APPENDIX A

GLOSSARY

The appendix includes definitions, abbreviations, and surveyors' measures and conversions.

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Definitions

A

Abstract

A summary of the notable features associated with survey points (marks). Information in the abstract includes if the monument was set or found, type of monument including stamping, location relative to the present traveled way (PTW) and other features such as fences, and if required, how to reach.

Accessories to corners (USPLS)

Physical objects adjacent to corners to which the corners are referred for their future identification or restoration. Accessories include bearing trees, mounds, pits, ledges, rocks, and other natural features to which distances or directions from the corner or monument are known. The accessories are part of the monuments.

Accuracy

The degree of conformity with a standard, or the degree of perfection attained in a measurement. Accuracy relates to the quality of a result and is distinguished from precision, which relates to the quality of the operation by which the result is obtained.

Adjusted position

An adjusted value for the horizontal or vertical position of a survey mark (point), in which discrepancies due to random errors in the observed data are distributed according to a predefined mathematical relationship.

Aerial photograph

Any photograph taken from the air – also called aerial photo.

Aerial photography

The art, science, or process of taking aerial photographs.

Aerial survey

A survey using photographic, electronic, or other data obtained from an airborne station.

Aerialtriangulation

See aerotriangulation.

Aerotriangulation

The determination of horizontal and vertical coordinates of points on the ground from measurements performed using overlapping aerial photographs and from already known coordinates of points on the ground.

Altitude

- The vertical angle between a horizontal plane and the line to the observed or defined object. In surveying, a positive altitude (measured upward from the horizon) is termed an angle of elevation and a negative altitude (measured downward from the horizon) is termed an angle of depression.
- Altitude is sometimes used to apply to elevation above a datum, the altitude of an airplane above ground, or above sea level.

Angle

The difference in direction between two convergent lines. It may be classed as horizontal, vertical, oblique, or spherical, according to whether it is measured in a horizontal, vertical, or inclined plane, or in a curved surface.

Angle, central

- The angle at the center of a circular arc that passes through beginning (PC) and end (PT) of the arc. This angle is also equal to the change in direction of the tangents to the arc that pass through the PC and PT. The central angle is equal to the deflection angle at the PI. In route surveys, it is commonly referred to as delta.
- For spirals, the central angle is called theta.

Angle, deflection

A horizontal angle measured from the prolongation of the preceding line, right or left, to the following line.

Annotated photography

A photograph on which information has been added to identify, classify, outline, clarify, or describe features that would not otherwise be apparent in examination of an unmarked photograph.

Aperture

- An opening—particularly that opening in the front of a camera through which light rays pass when a picture is taken.
- The diameter of the objective lens of a telescope or other optical instrument, usually expressed in inches, but sometimes as the angle between lines from the principal focus to opposite ends of a diameter of the objective lens.

Azimuth

The horizontal angle measured clockwise between the reference meridian and the line to an observed or described point. See “Grid azimuth,” “Magnetic azimuth,” and “Back azimuth.”

Azimuth mark

A mark set at a significant distance from a triangulation or traverse station to mark the end of a line for which the azimuth has been determined and to serve as a starting or reference azimuth for later use.

Azimuth pair

Two monuments between which the azimuth (bearing) is known. Generally used for obtaining the starting or ending direction of a traverse.

B

Back azimuth

The azimuth of a line at the end opposite the reference end. Back grid azimuths differ by 180 degrees from forward grid azimuth. Back geodetic azimuths differ from the forward geodetic azimuth by 180 degrees minus the convergence angle.

Backsight

- In traversing, a backsight (BS) is a sight to a previously established point.
- In leveling, a backsight is a reading to a point whose elevation has been previously determined.

Base line

Also see “Line, base (USPLS).”

- A surveyed line established with more than usual care, to which surveys are referred for coordination and correlation.
- For construction, a base line is the centerline of a railway or highway. A reference line for the construction of a bridge or other structure.
- A base line consists of a pair of stations for which simultaneous GPS data have been collected.
- An NGS calibrated base line, which is used to detect random or systematic errors associated with a total station.

Base station

Also called a reference station. A known location specifically to collect data for differentially correcting rover files or the relative processing of rover files.

Bearing

The directions of one point or object with respect to another, where the direction of the line is expressed by the acute angle with respect to the reference meridian. Bearings are measured clockwise or counterclockwise from north or south, depending on the quadrant.

Bench mark

A relatively permanent object, natural or artificial point whose elevation above or below an adopted datum is known. See “Temporary bench mark.”

Bridging

The extension and adjustment of a photogrammetric survey between areas with ground control.

C

C-factor

An empirical evaluation, which expresses the vertical (elevation) measuring capability of a stereoscopic system; generally defined as the smallest contour interval that can be plotted to required accuracy. The C-factor is often used to determine the flight height from which aerial photographs should be taken for photogrammetrically accomplishing topographic mapping at the smallest contour interval accurately plottable from using a particular aerial camera and instrument system. The practicable flight height is the contour interval multiplied by the C-factor.

Cairn

An artificial mound of rocks, stones, or masonry, usually conical or pyramidal, whose purpose is to designate or to aid in identifying a point of surveying or cadastral importance.

Call (USPLS)

A reference to or statement of an object, course, distance, or other matter of description in a survey or grant requiring or calling for a corresponding object or other matter of description on the land.

Cartography

The art and science of expressing graphically, by maps and charts, the known physical features of the earth or of another celestial body; usually includes the works of humankind and its varied activities.

Centerline

As applied to a street or alley, a line midway between the sidelines. As applied to a highway, the line from which other elements such as right-of-way and edge of pavement are determined. See “Present traveled way.”

Chain

A unit of length used in the subdivision of public lands of the United States. The Gunter’s chain is 66-ft. long and is divided into 100-links, each link being 0.66-ft. long (early chains were 50-links, or 33-ft. in length).

Chaining

Measuring distances on the ground using a chain or tape. Chaining and taping are considered synonyms.

Check structure (irrigation)

A structure that can be used to raise the level of water in an irrigation canal for turnouts.

Chord

A straight line connecting two points on a curve.

Circle (surveying instrument)

The circular disc of a surveying instrument, which is perpendicular to and centered about an axis of rotation.

Circle position

A prescribed setting (reading) of the horizontal circle of a total station, to be used for the observation on the initial station of a series of stations that are to be observed.

Circuit closure

In leveling, the amount by which the algebraic sum of the measured differences of elevation fails to equal the theoretical closure, zero.

Clockwise angle

A horizontal angle measured to the right. A clockwise angle may have any value between zero degrees and 360 degrees. Azimuths are clockwise angles measured from either north or south.

Closed traverse

A traverse that begins at a known or adopted position and closes back to the same beginning point or closes to a second or subsequent known point. The preferred method is to begin at one known control point and close to a second or subsequent known control point. This gives a check of the orientation of the traverse.

Closing error

See “Error of closure.”

Closing the horizon

An expression for measuring the last of a series of horizontal angles at a station. At any station, the sum of the individual horizontal angles between adjacent lines should equal 360 degrees. The amount by which the sum of the measured angles fails to equal 360 degrees is the angular error of closure. This error is distributed as a correction among the measured angles to make their sum exactly 360 degrees. The error and the correction have opposite algebraic signs.

Collimation, error of

The angle between the line of collimation (line of sight) of a telescope and its collimation axis. When the collimation adjustment of an instrument is perfect (which is never the case), the line of collimation and the collimation axis will coincide, and the error of collimation will be zero. In practical work, the adjustment is carried to where the error is so small that it can be considered to be negligible. Error of collimation is a systematic error and, in a series of observations, is usually treated as being of the constant error type.

Combination Scale Factor (CSF)

The sea level factor x grid scale factor. Used to determine ground distances from state plane grid distances.

Commencing, point of

In metes and bounds description, the starting point, if not a part of the tract being described: e.g., “Commencing on the northwest corner of Section 12, T 44N, R 67W, 6th P M, thence southerly along the west line of said section 500-ft. to the point of beginning.”

Compass adjustment

A method used to distribute random errors in survey measurements such as a traverse. Based on the assumption that after the angular error is distributed, the closure is a result of distance measurements only.

Contour interval

The difference in elevation between adjacent contour lines on a map.

Contour line

A line on a map representing equal elevation.

Contour map

See “Map, contour.”

Control

A system of points whose relative positions have been determined from survey data. See “Basic control,” “Horizontal control,” and “Vertical control.”

Control, geodetic

A system of horizontal and/or vertical control stations that have been established and adjusted by geodetic methods and in which the shape and size of the earth has been considered in position computations.

Control, horizontal

Control marks (points) with horizontal positions only. The positions may be referenced to either geodetic or plane coordinates.

Control, level

A series of bench marks or temporary bench marks of known elevation, established throughout a project.

Control, photo

Any station in a horizontal and vertical control system that is identified on a photograph and used for correlating the data shown on that photograph; also termed photo control point, picture control point, and ground control point.

Control point

Also called a control mark. A monumented point to which coordinates have been or are being assigned by the use of surveying observations. The National Geodetic Survey maintains a nation-wide set of control points. A station whose position (horizontal or vertical) has been determined from survey data and is used as a base for a dependent survey.

Control survey

A survey that provides positions (horizontal or vertical) of points to which supplementary surveys are adjusted.

Control traverse

A main scheme closed traverse, which is performed to the highest degree of precision used on a project. The control traverse is used as the horizontal datum base for all aspects of a project. Secondary traverses to such features as topographic features, aerial targets and property corners are tied to the control traverse.

Conventional survey

- A survey using instruments such as total stations and digital levels.
- A centerline survey where data is recorded by stations and offsets. This type generally is restricted to overlay projects.

Coordinates

Linear or angular quantities, or both, which designate the position of a point in relation to a given reference frame. There are two general divisions of coordinates used in surveying: polar coordinates and rectangular coordinates. These may be subdivided into three classes: plane coordinates, grid coordinates, and geodetic coordinates.

Corner

A point on a land boundary at which two or more boundary lines meet. Can be a property corner or a property controlling corner or a public land survey corner or any combination of these. Not the same as monument, which refers to the physical evidence of the corner's location on the ground.

Corner (USPLS)

A point on the surface of the earth, determined by the surveying process, marking an extremity of a boundary of a subdivision of the public lands, usually at the intersection of two or more surveyed lines; often incorrectly used to denote the physical structure, or monument, erected to mark the corner point. Corners are described in terms of the points they represent.

Corner, closing (USPLS)

A corner at the intersection of a surveyed line with a previously established boundary line. To compensate for convergence of the meridians, standard parallels (once termed "correction lines") are established at intervals of 24-mi. These were formerly established at varying intervals up to 60-mi. Corners established at the time the standard parallel is run are termed "standard corners" and generally govern the surveys to the north. A second set of corners—closing corners—is established at the point where the subsequent survey lines intersect a previously established line. Closing corners are also established at the boundaries of reservations, grants, claims, and other previously surveyed or segregated tracts of land.

Corner, double (USPLS)

Normally the two sets of corners along a standard parallel; the standard township, sections, and quarter-section corners placed at regular intervals of measurement. Additionally, the closing corners established on the line at the points of intersection of the guide meridians, range and section lines of the surveys brought in from the south.

Corner, existent (USPLS)

A corner whose position can be identified by verifying the evidence of the monument, or its accessories, by reference to the description that is contained in the field notes, or where the point can be located by an acceptable supplemental survey record, some

physical evidence, or testimony. Even though its physical evidence may have entirely disappeared, a corner will not be regarded as lost if its position can be recovered through the testimony of one or more witnesses who have a dependable knowledge of the original location.

Corner, found

A term adopted to designate an existent monument that has been recovered by field investigation.

Corner, lost (USPLS)

A previously established survey corner whose positions cannot be recovered beyond reasonable doubt, either from traces of the original marks or from acceptable evidence or testimony that bears on the original position, and whose location can be restored only by reference to one or more interdependent corners.

Corner, property

A geographic point on the surface of the earth and is on, is a part of, and controls a property line.

Corner, property controlling (USPLS)

A public land survey corner or any property corner that does not lie on a property line of the property in question, but which controls the location of one or more of the property corners of the property in question.

Corner, meander (USPLS)

A corner established at the intersection of standard, township, or section lines with the banks of navigable streams or any meanderable body of water. See also “Corner, (USPLS).”

Corner, obliterated (USPLS)

A corner at which there are no remaining traces of the monument or its accessories, but whose location has been perpetuated or may be recovered beyond reasonable doubt by the acts and testimony of the interested landowners, competent surveyors, other qualified local authorities, witnesses, or by some acceptable record evidence. A position that depends upon the use of collateral evidence can be accepted only as duly supported, generally through proper relation of known corners, and by agreement with the field notes regarding distances to natural objects, stream crossings, line trees, and off-line tree blazes, etc., or unquestionable testimony.

Corner, witness (USPLS)

A witness corner, by conventional usage, is a monumented point usually on a line of the survey and near a corner. It is employed in situations where it is impracticable to occupy the site of a corner. When the true point for a corner falls upon an inaccessible place (such as within an unmeandered stream, lake, or pond, or in a marsh, or upon a precipitous slope of cliff), where the corner cannot be occupied, a witness corner will be established at some suitable point where the monument may be permanently constructed, but preferably on a line of the survey. Usually only one witness corner will be established in each instance, and it will be located upon any one of the surveyed lines leading to a corner if a secure place within 10-chains is available. If there is not a place to be found on a surveyed line within that limiting distance that can be occupied and marked, a witness corner may be located in any direction within a distance of 5 chains. If

a monument replacement is involved using witness corner and a specific distance given is a direct tie, no form of proration is acceptable.

Crab

The condition, occurring when the sides of an aerial photograph are not parallel or perpendicular to the direction of flight. It results when the aircraft's longitudinal axis does not coincide with the flight direction.

Curve, circular

A curve of constant radius. All points on the curve are equal distance from the center of the circle.

Curve, compound

Name for two circular curves of different radii, which are tangent at one point with both curves lying on the same side of the common tangent.

Curve, degree of

The degree of curve (D) defines the radius of a highway or railroad circular curve. There are two definitions:

- Chord: The angle subtended at the center of a circle by a chord of 100 ft.
- Arc: The angle subtended at the center of a circle by an arc of 100 ft.

Definition one was used in railroad and early highway design. Definition two is used in present-day engineering of highway design.

D

Datum

Any numerical or geometrical quantity or set of such quantities that may serve as a reference or base for other quantities.

Datum, horizontal

The position on the spheroid of reference assigned to the horizontal control (triangulation and traverse) of an area and defined by:

- The position (latitude and longitude) of one selected station in the area.
- The azimuth from the selected station on an adjoining station.

The horizontal-control datum may extend over a continent or be limited to a small area. A datum for a small area is usually called a local datum. The horizontal-control datum for the North American continent is known as the North American Datum of 1983 (NAD83).

Datum, mean sea level

A determination of mean sea level that has been adopted as a standard datum for heights or elevations. The NGVD29 is an example. Mean sea level datum was based on tidal observations over a number of years at various tide stations along the coasts. NGVD29 has been superseded by NAVD88.

Datum, state plane coordinates

The surface onto which each point is projected mathematically from the corresponding point on the spheroid to its corresponding point on a flat surface. For illustrative

purposes, the Lambert conformal projection is represented by a cone and the Transverse Mercator projection by a cylinder.

Deflection angle

A horizontal angle measured from the prolongation of the preceding line, clockwise or counterclockwise as necessary, to the following line.

Departure

In a plane survey, the amount that one end of a line is east or west of the other end. Also equal to the difference between the X-coordinate of the two ends of the line. It is equal to the length of the line times the sine of the bearing.

Digital Terrain Model (DTM)

An electronic three-dimensional map of a land surface.

Direction

The angle between a line and an arbitrarily chosen reference line. When the reference line is north or south and the angle is designated east or west and less than 90 degrees, the direction is called the bearing. When the reference line is north or south and the angle is clockwise between 0 degrees and 360 degrees, the direction is called the azimuth.

Directional instrument

A theodolite or total station in which the horizontal circle remains fixed during a set of observations and the direction of each point of the instrument is read on the circle. Horizontal angles cannot be repeated or accumulated on a direction instrument, but the circle can be advanced in position between successive sets of observations.

Direct reading

The reading of the horizontal or vertical circle of a theodolite or total station the instrument direct orientation. In field notes, the letter “D” preceding the observed value indicates a direct reading.

Discrepancy

- The difference between duplicate or comparable measures of a quantity.
- The difference between computed values of a quantity obtained by different processes in the same survey.

Displacement, height

Displacement of images radially inward or outward with respect to the photograph nadir, depending on whether the ground objects are, respectively, below or above the elevation of the ground nadir.

Displacement, relief

Displacement of images radially inward or outward from the nadir point of the photograph. Relief displacement of images is caused by differences in elevation of the corresponding ground objects whether below or above, respectively, the elevation of the ground nadir.

Displacement, tilt

Displacement of images on a tilted photograph radial from its isocenter. Tilt displacement is outward or inward with respect to the isocenter, according to whether the images are on the low or high side of the isometric parallel (the low side is the closest to the earth, or the object plane).

Distortion

Any shift in the position of an image on a photograph that alters the perspective characteristics of the photograph. Causes of image distortion include lens aberration, differential shrinkage of film or paper, and motion of the film or camera.

Diversion box (irrigation)

Usually, a concrete structure that allows irrigation water to be routed in several different directions.

Diversion structure (irrigation)

A structure similar to a turnout but used to divert water from a river or stream into the beginning of an irrigation canal.

Double centering

A method of prolonging a line from a fixed point whereby the backsight is taken with the telescope in the direct position. The telescope is placed in the inverted position and the foresight is made. The point at which the vertical cross hair intersects the hub is then marked. The instrument is then rotated 180 degrees to take a backsight with the telescope in the inverted position, and a second projected point with the telescope in the direct position is marked on the hub. A point midway between the two marked points is the true point on the prolonged line.

Double proportionate measurement

A method for restoring a lost corner of four townships or a lost interior corner of four sections. It is based on the principle that monuments north and south should control the latitudinal position of a lost corner, and monuments east and west should control the longitudinal position. In this method, the influence of one identified original corner is balanced by the control of a corresponding original corner upon the opposite side of a particular missing corner, which is to be restored, each identified original corner being given a controlling weight inversely proportional to its distance from the lost corner.

Drift

The lateral shift or displacement of the aircraft from the planned flight path due to the action of the wind, navigational errors, or other causes.

Drop structure (irrigation)

Usually concrete, steps in an irrigation canal used to flatten canal slope between steps.

E

Easting (east)

A linear distance eastward from the north-south line that passes through the origin (or false origin) of a grid. The false origin is selected so that all east coordinates are positive. Also referred to as the X-coordinate.

Elevation

The vertical distance from a datum, such as NAVD88 to a point or object on the earth's surface.

Emulsion (photography)

A suspension of a light-sensitive silver salt (especially silver chloride or silver bromide) in a colloidal medium (usually gelatin), which is used for coating photographic films, plates, and papers. Types of photographic emulsions currently in common usage are panchromatic (black and white), color negative, color positive, infrared color, and infrared black and white.

Endlap

The overlap area common to two successive aerial photographs in a strip.

Ephemeris

- A publication giving coordinates of celestial bodies at uniform time intervals; the coordinates are usually given for one calendar year. A publication giving similar information in a form suitable for use by a navigator is called an almanac.
- A data file that contains orbit information on all satellites, clock corrections, and atmospheric delay parameters. It is transmitted by a GPS satellite to a GPS receiver, where it facilitates rapid satellite vehicle acquisition within GPS receivers. Almanac data must be acquired before GPS navigation can begin.

Error of closure

The amount by which the value of a quantity obtained by surveying operations fails to agree with another value of the same quantity held fixed from earlier determinations or with a theoretical value of the quantity.

Extrapolation

The process of estimating the value of a quantity beyond the limits of known values by assuming that the rate of change between the last few known values continues.

Eye base

The interpupillary distance between the eyes of an individual.

F

Fiducial marks (photogrammetry)

Index marks, at least four, rigidly connected with the camera lens through the camera body and forming images on the negative that define the principal point of the photograph. Also, those marks, usually four in number, in any instrument that define the axes whose intersections fix the principal point of a photograph or negative and fulfill the requirements of interior orientation.

Flight height

The height of the camera above the mean elevation of the ground at the instant of exposure.

Flight line

A line drawn on a map or chart to represent the track of the aircraft during the period of taking aerial photographs.

Flight map

A map showing the lines along which an aircraft is to fly when aerial photographs are being taken and/or the locations at where photographs are to be taken.

Flight strip

A succession of overlapping aerial photographs taken along a single course.

Focal length

A general term for the distance between the center, vertex, or rear node of a lens (or the vertex of a mirror) and the point at which the image of an infinitely distant object comes into critical focus. The term must be preceded by an adjective such as “equivalent” or “calibrated” to have precise meaning.

Foresight

- A point to which an instrument sighting is made for measuring or establishing its elevation and/or its horizontal positions.
- In leveling, the foresight is an observation made to a point of unknown elevation.

G

Gap (aerial photography)

Any space between aerial photographs failing to meet minimum ground coverage requirements. The gap may be space not covered by any photograph in line of flight or between separate flights, or the space where specified endlap or sidelap was not obtained.

General Land Office

Formerly an office of the United States government, being a division of the Department of the Interior, having charge of all executive action relating to the public lands, including their survey, sale or other disposition, and patenting; originally constituted by Act of Congress in 1812. The General Land Office and the US Grazing Service were consolidated into the Bureau of Land Management under the Department of the Interior by the 1946 Reorganization Plan No 3, 403.

Geodetic surveys

Surveys in which the shape of the earth is considered.

Geoid

Theoretical continuous surface that is perpendicular at every point to the direction of gravity.

Global Navigation Satellite System (GNSS)

A system for providing precise location, which is based on data transmitted from a constellation of satellites.

Grid

A surface that consists of imaginary parallel lines that intersect at right angles. The term is frequently used to designate a plane-rectangular coordinate system.

Grid azimuth

An azimuth measured from grid north.

Grid coordinates

The X (E) and Y (N) values that designate a point on a grid.

Grid factor

A scale factor used to convert ellipsoid distances to grid distance and vice versa.

Grid length

The distance between two points as obtained by computation from the plane-rectangular coordinates of the points. In the state coordinate systems, a grid length differs from a geodetic distance by the amount of a correction based on a grid scale and elevation scale.

Grid tick

A small mark placed at the edge of a map or drawing to indicate a measurement. The grid system used may be indicated by ticks for future reference.

Ground control

In photogrammetry, control obtained from surveys as distinguished from control obtained by photogrammetric methods.

Guard stake

A stake driven near (within 6-in.) a hub, usually sloped with the top driven to clear the hub. The guard stake protects the hub, and the markings on the stake identify it.

H

Head gate (irrigation)

A concrete structure that includes slide gates, screw gates, or turnouts.

Height of instrument

- The height of the center of the telescope (horizontal axis) above the ground or station mark.
- Leveling: The height of the line of sight of the leveling instrument above the adopted datum.

Height of signal

Vertical distance from the top of the control point to the center of the object observed: for example, the distance from the top of the control point to the center of a prism.

Highwater mark

The visible mark left on a pier, abutment, rock, etc., indicating the water surface level (elevation) during a flood.

Horizontal angle

An angle measured in a horizontal plane.

Horizontal axis (total station)

The axis about which the telescope of a total station rotates when moved vertically. It is the axis of rotation that is perpendicular to the vertical axis of the instrument and to the axis of the collimation of the telescope. It should coincide with the line through the centers of the pivots that support the telescope. For an instrument in complete adjustment, it occupies a horizontal position, and when the telescope is rotated around it, the axis of collimation will define the vertical plane. Deviations from this condition are measured with a striding level or with a hanging level.

Horizontal control

Control stations whose horizontal coordinates are known.

Horizontal datum

In plane surveying, the grid system of reference used for the horizontal control of an area, defined by the easting and northing of one station in the area and the azimuth from this selected station to an adjacent station.

Horizontal direction

A direction in a horizontal plane.

Horizontal distance

The distance measured in a horizontal plane, as distinguished from a distance measured on a slope.

Horizontal plane

A plane perpendicular to the direction of gravity.

Horizontal position

The grid position of a horizontal control point.

Horizontal and vertical control point

When used in aerial photo work, it refers to a photo image point that has X, Y, and Z coordinate values. These image points are used to control the scale and elevation of stereo models in the preparation of topographic maps.

Hub

A wooden stake with a tack or other marker to indicate the exact position. A guard stake protects and identifies the hub.

I

Intersection

A method of locating the horizontal position of a point by observations from two or more points of known position. A point whose horizontal position is located by intersection is known as an intersection station.

Instrument direct

The theodolite or total station when oriented in its normal position. In field notes, “D” signifies a reading with the instrument direct, called a “direct reading.”

Instrument reversed or inverted

The theodolite or total station when the telescope is inverted from its normal position. In field notes, “R” signifies a reading with the instrument reversed, called a “reversed reading.”

Inverse computation

The computation for the length and azimuth of a line from the coordinates of its endpoints. This is the inverse of the survey computation in which the position of a new station is determined through the length and azimuth of the connecting line.

L

Latitude

- Angular distance measured on a meridian, north or south from the equator.
- In plane surveying, the amount that one end of a line is north or south of the other end. Also equal to the difference between the Y-coordinate of the two ends of the line.
- It is equal to the length of the line times the cosine of the bearing.

Least squares

An adjustment method to distribute random errors associated with conventional survey or a GPS network. The adjustment minimizes the sums of the squares of the residual. Generally preferred over the compass adjustment.

Level

- Pertaining to a level surface.
- To make horizontal at the point of observation.
- An instrument for leveling.

Level loop

The measurement of elevations by differential leveling from a known bench mark to another known bench mark. A level loop may also commence at a known bench mark and close on the same bench mark.

Level datum

A level surface to which elevations are referred. The generally adopted level datum for leveling in the United States is NAVD88. For local surveys an arbitrary level datum is

often adopted and defined in terms of an assumed elevation for some physical mark (bench mark).

Level line

- A line in a horizontal plane.
- A line over which leveling operations are accomplished.

Level net

Lines of spirit leveling connected together to form a system of loops or circuits extending over an area. Also called a vertical control net.

Level surface

A horizontal plane.

Leveling

The operation of measuring vertical distances, directly or indirectly, to determine elevations.

Leveling, differential

The process of measuring the difference of elevation between any two points by spirit leveling.

Leveling, reciprocal

A procedure for measuring zenith angles and distances from both ends of a line for the determination of differences in elevations. This method compensates for earth curvature and the effects of atmospheric refraction.

Leveling, spirit

The determination of elevations by use of a leveling rod and an instrument using a spirit level to establish a horizontal line of sight; the term has now been broadened to include leveling by means of other types of levels, such as a pendulum level and digital levels.

Leveling, trigonometric

The determination of differences in elevation trigonometrically from observed zenith angles and measured slope distances.

Leveling rod

A rod or bar with a flat face graduated in linear units with zero at the bottom, used in measuring the vertical distance between a point on the ground and the horizontal line of sight of a leveling instrument.

Line, base (USPLS)

A line extending east and west along the astronomic parallel passing through the initial point, along which standard township, section, and quarter-section corners are established. As may be inferred from its designation, the base line is the line from which is initiated the survey of the township boundaries and section lines. Auxiliary governing lines, known as standard parallels or correction lines, are established along astronomic parallels usually at intervals of 24-mi north or south of the base line. In some of the early surveys, the base line was referred to as the “basis parallel.”

Line, grade

The profile of the road, usually expressed as a percentage, which is the number of units of change in elevation per 100-units of horizontal distance.

Line, random

A trial line directed as closely as possible toward a fixed terminal point that is not visible from the initial point. The error of closure (amount by which the second station is missed) permits the computation of a correction to the initial azimuth of the random line. It also permits the computation of offsets from the random line to establish points on the line between the survey stations.

Longitude

The angle between the plane of a given meridian and the plane of an arbitrary initial meridian, the meridian of Greenwich. It may be measured as the angle at the poles between the two meridians, as the arc of the equator intercepted between the meridians, or as the arc of a parallel of latitude intercepted between the meridians.

Loop traverse

A closed traverse that starts and ends at the same station.

M

Magazine (photography)

A container for rolled film or photographic plates attached to the camera body and usually equipped with automatic mechanisms to advance and position the photographic material for exposure.

Magnetic azimuth

An azimuth measured with reference to the direction indicated by a magnetic compass needle. Magnetic azimuth is measured from magnetic north, which is east or west of true north as shown by the magnetic declination.

Magnetic declination

The angular amount that a magnetic compass needle points eastward or westward from north.

Magnetic declination

Regular or irregular changes in the magnetic declination with time.

Map

A representation on a plane surface, at an established scale, of the physical features (natural, artificial, or both) of a part or the whole of the earth's surface, by the use of signs and symbols, and with the method of orientation indicated. Also, a similar representation of the heavenly bodies. A map may emphasize, generalize, or omit the representation of certain features to satisfy specific requirements. The type of information, which a map is designed primarily to convey, is frequently used, in adjective form, to distinguish it from maps of other types. A map should contain a record of the projection upon which it is constructed.

Map, base

- A map showing certain fundamental information, copies of which are used to compile additional data of specialized nature. Often used to define a large-scale planimetric map compiled from aerial photographs, copies of which are used for the addition of contours and other data by use of the plane table and photogrammetric methods.
- A map containing all the information from which maps showing specialized information can be prepared, a primary map.

Map, cadastral

A map showing the boundaries of subdivisions of land, usually with the bearings and lengths thereof and the areas of individual tracts, for purposes of describing and recording ownership. A cadastral map may also show culture, drainage, and other features relating to the value and use of land.

Map, contour

A map that portrays the elevation and configurations of the ground by contour lines and lacks any other details except notations and contour elevations.

Map, engineering

A map showing information that is essential for planning an engineering project or development and for estimating its cost. An engineering map is usually a large-scale map of a comparatively small area or of a route. It may be entirely the product of an engineering survey, or reliable information may be collected from various sources for the purpose and assembled on a base map.

Map, highway

A map containing the planimetric configurations of a highway and its connections, at grade or by controlled access, to other highways; also, a map containing the details of curvature, roadside, and cross drainage, right-of-way boundaries, and delineations regarding adjacent occupancy and land uses. The detail in a highway map is dependent entirely upon its scale and the purpose of its use whether for merely indicating travel routes or for depicting construction details.

Map, planimetric

A map that presents only the horizontal positions for the features represented; distinguished from a topographic map by the omission of relief in measurable form.

Map, projection, Lambert conformal conic

A conformal map projection of the so-called conical type, on which all geographic meridians are represented by straight lines which meet in a common point outside the limits of the map, and the geographic parallels are represented by a series of arcs of circles having this common point for a center. Meridians and parallels intersect at right angles, and angles on the earth are correctly represented on the projection. This projection may have one standard parallel along which the scale is held exact, or there may be two such standard parallels, both maintaining exact scale. At any point on the map, the scale is the same in every direction. It changes along the meridians and is constant along each parallel. Where there are two standard parallels, the scale between those parallels is too small, beyond them to large.

Map scale

The relationship existing between a distance on a map and the corresponding distance on the earth. Map scale may be expressed as an equivalence, usually by different units: that is, 1 in. = 1 mi., as a numerical fraction; or ratio (1/63,360 or 1:63,360); or graphically, by a bar scale. Fractional map scale is representative in any linear units and is often called the representative fraction, or RF, when the numerator is unity.

Map scale, graphic (or bar)

A line on a map subdivided and marked with the distance which each of its parts represents on the earth.

Map, topographic

A map that presents the horizontal and vertical positions of the features represented; distinguished from a planimetric map by the addition of relief in measurable form. A topographic map usually shows the same features as a planimetric map but uses contours or comparable symbols to show mountains, valleys, and plains; and in the case of hydrographic charts, symbols, and numbers to show depths in bodies of water.

Mark (Point)

A definite object (such as an imprinted metal disk) used to designate a survey mark or point. Usually used with a qualifying term such as station mark, reference mark, azimuth mark, or bench mark. Sometimes refers to the entire survey monument.

Mass diagram

The earthwork mass diagram is a continuous graph of net cumulative yardage at any point on an earthwork project. It is used to analyze amounts of excavation and embankment, balance points, and haul requirements.

Mean sea level (MSL)

The average height of the surface of the sea for all stages of the tide over a 19-year period, usually determined from hourly height readings. A determination of mean sea level that has been adopted as a standard for heights is called a sea level datum. It was based upon observations taken over a number of years at various tide stations along the coasts of the United States and Canada.

Memorial (USPLS)

A durable article deposited in the ground at the position of a corner to perpetuate that position should the monument be removed or destroyed. The memorial is usually deposited at the base of the monument and may consist of anything durable, such as glass or stoneware, a marked stone, charred stake, or a quantity of charcoal.

Meridian

A north-south line from which longitudes (or departures) and azimuths are reckoned.

Meridian, central

- The line of longitude at the center of a projection. One of the parameters for construction of a projection.
- (State Plane Coordinate System) The meridian used as the Y-axis for computing projection for a state coordinate system. The central meridian of the system usually passes close to the center of projection.

Metes and bounds

A method of describing land by measure of length (metes) or the boundary lines (bounds). The most common method is to recite direction and length of each line as one would walk around the perimeter. In general, the metes and bounds can be recited by reference to record; natural or artificial monuments at the corners; and record, natural, or cultural boundary lines. See also “Description, metes and bounds.”

Monument (USPLS)

A physical structure that marks the location of either a property corner or a property controlling corner or other survey points. In public-land surveys, the term “corner” is employed to denote a point determined by the surveying process, whereas the “monument” is the physical structure erected to mark the corner point upon the earth’s surface. Monument and corner are not synonymous, though the two terms are often used in the same sense.

Monument, record

An adjoiner property called for in a deed such as a street or parcel of land. Frequently the boundary line of the adjoiner is referred to as the record monument; actually, the entire property, rather than the line, is the monument. Physical monuments may or may not mark a record monument.

Mosaic, photographic

An assembly of aerial photographs whose edges usually have been cut and matched to form a continuous photographic representation of a portion of the earth’s surface. Often called an aerial mosaic.

- Controlled mosaic: A mosaic oriented and scaled to horizontal ground control; usually assembled from rectified photographs.
- Uncontrolled mosaic: A mosaic in which the photographs have not been adjusted by the reference to ground control.

Most probable value

That value of a quantity that is mathematically determined from a series of observations and is more nearly free from the effects of blunders and errors than any other value that might be derived from the same series of observations.

Multipath

Interference caused by reflected GPS signals arriving at the receiver, typically as a result of nearby structures or other reflective surfaces.

N

Nadir

The point on the celestial sphere directly beneath the observer and directly opposite the zenith.

Neat model

The shared area between two aerial photographs lying between the principal point of each photograph.

Normal

In general, a straight line perpendicular to a surface or to another line. Also, a condition of being perpendicular to a surface or line. In geodesy, a straight line perpendicular to the surface of the spheroid.

North

The primary reference direction relative to the earth; the direction indicated by 0 degrees in any system. A term used to define:

- An astronomic meridian.
- A geodetic meridian.
- The direction of north from magnetic north corrected for declination.
- The cardinal directions run in the Public Land Survey.

The use of the term “True North” should be avoided.

North arrow

An arrow-like symbol indicating the direction and the type of meridian to which the control framework of a map or drawing is referenced. Auxiliary arrows may be shown indicating the direction of other meridians that may be of interest to the user of the map.

North, magnetic

The direction of the north-seeking end of a magnetic compass needle not subject to transient or local disturbance.

Northing (north)

A linear distance northward from the east-west line that passes through the origin (or false origin) of a grid. Generally, the false origin is selected so that all northings remain positive. Same as y-coordinate.

O

Objective

The lens in a microscope or telescope that is nearest the object. Also, the lens used in a camera.

Oblique photograph (aerial)

An aerial photograph taken with the camera axis intentionally tilted between 3 and 90 degrees from vertical.

Observed value

A value of a quantity that is obtained by instrumental measurement of the quantity. The term “measured” is often applied to the value of a quantity derived from instrumental measurement after corrections have been applied for systematic errors.

Occupied station

A traverse or some other mark over which a total station or GPS antenna is set up for the measurement and recording of survey data.

Offset line

A supplementary line close to, and usually parallel to, a main survey line to which it is referenced by measured offsets. When the line for which data are desired is in such position that it is difficult to measure over it, the required data are obtained by running an offset line in a convenient location and measuring offset from it to salient points on the other line.

Open traverse

A traverse that starts at a point of known or assumed position and ends at a point whose relative position is unknown with respect to the starting point.

Order of accuracy

A mathematical ratio defining the general accuracy of the measurements made in a survey.

Orthophoto

A photo reproduction that has been corrected for camera lens distortions, tilt, and topographic displacement. Because of these corrections, objects in an orthophoto appear in their true orthographic position.

Overlap

- The amount by which one photograph includes the same area as covered by another, customarily expressed as a percentage.
- That area of a map or chart, which overlaps the same geographical area on an adjoining map or chart.
- An area included within two surveys of record, which by the record is described as having one or more common boundary lines with no inclusion of identical parts.

Overlapping pair (photogrammetry)

Two photographs taken at different exposure stations in such a manner that a part of one photograph shows the same terrain as shown on a part of the other photograph. This term covers the general case and does not imply that the photographs were taken for stereoscopic examination.

Overlay (mapping)

A record on a transparent medium to be superimposed on another record: for example, maps showing original land grants (or patents) prepared as tracing-cloth overlays in order that they can be correlated with the maps showing present ownership. Also, any of the several overlays that may be prepared in compiling a manuscript map, usually described by name: for example, lettering overlay.

P

Parallax

The apparent displacement of the position of any point with respect to a reference point or system, caused by a shift in the station of observation. The parallax of one point in space in respect to a reference point is the angle of convergence of the rays from two observation stations to the reference point, minus the angle of convergence of the rays from the same two observation stations to the second point. On a pair of photographs of

the points in space taken from the two observation stations, parallax is measured by distances on the photographs rather than by angles.

Parallax, instrumental

A change in the apparent position of an object with respect to the reference marks of an instrument which is due to imperfect adjustment of the instrument, to a change in the position of the observer, or both.

Parallel, geographic

A line on the earth having the same latitude.

Parallel, standard (USPLS)

An auxiliary governing line initiated at a selected township corner on a principal meridian, usually at intervals of 24-mi. from the base line, on which standard township, section, and quarter-section corners are established.

Pass point

A natural image or marked point visible on a photograph for which the horizontal position and/or elevation has been or will be determined by photogrammetric use of the photograph and its stereoscopically adjacent photographs. A pass point is used for the orientation of photographs in photogrammetric instruments in the same manner in which supplemental control points are used.

Perpendicular

A perpendicular line, plane, etc. A distinction is sometimes made between perpendicular and normal—the former applying to a line at right angles to a straight line or place, and the latter referring to a line at right angles to a curve or curved surface.

Phase

The visible aspect of an object. The apparent displacement of an object or signal caused by one side being more strongly illuminated than the other. The resultant error in pointing is similar to the error caused by observing an eccentric signal.

Phase of target (error caused by)

Uneven illumination of target causing error in sighting.

Photo ID point

The photo identification point is a photo image point visible on the photograph and identifiable on the ground. Photo ID points can be pre-marked (targeted) points, but more commonly, they are definable physical features. The term is generally used to refer to photo image points used to supplement control after photos have been taken.

Photogrammetry

The art, science, and technology of obtaining reliable information about physical objects and the environment through the processes of recording, measuring, and interpreting photographic images and patterns of electromagnetic radiant energy and other phenomena.

Photograph

A general term applying to either a positive or a negative exposed on light-sensitized material by use of a camera; also, the print made photographically from the negative or positive. The photograph may be exposed or printed, using any one of these types of emulsions: panchromatic, negative, or positive color, infrared color, or infrared black and white.

Photographic interpretation

The determination of the nature and description of objects imaged on a photograph.

Pier

An intermediate support for the adjacent ends of two bridge spans.

Plane coordinates

See “Grid coordinates.”

Plane survey

A survey in which the effect of the curvature of the earth is neglected, and computations of the relative positions of the stations are made using the principles of plane geometry and plane trigonometry.

Plat (USPLS)

The term “plat,” as employed by the US Bureau of Land Management, refers to the drawing that represents the particular area included in a survey, such as a township, private land claim, or mineral claim, and the lines surveyed, established, retraced, or resurveyed, showing the direction and length of each line; the relation to the adjoining official surveys; the boundaries, descriptions, and area of each parcel of land subdivided; and, as nearly as may be practicable, a representation of the relief and improvements within the limits of the survey.

Plat, supplemental (USPLS)

A plat prepared entirely from office records designed to show a revised subdivision of one or more sections without change in the section boundaries and without other modification of the subsisting record. Supplemental plats are required where the subsisting plat fails to provide units suitable for administration or disposal, or where a modification of its showing is necessary. They are also required to show the segregation of alienated lands from public lands, where the former are included in irregular surveys of patented mineral or other private claims made after the plat of the subsisting survey, or where the segregation of the claims was overlooked at the time of its approval.

Plumb bob

A conical device, usually of brass and suspended by a cord, by means of which a point can be projected vertically into space over relatively short distances.

Point of curve (PC)

The point of change from a line to a curve.

Point of intersection (PI)

The point of intersection of two lines.

Point of tangent (PT)

The point of change from a curve to a line.

Point of vertical curve (PVC)

The point of change from a line of uniform slope to a vertical curve.

Point of vertical intersection (PVI)

The point of intersection of two lines, each having different uniform slope.

Point of vertical tangent (PVT)

The point of change from a vertical curve to a line of uniform slope.

Point-transfer device

A stereoscopic instrument used to mark corresponding image points on overlapping photographs.

Polaris

The second-magnitude star, Alpha, in the constellation Ursa Minor (Little Dipper); also known as the polestar, or North Star, because of its proximity to the north pole of the celestial sphere. Polaris is well situated for determinations of astronomical azimuth and for the determination of the direction of the celestial meridian. It is at the extreme outer end of the handle of the Little Dipper.

Position

- Data that define the location of a point with respect to a reference system.
- The place occupied by a point on the surface of the earth.
- The coordinates that define the location of a point on the geoid or spheroid.
- A prescribed setting (reading) of the horizontal circle of a total station that is to be used for the observation on the initial station of a series of stations to be observed.

Position, astronomical

- A point on the earth whose coordinates have been determined because of observations of celestial bodies.
- A point on the earth, defined in terms of astronomical latitude and longitude.

Position, geodetic

A position of a point on the surface of the earth expressed in terms of geodetic latitude and geodetic longitude. A geodetic position implies an adopted geodetic datum. In a complete record of a geodetic position, the datum must be stated.

Positive (photography)

A photograph having approximately the same rendition of light and shade as the original subject. A print from a negative.

Precision

The degree of refinement in the performance of an operation, or the degree of perfection in the instruments and methods used when making the measurements. A measure of the uniformity or reproducibility of the result. Precision relates to the quality of the operation by which a result is obtained and is distinguished from accuracy, which relates to the quality of the result.

Present traveled way

The center of pavement. Not the same as centerline though often used interchangeably.

Pressure plate (photography)

A flat plate, usually of metal but frequently of glass or other substance, which using mechanical force, presses the film into contact with the focal plane of the camera.

Prima facie evidence

Evidence deemed by law to be sufficient to establish a fact if the evidence is not disputed.

Print (photography)

A photographic copy made by projection or contact printing from a photographic negative or from a transparent drawing, as in blueprinting.

- Contact print: A print made with the negative or transparent drawing in contact with the sensitized surface.
- Ratio print: A print, the scale of which has been changed from that of the negative by enlargement or reduction.

Profile

A vertical section of the surface of the ground, or of underlying strata, or both, along any fixed line.

Profile, ground

A line indicating ground elevations of a vertical section along a survey line.

Profile grade

The trace of a vertical plane intersecting the top surface of the proposed wearing surface, usually along the longitudinal centerline of the roadbed. Profile grade means either elevation or gradient of such trace according to the context.

Progress sketch

A map or sketch showing work accomplished. In triangulation and traverse surveys, each point that is established is shown on the progress sketch as well as lines observed over and base lines measured. In a leveling survey, the progress sketch shows the route followed and the towns passed through but not necessarily the locations of the bench marks.

Prolongation

With reference to a line, a term used to indicate the continuity in the same direction of the recited course that is to be lengthened. A line is prolonged, but a curve is continued. A prolongation of a curve is the extension of the tangent to the curve and should not be

used in referring to curve continuation. The prolongation of a line, composed of several parts of different directional values, is the prolongation of the course nearest to the recited intersection or monument.

Property controlling corner

A public land survey corner or any property corner which does not lie on a property line of the property in question, but which controls the location of one or more of the property corners of the property in question.

Property corner

A geographic point on the surface of the earth and is on, is a part of, and controls a property line.

Proportionate measurement

A measurement that applies an even distribution of a determined excess or deficiency of measurement, ascertained by retracement of an established line, to provide concordant relations between all parts.

Proportioning excess or deficiency (principle of)

A principle, governed by several rules, of distributing excess or deficiency. For example, the frontage of 10 lots in a city block may total 1,000 ft. by deed or plan. The measured length of the block is 1,007.42 ft. The excess, 7.42 ft., must be distributed among the 10 lots.

Prorate

To divide or distribute proportionally.

Proration

A method of distributing discovered excess or deficiency between parties having equal rights or proportionate rights to the excess or deficiency. A method of calibrating the tape of a recent surveyor against that of the original surveyor.

Q

Quarter line

In public land surveys made on a township, range, and section basis, a quarter line is one of two lines joining opposite quarter section corners, and by the two lines the original survey of a section of land is divided into four parts. Also known as a mid-section line.

R

Radial survey

The measurement of angles and distances from a principal control point to a series of additional points, with the position of each point determined independent of the others.

Range (USPLS)

Any series of contiguous townships situated north and south of each other; also, sections similarly situated within a township. Ranges of townships are numbered consecutively east and west from a principal meridian; thus, “range 3 east” indicates the third range or row of townships to the east from a principal meridian. The word range is used in

conjunction with the appropriate township to indicate the coordinates of a particular township with reference to the initial point; thus, “township 14 north, range 3 east” indicates the township which is the 14th township north of the base line and the third township east of the principal meridian.

Real Time Kinematic (RTK)

The Differential GPS procedure whereby carrier phase corrections are transmitted in real time from a reference station to the user's roving receiver.

Reciprocal zenith angles

Zenith angles observations taken with the instrument occupying both ends of a line for trigonometric leveling purposes to correct for the effects of refraction, parallax, and earth curvature.

Reconnaissance

A general examination or survey of a region with reference to its primary features, usually as a preliminary to a more detailed survey.

Recording a deed

The recording of deeds to give constructive notice of conveyance to purchasers and creditors. A deed may be valid between the grantor and grantee but will fail to give constructive notice to others if not so recorded.

Recovery of station

The expression for visiting a survey station, identifying its mark as authentic and in its original location, and verifying or revising its description. The term is usually modified to indicate the type or nature of the recovery, such as recovered bench mark or a recovered triangulation station.

Reduction to sea level

A reduction applied to a measured horizontal length on the earth’s surface to reduce it to the surface of the sea-level datum of the reference spheroid.

Reference mark

A permanent supplementary mark near a survey station to which it is related by an accurately measured distance and direction and/or a difference in elevation.

Referencing

The process of measuring the horizontal (or slope) distances and directions (azimuths or bearing) from a survey station to nearby landmarks, reference marks, and other objects that can be used in the recovery of the station.

Reflecting prism

A prism in which deviation of a light beam is produced by reflection within the prism. Almost all prisms used in photogrammetric instruments are of this type.

Refraction

The bending of light rays in passing from one transparent medium into another that has a different index of refraction. The angle of refraction is the angle that the refracted ray makes with the normal to the surface separating the two media.

Refraction, horizontal

The lateral effect of terrestrial refraction that affects the observed values of horizontal directions.

Refraction, index of

The sine of the angle of incidence divided by the sine of the angle of refraction equals a constant when one of the media is air. The index of refraction can also be explained as the ratio of the velocity of light in one medium to that in another. The indices of glass range from 1 46 to 1 80.

Relief

Variations in the elevation of the ground surface, also features of height above a plain or reference datum. On a topographic map, relief is depicted by hachures or shading, or more accurately by contours or by spot elevations or both.

Repetition of angles

The accumulation of a series of measures of the same angle on the horizontal circle of a total station. In making these readings, the final reading of one measure is used as the initial setting of the next measure of the angle. The observed value of the angle is obtained by dividing the total arc passed over by the number of observations.

Resection

- The graphical or analytical determination of a position, as the intersection of at least three lines of known direction to corresponding points of known position.
- Surveying: The determination of the horizontal position of a survey station by observed directions from the station to points of known positions. Also, the line drawn through the plotted location of a station to the occupied station.
- Photogrammetry: The determination of the position and/or altitude of a camera, or the photograph taken with that camera, with respect to the exterior coordinate system.

Restoration

The recovery of one or more lines or corner positions, or both of a prior approved survey, or the replacement of one or more lost corners or obliterated monuments by approved methods, including the substantial renewal of one or more monuments as required for the purpose of a survey.

Resurvey

A retracing on the ground of the lines of an earlier survey in which all points of the earlier survey that are recovered are held fixed and used as a control. If too few points of the earlier survey are recovered to satisfy the control requirements of the resurvey, a new survey may be made. A resurvey is related directly to an original survey although several resurveys may interpose between them. See also “Resurvey, dependent” and “Resurvey, independent.”

Resurvey, dependent

A resurvey for accomplishing a restoration based on the original conditions according to the records. The dependent resurvey is made, first by identifying existing corners and other recognized and acceptable points of control of the original survey, and second, by restoring the missing corners by proportionate measurement in harmony with the original

survey. This type of resurvey is used where there is fair agreement between the conditions on the ground and the records of the original survey. Titles, areas, and descriptions should remain unchanged. Contrasted with independent resurvey.

Resurvey, independent

A resurvey that is not dependent on the records of the original survey but is intended to supersede them in establishing new land boundaries and subdivisions. It is made in areas having both private and public lands represented in the tract to be resurveyed and where the ground evidence of the original survey has become entirely lost or the descriptions of the earlier survey are irreconcilable. An independent resurvey is accomplished in three steps: the out-boundaries of lands subject to resurvey are first reestablished, following the method of dependent resurvey; the private lands are segregated, with consideration for the bona fide rights of the claimants; and new boundaries and descriptions are established for the remaining public lands. Contrasted with dependent resurvey.

Retracement

A term applied to a survey that is made for the purpose of verifying the direction and length of lines and identifying the monuments and other marks of an established prior survey.

RINEX Receiver Independent Exchange format

A set of standard definitions and formats to promote the free exchange of GPS data and facilitate the use of data from any GPS receiver with any software package. The format includes definitions for three fundamental GOS observables: time, phase, and range.

Riprap

Large angular stones used to minimize bank erosion.

Rover

Any mobile GPS receiver collecting data during a field session. The receiver's position can be computed relative to another stationary GPS receiver.

S

Scale factor

A multiplier for reducing a distance obtained from a map by computation or scaling to the actual distance on the datum of the map. Also, in the state coordinate systems, scale factors are applied to geodetic lengths to obtain grid lengths, or to grid lengths or obtain geodetic lengths.

Screw gate (irrigation)

A structure like a slide gate, but generally has a round handle to assist in raising or lowering a gate.

Semi-diameter

In making observation of the sun or the moon, the angle should be measured to one edge (or limb) of the body, and the observed angle should be reduced to the center by adding or subtracting the apparent semi-diameter. This quantity may be found in the Nautical Almanac. For the sun, it is approximately 16 minutes of arc but varies about 15 seconds of arc either way.

Set of angles

A set of angles consisting of two pointings of an instrument. For horizontal angles, a set consists of direct and reverse pointing of the instrument. For zenith angles, a set consists of a left (vertical circle left) and a right (vertical circle right) pointing of the instrument. A meaned set of angles removes systematic instrument adjustment and leveling errors from an observation. Correct operation of instruments requires a minimum of one set of angles for traverse or layout work.

Sidelap

The overlap area common to two parallel strips of aerial photographs.

Side shot

A reading or measurement from a survey station to locate a point that is not intended to be used as a base for the extension of the survey. A side shot is usually made for the purpose of determining the position of some object that is to be shown on the map.

Single proportionate measurement

A method of proportioning measurement in the restoration of a lost corner whose position is determined with reference to alignment in one direction. Examples of such corners are quarter-section corners on the line between two section corners, all corners on standard parallels, and all intermediate positions on any township boundary line. The ordinary field problem consists of distributing the excess of deficiency between two existent corners in such a way that the amount given to each interval bears the same proportion to the whole difference as the record length of the interval bears to the whole distance. After having applied the proportionate difference to the record length of each interval, the sum of the several parts will equal the new measurement of the whole distance.

Slide gate (irrigation)

A structure that is usually, metal and manually slides up and down and is located in a head gate. See “Screw gate.”

Spheroid

A mathematical figure closely approaching the geoid in form and size and used as a surface of reference for geodetic surveys.

Station

A term meaning a point every 100 ft. on centerline; in traversing, the name of a traverse point. The name of a point.

Stereocompilation

- The procedure of producing a map from aerial photographs by means of stereoplotting instruments.
- The map data are produced with stereoplotting instruments.

Stereoscope

An optical instrument used for viewing two properly related photographs or diagrams simultaneously to obtain the mental impression of a three-dimensional model.

Stereoscopic principle (photographic mapping)

The formation of a single, three-dimensional image by binocular vision of two photographic images of the same terrain taken from different exposure stations. With proper equipment, all measurements needed in map construction can be made from this visual model.

Strip adjustment

Reference similar to a block adjustment but limited to a single strip of photographs.

Subchord

Any chord of a circular curve whose length is less than that of the chord adopted for laying out the curve. In a railroad curve, for example, a subchord is a chord less than 100 ft. in length. Also, any chord of a circular curve that is less than the long chord between the extremities of the curve.

Subdivision (real estate)

A tract of land surveyed and divided into lots for purposes of sale.

Subdivision (USPLS)

The subdivision of a township, such as a section, half-section, quarter-section, quarter-quarter or sixteenth-section, or lotting, including the lot, section, township, and range numbers, and the description of the principal meridian to which referred, all according to the approved township plat.

Surveying

- The science and art of making all essential measurements in space to determine the relative position of points and/or physical and cultural details above, on, or beneath the surface of the earth and to depict them in usable form, or to establish the position of points and/or details. Also, the actual making of a survey and the recording and/or delineation of dimensions and details for subsequent use.
- The acquiring and/or accumulation of qualitative information and quantitative data by observing, counting, classifying, and recording according to need. Examples are traffic surveying to determine the type, number, speed, relative positions, and origin and destination of vehicles; and soil surveying to classify soils by type and measure and delineate their boundaries.

Surveying, geodetic

That branch of the art of surveying in which account is taken of the figure and size of the earth. In geodetic surveying, prescribed precision and accuracy of results are obtained through the use of special instruments and field methods and equations based on the geometry of a mathematical figure approximating the earth in form and size.

Surveying, land

Land surveying is the art and science of:

- Re-establishing cadastral surveys and land boundaries based on documents of record and historical evidence.
- Planning, designing, and establishing property boundaries.

- Certifying surveys as required by statute or local ordinance such as subdivision plats, registered land surveys, judicial surveys, and space delineation.

Land surveying can include associated services such as mapping and related data accumulation; construction layout surveys; precision measurements of length, angle, elevation, area and volume; horizontal and vertical control systems; and the analysis and utilization of survey data.

Surveying, plane

A branch of the art of surveying in which the surface of the earth is considered a plane surface. For small areas, precise results may be obtained with plane-surveying methods, but the accuracy and precision of such results will decrease as the area surveyed increases in size.

Surveying, route

Term for locating, designing, and constructing a railroad, highway, canal, pipeline, transmission line, or other linear facility. Route surveying comprises all reconnaissance surveys, the preliminary survey, the location survey, and surveys made during construction.

T

Tangent

- A straight line that touches a given curve at one and only one point and does not intersect it.
- In route alignment, that part of alignment from one PI to the next PI, the distance from the PT of one curve to the PC of the next curve, or the distances from the PC to PI and PI to PT of a curve.

Taping

The operation of measuring distances on the ground with a tape or chain. Formerly the terms chaining and taping were used synonymously, but the term taping is now preferred for all surveys except those of the public-land system. For the latter, because of historical and legal reasons, the term chaining is preferred. See also “Chaining.”

Taping (breaking tape)

A method of taping on slopes whereby all measurements are made with a part of the tape held horizontally.

Taping, standard tension

The tension or pull at which a tape was standardized.

Target

- Any object or point toward which something is directed.
- An object that reflects enough of a radiated signal to produce an echo signal on detection equipment.

Target, photographic

A pre-marked image point used to control the photography for mapping purposes or to extend control by photogrammetric methods. A target is centered over a point that would

otherwise not be visible on a photo. A target generally is black and white and may be made of various materials (for example: paint, plastic, cloth, or lumber). Also called signals or panels. The preferred term is photographic target.

Temporary bench mark

A semi-permanent object, where the elevation above or below an adopted datum is known. Usually designated as a TBM.

Thalweg

The line following the lowest part of a valley. Generally used for the location of the lowest points in a river or creek.

Thence

In surveying and in descriptions of land by courses and distances, this word, preceding each course given, imports that the following course is continuous with the one before it.

Theodolite

A precision surveying instrument consisting of an alidade with a telescope. It is mounted on an accurately graduated circle and is equipped with necessary levels and reading devices. Sometimes, the alidade carries a graduated vertical circle. There are two general classes of theodolites: direction theodolites and repeating theodolites.

Theodolite, directional instrument

A theodolite in which the graduated horizontal circle remains fixed during a series of observations. The telescope is pointed on a number of signals or objects in succession, and the direction of each is read on the circle, usually using micrometer microscopes. In measuring horizontal angles with a direction instrument, angles are not repeated (accumulated) on the circle, but precision and accuracy are obtained by having the circle of high quality, by using precision methods of reading the circle, and by shifting the circle between sets so that each direction is measured on a number of different parts of the circle. Direction instruments are used exclusively in first-order and second-order triangulation.

Theodolite, repeating instrument

A theodolite so designed that successive measures of an angle may be accumulated on the graduated circle, and a final reading of the circle, which represents the sum of the repetitions, may be made. The observed value of the angle is obtained by dividing the total arc passed through in making the series of observations by the number of times the angle has been observed. The total arc passed through may include several complete circuits of the circle, which must be added to the circle reading before making the division. The repeating theodolite is also termed a repeating instrument. Theoretically, it is an instrument of great precision, but in its mechanical operation, it does not give results as satisfactory as the directional instrument.

Tilt (photogrammetry)

The angle at the perspective center between the photograph perpendicular and the plumbline (or other exterior reference direction); also, the dihedral angle between the plane of the photograph and the horizontal plane. The direction of tilt is expressed by swing (when referred to the axes of the photograph) or azimuth (when referred to the exterior coordinate system). In aerial photography, tilt may be separated into its component angles, referred to the fiducial axis, with the X-axis being the one more nearly in the direction of flight. In aerial-camera orientation, a positive X tilt results from the left

wing of the aircraft being lowered, displacing the nadir point in the positive Y direction. Similarly, a positive Y tilt results from the nose of the aircraft being lowered, displacing the nadir point in the positive X direction.

Total stations

Total stations are classified as automatic or manual. Field procedures are different for the two classes.

Traverse

A method of surveying in which lengths and directions of lines between points on the earth are obtained by or from field measurements and used in determining positions of the points. A survey traverse may determine the relative positions of the points that it connects in series, and if tied to control stations on an adopted datum, the positions may be referred to that datum. Survey traverses are classified and identified in a variety of ways: according to methods used, as astronomical traverse; according to quality of results, as first-order traverse; according to purpose served, as geographical-exploration traverse; and according to form, as closed traverse, etc.

Traverse, closed

A survey traverse that starts and ends upon the same station or upon stations whose relative positions have been determined by other surveys of equal or higher order of accuracy.

Transverse, open

A survey traverse that begins from a station of known or adopted position but does not end upon such a station. Also termed an open-end traverse.

Triangulation

A method of surveying in which the stations are points on the ground at the vertices of a chain or network of triangles. The angles of the triangles are measured instrumentally, and the sides are derived by computation from selected sides or bases, the lengths of which are obtained by direct measurement on the ground or by computation from other triangles. A triangulation system of limited width (generally that of one triangle), designed to progress in a single general direction, is designated arc triangulation, and the chain of triangles (or polygons composed of abutting or overlapping triangles) is called a triangulation arc. A network of triangulation designed to cover an area with abutting or overlapping triangles is designated area triangulation, and the resulting configuration is called a triangulation net.

Triangulation (photogrammetry)

See aerotriangulation.

Tribach

The three-arm base of a surveying instrument that carries the foot-screws used in leveling the instrument.

Trilateration

A method of surveying wherein the lengths of the triangle sides are measured, usually by electronic methods, and the angles are computed from the measured lengths. Compare with triangulation.

True value

That value of quantity that is completely free from blunders and errors. Because the errors to which physical measurements are subject cannot be known exactly, it follows that the true value of a quantity cannot be known with exactness. In survey work, the most probable value is used as best representing the true value of the quantity.

Turnout (irrigation)

A structure located above a check structure and used for routing water out of the main irrigation channel.

Turning point (TP)

In differential leveling, a point, the height of which is determined before the leveling instrument is moved, used to determine the height of the instrument after resetting.

U

Underground mark

A surveying mark set and plumbed below the center of a surface mark. It is separated from the surface mark in order to preserve the station in case of destruction of the surface mark.

V

Vertical angle

An angle between two intersecting lines in a vertical line.

Vertical control

Term for establishing bench marks.

Vertical control point

A targeted or photo ID point that has only vertical or elevation control established. To properly control photographs for highway mapping purposes, it is necessary to have more vertical control points than horizontal control. When leveling to vertical control points, three elevations at the point need to be recorded, even if they are the same. First, the elevation of the monument set at the point is required. This is the point through which the level circuit will be closed. Second is the elevation of the ground at the center of the target (the mean elevation of a 1-ft. diameter circle around the point). The third is the elevation of the center of the target. This is important when the point and the ground are in a depression which the target bridges.

Viewfinder (aerial photogrammetry)

A device similar to a camera but with the ground glass in the focal plane of the lens. The viewfinder is mounted vertically in the floor of an airplane for the purpose of viewing the landscape and determining when photographs should be taken. It is graduated to determine the spacing between photographs necessary to obtain the desired overlap. Because the viewfinder is aligned with the true direction of flight, the angle of crab between the longitudinal axis of the plane and the direction of flight can be obtained.

W

WAAS

Wide Area Augmentation System is an FAA-funded system of equipment and software that augments GPS. The WAAS provides a satellite signal for WAAS users to support enroute and precision approach aircraft navigation.

Watershed

The area contained within a drainage divide above a specified point on a stream. In water-supply engineering, it is termed a watershed, and in river-control engineering, it is termed a drainage area, drainage basin, or catchment area.

Weight (surveying)

The relative reliability (or worth) of a quantity as compared with other values of the same quantity. If one value of a quantity has a weight of 2, and another value of the same quantity has a weight of 1, the first value is worth twice the second value, and a mean value would be obtained by taking a weighted mean twice the first value plus once the second value, the sum being divided by 3.

Wiggling in

A survey procedure used when it is necessary to establish a point exactly on line between two control points, neither of which can be occupied. It is essentially a trial-and-error technique where repeated fore and back readings are taken, and the instrument is shifted after each pair of readings until exactly in line with the stations. Also called ranging in.

Wing point

A vertical control point, either targeted or identified as a picture point, usually placed in the corners of the neat model.

Witness mark

A material mark placed at a known distance and direction from a property corner, instrument, or other survey station to aid in its recovery and identification. In surveying, a witness mark is established as an aid in the recovery and identification of a survey station or other point to which it is a witness. A mark, which is established with such precision and accuracy that it may be used to restore or take the place of the original station, is more properly called a reference mark in control surveys and a witness corner in land surveys. Also called witness post or witness stake.

Witness point (USPLS)

A monumented station on a line of the survey.

Witness post

Delineator post driven 3 ft. southwest of basic ground control survey stations.

Witness sign

A metal fence post or composite fiber post with a “Do Not Disturb Survey Monument” sign attached. The witness sign is set close to a survey control point to aid in its protection and recovery.

X

X, Y, and Z coordinates

Three separate coordinate values that are referenced to a known or adopted datum. The X value is an east-west or longitudinal coordinate. The Y value is a north-south or latitudinal coordinate value. The Z value is an elevation value. When coordinates are computed or listed, it is customary practice to list the Y (north) value first, next the X (east) value, and then the Z (elevation) value.

Z

Zenith

Reference for where the point produced by a plumb line projected up from the observer meets the Celestial Sphere.

Zenith angle

An angle measured from the zenith (straight up) to a point. In modern survey instruments, the zenith angle replaces the vertical angle and is used to reduce slope measurements to horizontal and vertical differences. The use of zenith angles correctly signs the value of the vertical difference for computer computation.

Abbreviations

The following are abbreviations typically used in conventional survey notes:

Adjusted	ADJ
Ahead	AHD or AH
And	&
Aluminum Cap	AC
At	@
Avenue	AVE
Average	AVG
Azimuth	AZ
Back	BK
Backsight	BS
Bearing	BRG
Begin	BEG
Bench Mark	BM
Bottom	BOT
Bottom of Bank	BOB
Bottom of Slope	BOS
Boulevard	BLVD
Boundary	BNDRY
Brass Cap	BC
Bridge	BR
Bridge End	BE
Building	BLDG
Bureau of Land Management	BLM
Calculated	CALC
Cast Iron Pipe	CIP
Catch Basin	CB
Catch Point	CP
Cement Treated Base	CTB
Centerline	C/L
Centimeter	CM or cm
Chain	CH
Chain Link Fence (w/ height)	CL-4F,5F,6F
Chord	CHD
Clean Out	CO
Closing Corner	CC
Cloudy	CLDY
Concrete	CONC
Concrete Block Wall	CBW
Concrete Nail	CN

Conduit (specify type)	COND (TEL)
Construction	CONST
Control Number	CN
Control of Access	C/A
Corner	COR
Corrugated Metal Pipe	CMP
Corrugated Steel Pipe	CSP
County	CO
Creek	CR or CK
Crossing	XING
Cross Section	XSEC
Culvert	CULV
Curb	CB
Curb and Gutter	C&G
Current Water Surface Elevation	WSE
Curve to Spiral	CS
Cut	C
Daylight	DL
Deflection	DEFL
Degree of Curvature	D
Description	DESC
Destroyed	DEST
Detour	DET
Diameter	DIA
Difference in Elevation	DE
Distance	DIST
District	DIST
District Construction Engineer	DCE
Ditch	DT
Double	DBL
Down Drain	DD
Drain	DR
Drill Hole	DH
Drive	DR
Driveway	DRWY
Drop Inlet	DI
East	E
East Bound	EB
Easterly	ELY
Edge of Gutter	EG
Edge of Oil	EO
Edge of Pavement	EP
Edge of Shoulder	ES

Edge of Traveled Way	ETW
Electronic Distance Measurement or Measurer	EDM or EDMI
Elevation	EL or ELEV
End Wall	EW
Engineering Project Manager	EPM
Equation	EQ
Existing	EX
External	EXT
Fahrenheit	F
Fence	FN or FX
Fence Post	FP
Feet	FT or ‘
Field Book	FB
Fill	F
Finish Grade	FG
Finish Grade Stake	FGS
Fire Hydrant	FH
Flood Control	FC
Flow Line	FL
Flush	FL
Foot	FT or ‘
Footing	FTG
Foresight	FS
Found	FND
Foundation	FDN
Frontage Road	FR RD
Galvanized	GALV
Galvanized Steel Pipe	GSP
Gas Line	GL
Gas Valve	GV
Global Positioning System	GPS
General Land Office	GLO
Grade Separation	GR SEP
Grid	GRD
Ground	GRND
Guard Rail	GR
Gutter	GTR
Headwall	HDWL
Height	HT
Height of Instrument	HI
Highway	HWY
High Water	HW
Hinge Point	HP

Horizontal	HORIZ
Hub & Tack	H&T
Inch	IN or “
Inside Diameter	ID
Instrument	INSTR
Interchange	INTCH
Intersection	INT
Invert	INV
Iron Pin	IP
Irrigation Pipe	IRR P
Joint Use Pole	JP
Junction	JCT
Kilometer	KM or km
Land Surveyor	LS
Lane	LN
Left	LF or LT
Length of Circular Curve	Lc or L
Length of Spiral Curve	Ls
Length of Vertical Curve	L
Link	lk
Location Hydraulic Study Report	LHSR
Long Chord	LC
Manhole	MH
Marker	MKR
Maximum	MAX
Measured	MEAS
Median	MED
Meter	M or m
Mid Ordinate	MO
Mid-Point of Curve	MPC
Mile	MI
Mile Post	MP
Millimeter	MM or mm
Minute	MIN or ‘
Montana Department of Transportation	MDT
Nail	NL
National Geodetic Survey	NGS
Natural Gas Line	NG
Normal Water Elevation	NW EL
North	N
North Bound	NB
Northerly	NLY
Number	# or NO

Offset	O/S or O
Old Ground	OG
On Centers	OC
Original Ground	OG
Outside Diameter	OD
Overhang	OH
Overhead Crossing	OC
Overhead	OH
Page(s)	PG or PGS
Parker-Kalon Nail	PK
Parts per Million	PPM or ppm
Party Chief	PC
Pavement	PVMT
Penny (i.e.: 60d nail)	d
Perforated Metal Pipe	PMP
Pipe	P
Place	PL
Plant Mixed Surface	PMS
Plastic	PLAS
Point of Curvature	PC
Point of Compound Curvature	PCC
Point of Intersection	PI
Point on Curve	POC
Point on Line	POL
Point on Semi-Tangent	POST
Point on Tangent	POT
Point on Vertical Curve	POVC
Power Pole	PP
Present Traveled Way	PTW
Principal Meridian	PM
Private	PVT
Professional Engineer	PE
Profile Grade	PG
Project	PROJ
Project Manager	PM
Projected	PROJ
Property Line	PL
Pull Box	PB
Punch Mark	PM
Radial	RAD
Radius	R
Radius Point	RP
Railroad or Railway	RR

Range	R
Record	REC
Reference	REF
Reference Monument	RM
Reference Point	RP
Reference Post	RP
Reinforced Concrete Box	RCB
Reinforced Concrete Pipe	RCP
Retaining Wall	RET W
Right	RT
Right of Way	R/W
Road	RD
Roadway	RDWY
Rounding	RN
Route	RT
Searched For Not Found	SFNF
Second	SEC or “
Section	S
Sewer Line (Sanitary)	SS
Sheet	SHT
Shoulder	SH
Sidewalk	SW
Slope Stake	SLP STK
South	S
South Bound	SB
Southerly	SLY
Spike	SPK
Spiral to Curve	SC
Spiral to Tangent	ST
Stake	STK
Staked	STKD
Standard	STD
Stand Pipe	SP
State Plane Coordinate	SPC
Station	STA
Steel	STL
Steel Pipe, High Pressure	SPHP
Steel Sectional Plate Pipe	SSPP
Storm Drain/Sewer	SD
Street	ST
Structure	STR
Subdivision	SUBD
Subgrade	SG

Surfacing	SURF
Survey	SURV
Tack	TK
Tangent	TAN
Tangent Length of Curve	T
Tangent to Spiral	TS
Telephone Cable	TEL C
Telephone Pole	TEL P
Temperature	TEMP
Temporary Bench Mark	TBM
Top Back of Curb	TBC
Top of Bank	TOB
Topographic	TOPO
Township	T
Tract	TR
Transmission Tower	TT
Traverse	TRAV
Turning Point	TP
Uniform Project Number	UPN
U S Coast & Geodetic Survey	USC&GS
U S Corps of Engineers	USCE
U S Forest Service	USFS
U S Geological Survey	USGS
U S Public Land Survey	USPLS
Vent Pipe	VP
Vertical Curve	VC
Vitrified Clay Pipe	VCP
Warped or Variable Slope	WS
Water Line	WL
Water Service	WS
Water Table	WT
Water Valve	WV
Welded Steel Pipe	WSP
West	W
West Bound	WB
Westerly	WLY
Wing Point	WP
Wing Wall	WW
With	W/
Witness Corner	WC
Woven Wire	WW
Yard	YD

Surveyors' Measures And Conversions

Constants

Pi, π

The number that denotes the ratio of the circumference of a circle to its diameter.

- π = 3.1415926536

Radian

The central angle of a circular arc that is equal in length to the radius of the arc.

- 180º ÷ π = 57.29577951º = one radian

Mean Radius of the earth

- ±20,906,000 feet or 6,372,000 meters

Temperature Conversions

Celsius to Fahrenheit

- = (9/5 C) + 32

Fahrenheit to Celsius

- = 5/9 (F- 32

Abbreviations

Linear (US)

Chain	ch
Link	lk
Mile	mi
Foot	ft or ‘
Inch	in or “
Yard	yd

Linear (Metric)

Centimeter	cm
Meter	m
Micron	µ
Millimeter	mm
Kilometer	km

Area (US and Metric)

Acre	A
Hectare	ha
Square Feet	Sq Ft

Pressure

Millibar	mb
Hectopascal	hPa

Linear Relationships (US)

1 lk = 7.92 in or 0.66 ft
80 ch = 1 mi
3 ft = 1 yd
1 ch = 66 ft or 100 lk
12 in = 1 ft
5280 ft = 1 mi

Linear Relationships (Metric)

0.001 m = 1 mm
10 mm = 1 cm
1 m= 100 cm
0.01 m = 1 cm
1,000 m = 1 km

Area (US)

1 A = 43,560 sq ft
1 sq mi = 640 A

Area (Metric)

10,000 sq m = 1 ha

Linear Conversions

Currently state statutes require the use of the international foot when converting state plane coordinates from meters to feet. The US Survey foot is generally used to convert total station distances from meters to feet.

1 in = 0.0254 m = 25.4 mm (US Survey foot)
1 ft (US Survey foot) = 12/39.37 = 0.30480061 m 1 ft (International foot) = 0.3048
1 mi = 1609.347 m (US Survey foot) or 1609.344 m (International foot) 1000 m = 0.62137 mi

Area Conversions

1 ha = 2.4711 A
1 A = 0.40469 ha

Pressure Conversions

1 in of mercury = 25.4 mm of mercury
1 mm mercury = 1.333333333 hPa