box are reversed from their normal position to give direct readings of the bearings. Thus in figure No. 2b, the sight line bearing through the vanes is N 40 degrees E.

## The Typical Problems Using The Surveyor's Compass:

The surveyor must make the conversion between magnetic bearing to the true bearing, because the magnetic declination can have annual, daily, and irregular variations existing at different dates. So it is important that the surveyor establish where the true geographic bearing is located.

## Taping Tools For Linear Measurements:

To measure the length of property lines the surveyor uses the following basic tools during the time period of the 13 colonies.

2. Gunther's Chain, the Oldest Surveyor Tool. This device was the best available measuring tool that the surveyor could use during the colonial period and during the building period of our young nation.

The Gunter's chain was a total of 66 feet long, and it was made up 100 of links, with each link equal to 7.92 inches long. It was made up of heavy wire which had a loop at each end, and joined together by three rings. See Figure No. 2c. The outer ends of this chain were made up into handles fastened to the end of the links which formed the 0 and 66 foot marks. Successive tags with one, two, three, four teeth, marked every tenth link from the ends of the chain. The center has a plain tag. Due to the wearing of the links the length had to be adjusted by the means of a bolt in the handles.

Measured lengths were recorded in chains. Links in a chain were recorded decimals of a chain or deci-

mals of a link were estimated. The 66 foot length of Gunther's chain was selected because of its relevance to the mile with the chain being 1/80th of a mile, and the relationship of the square chain to make up an acre. Ten square chains = (66 feet) (66 feet) (10) = 43,560 square feet = 1 acre. Another way to look at acreage is to measure it in rods. 1 chain = 4 rods. One acre = (4 rods) (4 rods) (10) = 160 square rods. Today the Gunther"s chain is seldom used and manufacturer now make a thin steel tape that marked off like the Gunther's chain.

3. Tapes are used to measure lengths of land boundary lines today. There are special purpose tapes,builder's tapes, invar tapes, ~~lavar tapes,~~ cloth tapes, and glass-fiber tapes.

4. Wire Tape were used before thin steel tapes were invented and produced. The surveyor's used wire tapes to measure the boundary lines of property. Wire tapes are still used today for certain surveying jobs.

5. Chaining Pins or taping pins are used to mark the tape lengths. They are usually made out of number 12 steel wire, and sharply pointed at one end. At the other end they have rounded loop. They are painted with alternate of red and white bands. There are eleven pins to a set on a steel ring.

6. Hand Level are used to keep the tape end at equal elevation when measuring over rough terrain. It is used with a plum bob.

7. Range Poles are called flags or lining rods are made of wood, steel or aluminum, and are about 1 inch thick. They are six to ten feet long, and come in various shapes in cross section such as round, or hexagonal with alternate red and white bands of 1 foot in length. Range poles are used for marking the alignment.

8. Plumb Bobs are used for taping, and should weigh around 8 oz. or more with a fine point. They have at least a 6 foot fish line cord free of any knots.

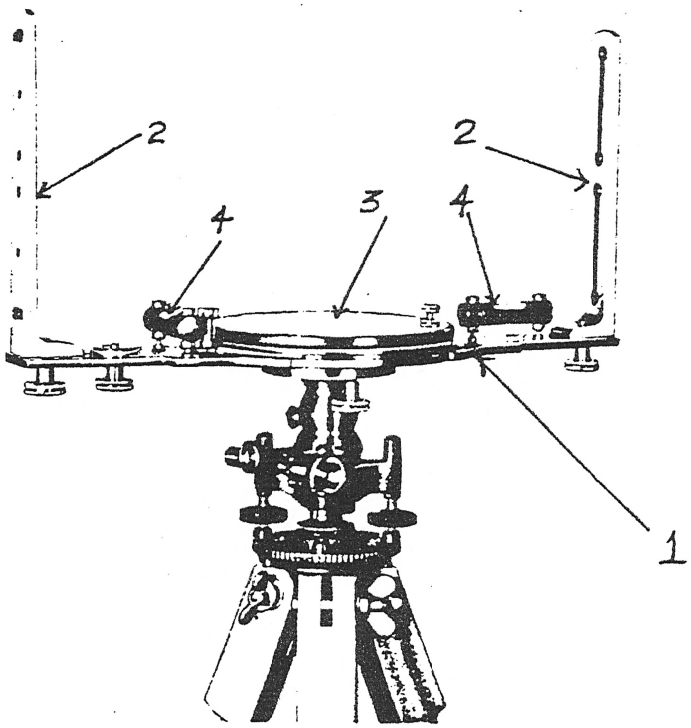



Figure 2a. Surveyor's Compass

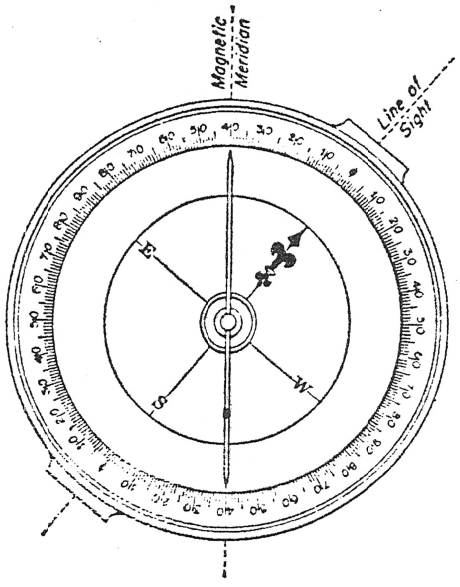



Figure 2b. Compass box

All of the above surveyor's tools are shown in Figure No. 2c. Tools not shown in Figure No. 2c that should be mentioned are the Keel, a colored lumber crayon, and the surveyor's Field Book, to enter drawings of property; record measurements of property boundary lines; notes on marker locations on the property; any calculations that were made in the field; and the property description.

Property Description Using Metes and Bounds System:

Terms Used In Metes and Bounds:

1. Metes is to measure or to assign by measure.

2. Bounds is the boundary lines or property limits.

3. Point Of Beginning (POB) has some natural feature.

4. Lengths and Bearings of successive lines from the POB are given in values of perches, and rods, chains for farm land. City lots can be measured in feet, and yards for most surveying jobs. Most of these measurements are being replaced by distances in feet and decimals of feet.

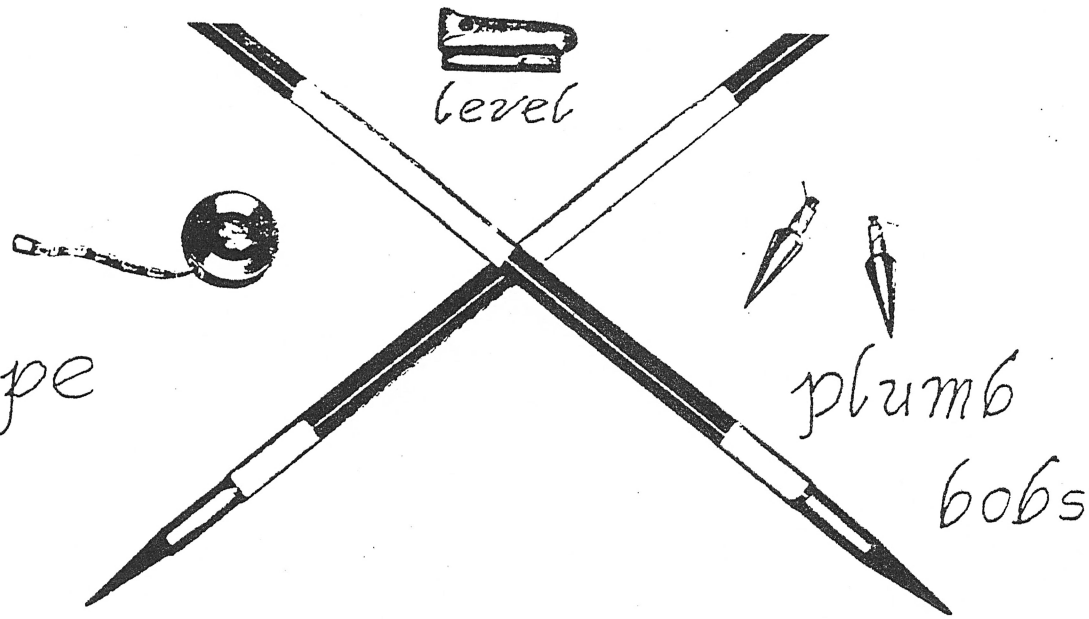
5. New Rules Of Surveying In 1975 the American Congress On Surveying And Mapping laid out the following rules:

   a. Surveyor's will now show equivalent values for areas are given in Square Meters and Hectare depending on the size of the land.

   b. Legal Description of existing deeds, records of plans are to be Converted To The Metric System only if and when conveyancing or subdivision takes place.

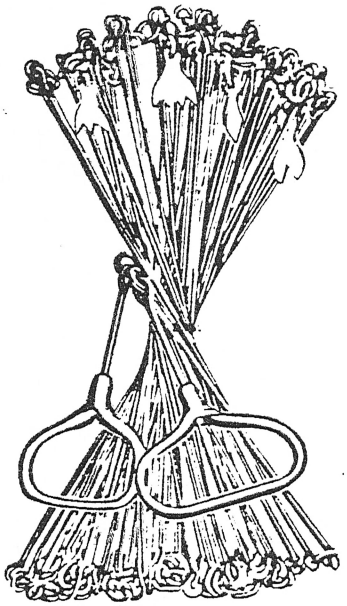
6. Bearings may be Magnetic or True, but the true bearing is always the best method.

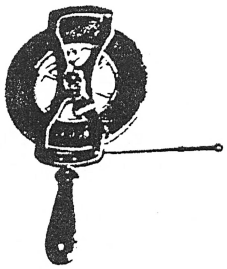
7. Property Descriptions are written by surveyor's and lawyers. Much care must be taken in writing these land descriptions of property so it dose not result in litigation to take place in the future.





chaining pins


Guntr's chain
Figure 2c.


wire Tape

8. Permanent Monuments are very important for any future surveyor must locate all boundary markers before an existing property can be surveyed again. Some states require iron pipes or concrete markers long enough to reach below the frost line on all property corners before surveying will be accepted for recording. Some large cities and some states have increased the precision of property surveys and have established a network of controlled monuments to supplement triangulation stations of National geographical Surveying. Property corners can be tied to these control points.

Description on Land Deeds:

The description on land deeds must have the following information placed within the description of the land deeds where the Metes and Bounds surveying system has been used.

1. Point Of Beginning (POB):

   a. Must be identifiable, permanent, well-referenced, and near the property.

   b. Coordinates should be given.

2. Definite Corners:

   a. Clearly defined points that make up the corners with coordinates if possible.

3. All Lengths and Directions Given For Property Sides:

   a. Lengths in feet and decimals of feet or in metric system units such as meters. During the colonial period surveyors gave the lengths of boundary lines in the unit of PERCHES and fraction of PERCHES. PERCHES is the same length as 1 rod or 16.5 feet. In most surveying jobs during the colonial period the surveyor would record the land area in acres and square perches.

   b. Directions given by angles of magnetic bearings or in the true bearing must be stated to permit computation of closure error.

   c. Date of the survey must be given when the bearing is refers to magnetic North because of annual, daily, irregular variation changes of the magnetic

declination must be considered. Declination is a horizontal angle between magnetic North and true North. Declination lines on a special map are called isogonic lines . In 1975 St. Louis, MO fell between 3 E & 4 E isogonic lines. So the angle of variation of about 3.5 degrees between magnetic North and true North. The U.S. Geographical Survey makes up the maps that show all of the isogonic lines in North America.

4. Names Of Adjoining Property Owners:

a. This avoid claims in case of error in description that leaves a gap or overlap.

5. Area:

a. Rural land is given in acres decimal of an acre.

b. City lots are given in Square Feet and decimal of square feet.

c. You can find that two surveyors can give two different descriptions for the same property in area, angles, and distances for property bound aries.

d. Only one rule is legally acceptable, otherwise procedures employed should be stated.

Surveying A City Lot:

Now we will go through a surveying description of the property of Archibald Milloy at Rockford, IA using the Metes and Bounds Surveying System. The property description was located in his Will and recorded at the Floyd County Court House around 4 May 1937 at the time of his death. We will go through the surveying description of city lots 3 and 4 in block 28, but first we need to go back to the quadrangle coordinate because the state of Iowa was completely surveyed using the quadrangle surveying system. Lots 3 and 4 in block 28 fall into the following quadrangle coordinate of NE 1/4 of section 15, Twp. 95 N, Range 18 W of the 5th P.M. Lots 3 and 4 faces onto Platt Street (today now Main Street) in Rockford, IA.

Metes and Bounds City Lot Description:

Starting at the point of beginning at the SE corner of lot 4, running thence West 15 feet, thence North 24 feet, thence East 26 feet, thence South 24 feet, thence West 11 feet to the point of beginning having 624 square feet more or less of lots 3 & 4 in block 28 in the town of Rockford, Iowa. See Figure No. 3 & 4.

Surveyors today convert American land measurements into metric land measurements.

Square meters = (square feet) (.09290) so

Square meters = (624) (.09290) = 57.9696 or about 58.

The area of these two lots can be converted into Hectare, but in this case it is not a practical measurement of land area. Here is how the conversion would be carried out.

Hectare = (square meters)/(10,000)

Hectare = (57.9696)/(10,000) = .0057969 or about .0058

Today the Metes & Bounds Surveying System is still used in all 13 original states, plus W. Virginia, Kentucky, Tennessee, and part of Ohio to measure rural land areas.

Surveying Rural Land With Metes and Bounds:

In Chester County, PA Adam Rickenbach who is not directly related, sold some of his acreage to be subdivided into two parts for John and Christian Feik. This deed was dated 4 September 1783. See Figure No. 5.

Metes and Bounds Rural Land Description:

First Subdivision:

Beginning at a heap of stones in line 0f Jacob Strik's land, thence by Feik's part of foresaid tract South three and a half degrees West, seventy one and third perches to a chestnut tree, thence by the land of William Dewees's South twenty five and an half degree East, ninety six perches to a chestnut tree in the welsh line, thence along said line North seventy five degrees East, sixty perches to a post near a marked white oak sapling, thence by part of Adam Rickenbach's land North thirteen and a half degrees West, ninety seven perches to the place of

beginning, containing by computation thirty-six acres and thirty seven square perches more or less.

Second Subdivision:

Beginning at a heap of stones in line with Jacob Strik's land, thence by Feik's part of the foresaid tract South thirteen and a half degrees East, ninety seven perches to a post near a marked white oak sapling in the welsh line, thence along the said line North seventy five degrees East, fifty perches to a gum tree, thence by Dewees's land North three degrees West, ninety two perches to a post, thence by the same West nineteen perches to a heap of stones at the corner of Jacob Stirk's land, thence along said Stirk's land South seventy and an half degrees West, fifty five and two thirds perches to the place of beginning containing thirty-six acres and thirty-six square perches more or less. See Figure No. 5. Total acreage of the two subdivisions are calculated below.

36 acres & 36 sq. rd. + 36 acres & 37 sq. rd. = 72 acres & 73 sq. rd. 73/160 = .45625 or total 72.45625 acres.

Notes Linear & Land Measurements:

Notes On Measurement:

1 meter is a little longer than 1 American yard. 1 meter has 100 centimeters.

1 inch = 25.4 millimeters or 2.54 centimeters. 1 meter or 2.54 cm/100cm = 39.37 inches.

Notes Land Measurements:

1 Hectare is a metric square measurement of land area. A Hectare makes up a field most of the time with boundary lines of 100 meters by 100 meters, which makes up of area of 10,000 square meters.

1 Hectare = 2.47 acres.

1 foot = (2.54 cm) (12) = 30.48 cm.

1 meter = (30.48 cm)/(100 cm) = 3.281 feet.

1 square meter = (3.281) (3.281) = 10.76 square feet.

Hectare =(10,000 sq.m.) (10.76 sq. ft.)= 107,600 sq ft.

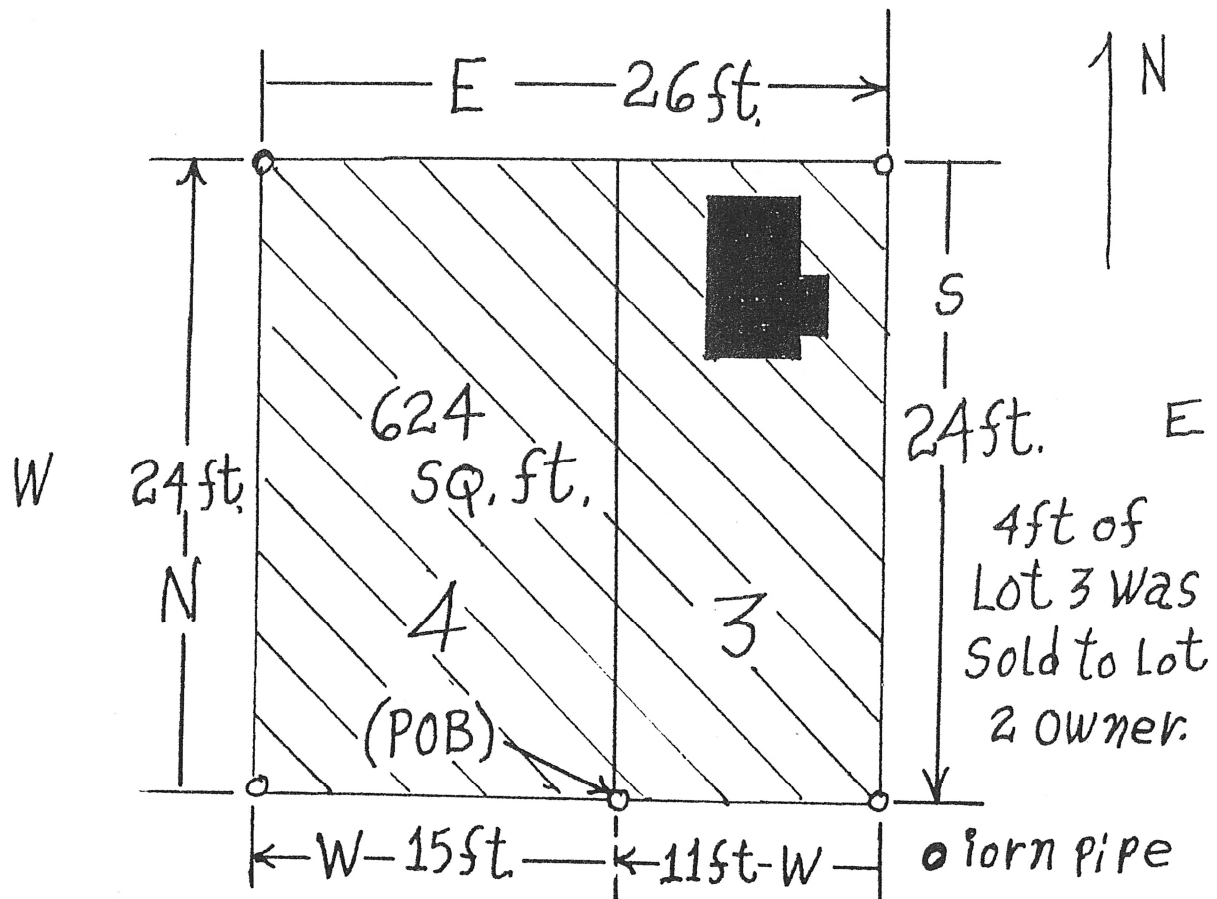



Figure No. 3 Meats & Bounds measurements of Lot 3&4 in block 28

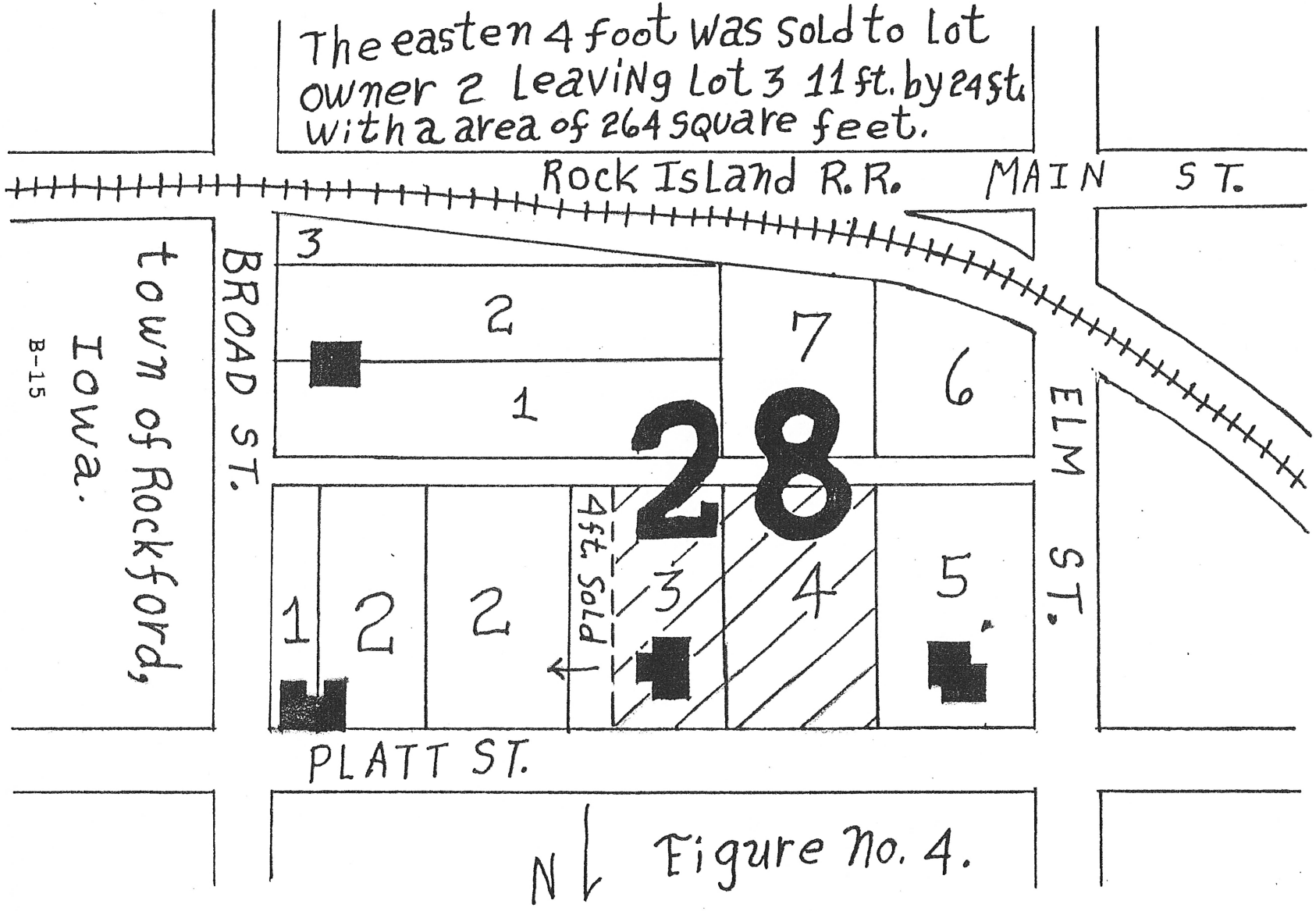

The easten 4 foot was sold to lot owner 2 leaving lot 3 11 ft. by 24 ft. with a area of 264 square feet.
Rock Island R.R.
MAIN ST.
town of Rockford, Iowa.
B-15
BROAD ST.
ELM ST.
28
3
2
1
7
6
1
2
2
4ft. Sold
3
4
5
PLATT ST.
N

Figure no. 4.

1 Hectare = 107,600 sq. ft./43560 sq.ft. = 2.47 acres.

1 sq. perches = 1 sq. rod = 272.25 sq. ft.

Some Conversions:

To Convert acres to Hectare multiply by .0447 times acres.

To convert feet to meters multiply by 0.3048 times ft.

To convert square ft. to sq. meters by multiply by 0.09290 times number of square ft.

Rods and Meters Conversions:

1 perches = 1 rod = 16.5 feet.

1 square rod = (16.5) (16.5) = 272.25 square feet. 272.25/9 = 30.25 square yards.

1 square meter = (No. of sq. yd.) (.8361).

1 square meter has sides of (3.281 ft.) by (3.281 ft.).

FORMULAS OF CONVERSIONS:

Hectare = (acres) (.4047)

Sq. ft. = (272.25 sq. ft.) (sq. rd.)

Sq. meters = (sq. ft.) (.09290)

Hectare = (sq. meters)/(10,000)

Total Hectare = (Hectare) + (fractional Hectare)

Calculations Of First Subdivision In Figure 5:

Hectare = (36 acres) (.4047) = 14.5692

Sq. ft. = (272.25 sq. ft.) (36) = 9801

Sq. meter = (9801 sq. ft.) (.09290) = 910.5129

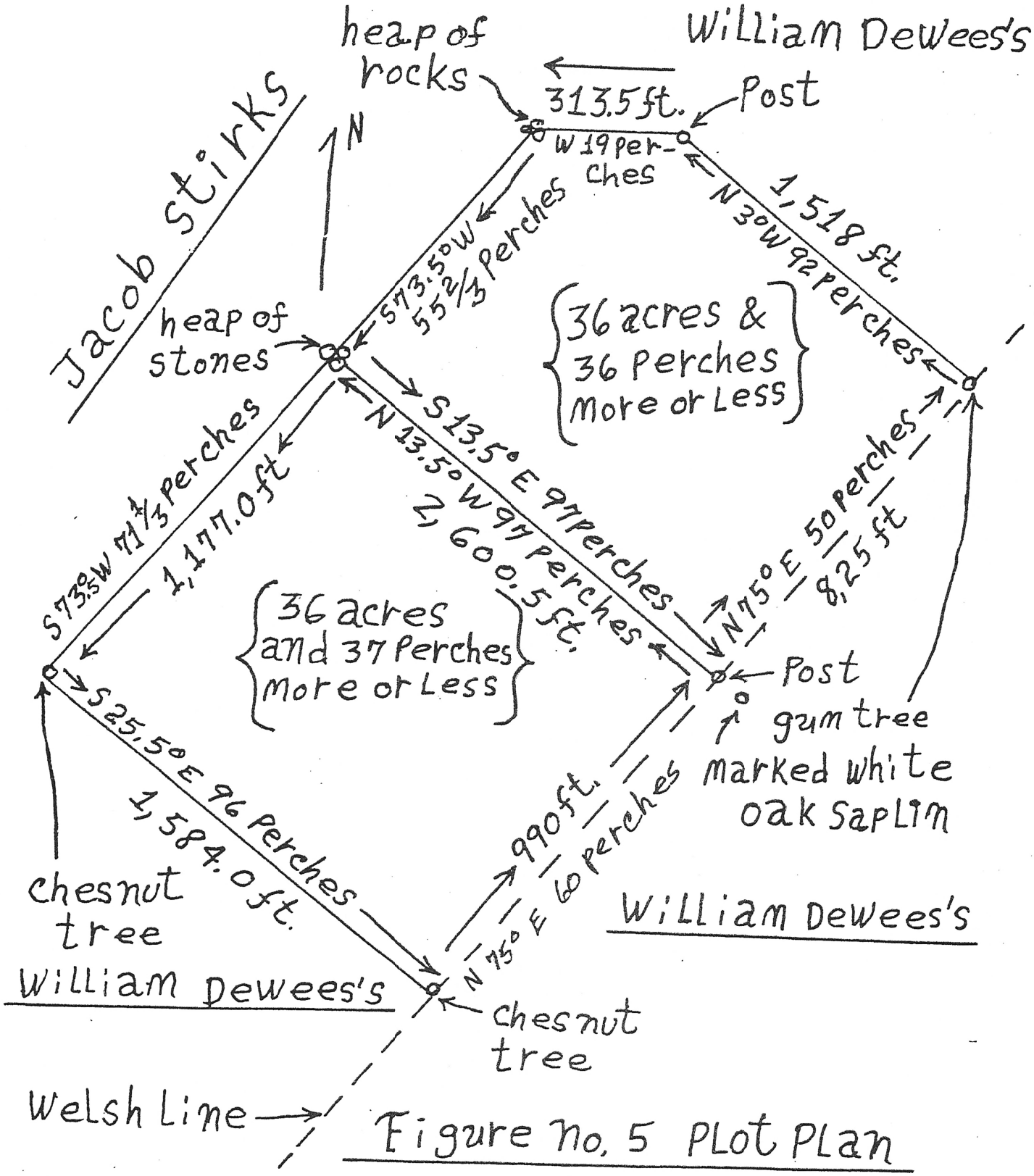



Figure No. 5 Plot Plan

Hectare = (910.5129 sq. meters)/(10,000) = .091051 Hectare
(part 1) = (14.5692 Hectare)+(.091051) = 14.660 Hectare

Calculations Of Second Subdivision In Figure 5:

Hectare = (36 acres) (.4047) = 14.5692

Sq. ft. = (272.25 sq. ft.) (37) = 10,073.25

Sq. meters = (10,073.25 sq. ft.) (.09290) = 935.80492

Hectare = (935.80492)/(10,000) = .093580

Hectare (part 2) = (14.5692 Hectare)+(.093580) = 14.663

Total Hectare:

Subdivision 1 = 14.660 + subdivision 2 = 14.663 = 29.323 Hectare.

Check and balance:

FORMULA:

(acres) (.4047) = (Hectare part 1) + ( Hectare part 2)

(72.45625 acres) (.4047) = (14.660 Hectare)+(14.663 Hectare)

29.323 Hectare = 29.323 Hectare

Information about Metes & Bounds Surveying System was obtained in part from R.C. Brinker and P.R. Wolf, Elementary Surveying, (New York: Harper & Row Publishers, 1977), 54-57, 146-148, 387-390.

Compiled By

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