ATLANTIC COAST PIPELINE, LLC
ATLANTIC COAST PIPELINE

and

DOMINION TRANSMISSION, INC.
SUPPLY HEADER PROJECT

Supplemental Filing
March 24, 2017

APPENDIX I

Correspondence for the Atlantic Coast Pipeline

APPENDIX I

Supplemental Summary of Public Agency Correspondence for the Atlantic Coast Pipeline

Agency/Contact Name(s)	Date of Correspondence	Format	Description
FEDERAL AGENCIES			
U.S. Forest Service – Monongahela and George Washington National Forests			
Kent Karriker, Carol Whetsell, Jennifer Adams, Alex Faught, Mitchell Kerr	12/06/16	Call Log	Discussion regarding Monongahela National Forest and George Washington National Forest boundaries.
Clyde Thompson	3/09/17	Letter	Steep slope design coordination.
Troy Morris	3/17/17	Letter	Ammendment to Special-Use Authorization.
U.S. Fish and Wildlife Service			
Liz Stout, Kim Smith, John Ellis	11/29/16	Meeting	Discussion regarding updated BA and Migratory Bird Plan.
Liz Stout, John Ellis, Sumalee Hoskin, Troy Anderson, Sarah McRae, Glen Smith	3/23/17	Email	Transmital of revised master waterbody table.
STATE/COMMONWEALTH AGENCIES			
WEST VIRGINIA AGENCIES			
West Virginia Division of Natural Resources, West Virginia Division of Forestry			
Jeffrey Layfield, Eric Judy	10/05/16	Meeting	Discussion regarding Allegheny Trail.
Stephen McDaniel, Sam England, Gary Foster, Matt Yeager	3/01/17	Meeting	Discussion regarding Allegheny Trail.
West Virginia Department of Environmental Protection			
Joseph Kessler	3/16/17	Letter	Transmital of Class II Administrative Update Application for Compressor Station 1.
West Virginia Division of Culture and History			
Susan Pierce	3/24/17	Letter	Transmital of Addendum 5 Aboveground Cultural Resources Survey Report.
City of Buckhannon			
James Hollen	3/13/17	Letter	Transmittal of requested information related to the Buckhannon River crossing and City of Buckhannon water supply.
VIRGINIA AGENCIES			
Virginia Department of Conservation and Recreation			
Chris Ludwig	2/27/17	Email	Pollinator seed mixes recommendations.
Rene Hypes	3/06/17	Email	Pollinator seed mixes recommendations.
Virginia Department of Game and Inland Fisheries			
Brian Moyer	7/06/16	Call Log	Discussion regarding birding and wildlife trails.
Marc Puckett	1/26/17	Email	Pollinator seed mixes recommendations.
Virginia Department of Environmental Quality			
Bettina Sullivan	3/09/17	Letter	90-day status notification for the CZM Program consistency review.

APPENDIX I (continued)

Supplemental Summary of Public Agency Correspondence for the Atlantic Coast Pipeline

Agency/Contact Name(s)	Date of Correspondence	Format	Description
Virginia Department of Historic Resources			
Roger Kirchen	3/24/17	Letter	Transmital of Addendum 5 Aboveground Cultural Resources Survey Report.
Roger Kirchen	3/24/17	Letter	Transmital of Archaeological Site Testing Report.
NORTH CAROLINA AGENCIES			
North Carolina Department of Agriculture & Consumer Services			
Bill Yarborough	1/27/17	Email	Pollinator seed mixes recommendations.
North Carolina Wildlife Resources Commission			
Vann Stancil	3/01/17	Email	Review of Neuse River Mussel Addendum Report
North Carolina Department of Natural and Cultural Resources			
Ramona Bartos	3/17/17	Letter	Review of Phase II investigations.
Ramona Bartos	3/20/17	Letter	Review of cemetary delineation report.
Renee Gledhill-Earley	3/24/17	Letter	Transmital of Addendum 4 Aboveground Cultural Resources Survey Report.
Renee Gledhill-Earley	3/24/17	Letter	Transmital of Archaeological Site Testing Report.

Federal Agencies

U.S. Forest Service – Monongahela and George Washington National Forests

ACP RE-ESTABLISHMENT OF BOUNDARIES AND CORNERS CALL

Date/Time: December 6, 2016 @ 2:00pm- 3:30pm US Eastern
Location: Conference Call/GoTo Meeting

Attendees	Forest Service	Kent Karriker, Carol Whetsell, Jennifer Adams, Alex Faught, Mitchell Kerr
	Dominion	Richard Gangle, Brittany Moody, Gregory Park, Luke Knapp
	Galileo Project	Maria Martin, Peter Rocco

Action Items

- Forest Service (FS) identifies locations on the Monongahela National Forest (MNF) and George Washington National Forest where boundaries need to be surveyed and submits a letter requesting the survey work.
- Greg gets crews out to survey once the locations are confirmed. Also confirms boundaries on National Forest System (NFS) land crossings in general and submits a route plan with corner locations.
- Galileo distributes boundary, survey and marker guidance with notes. *Complete.*
- Carol and Mitch use submitted geospatial data to identify relevant FS survey information and sends to Greg. *Complete, Carol uploaded information to FTP site on 1/3/2017.*
- Jennifer and Galileo coordinate exchanges of emails and ftp site information. *Complete.*

Discussion

- There are a couple of places on the MNF where the FS wants to make sure boundaries of NFS lands and right-of-way (ROW) and construction boundaries are correctly platted out. The locations are between mileposts 71 and 72 (near Gibson Knob) and 76 and 77 (near the Greenbrier River crossing). At this time it is unclear if there are similar concerns on the GWJ.
- Greg understands the FS would like his team to go out and find the corners and confirm the boundaries of the areas of concern and then overlay the ROW. Carol said it may be difficult to find the corners near the Greenbrier River crossing. If there are questions, Greg can email Jennifer, Carol, Mitch, Kent and Alex.
- Mitch said boundary markers and monuments will have to be replaced if moved (and or destroyed) during construction. He provided specs for the markers and delineator posts to Galileo. *(see attachments)*
- Atlantic Coast Pipeline (ACP) is using field work and existing boundary markers, historical records, and geospatial data to determine boundaries. Greg said he used to work for a firm that did boundary work for the FS and has licensed surveyors on his staff. He can share their qualifications when needed.
- FS asked ACP to include narrative on boundary marker reestablishment in the Construction, Operation, and Maintenance Plan. Alignment sheets on FS lands to show all boundary data and ties to existing exterior boundary corners related to the pipeline centerline, including offsets, and acreages of the different types of impacted areas(temporary, permanent, etc..).

- Revision 11a of the alignment sheets are the most current version.

Attachments: EM-7150-3 and EM-7150-4

United States Department of Agriculture

Forest Service

Engineering Staff

Washington, D.C.

EM-7150-3

Land Surveying Guide

Engineering Management Publications

Administrative Distribution

Professional Development

Management

Data Retrieval

This publication is an administrative document that was developed for the guidance of employees of the Forest Service—U.S. Department of Agriculture, its contractors, and its cooperating Federal and State Government Agencies. This information has not been approved for distribution to the public, and must not be construed as recommended or approved policy, procedures, or mandatory instructions, except by Forest Service Manual references.

Please direct any comments or recommendations about this publication to the following address:

FOREST SERVICE—USDA
Engineering Staff—Washington Office
Attn: D.J. Carroll, Editor
M.J. Baggett, Editorial Assistant
P.O. Box 2417—Washington, D.C. 20013

Telephone: Area Code 703—235-8198

United States Department of Agriculture

Forest Service

Engineering Staff

Washington, D.C.

EM.7 1 50-3

Land Surveying Guide

August 1985

Contents

Contents for Introduction

Introduction

OBJECTIVES

Provide land surveys to define legal and locatable property boundary lines and easements for access and for control to support mapping programs to assist in administering National Forest resources and facilities.

Forest Service Manual 7100, 7150, and 7700 provide authorization, objectives, policies, and responsibilities. This guide contains administrative and technical procedures.

This guide provides professional and technical guidance to land surveyors, engineers, and other personnel who perform field surveys.

The treatment of subject material is general and is intended to provide information and technical procedures as they relate to surveys. The guide is a working tool.

REFERENES

1. "Construction Measurements," B. Austin Barry, 1973, John Wiley & Sons, New York.

2. "Consulting Engineering, A Guide for the Engagement of Engineering Services," American Society of Civil Engineers Manual No. 45.

3. "Definitions of Surveying and Associated Terms," American Congress on Surveying and Mapping – American Society of Civil Engineers.

4. "Definitions of Terms Used in Geodetic and Other Surveys," Hugh C. Mitchell, 1948, Coast and Geodetic Survey, Government Printing Office, Washington.

5. "Electronic Distance Measuring Instruments," R. Tomlinson and T. Burger, 1971, American Congress on Surveying and Mapping, Falls Church, Virginia.

6. "Engineering Field Tables," U.S. Department of Agriculture, Forest Service; U.S. Department of the Interior, Bureau of Land Management, 1967, Government Printing Office, Washington.

7. "Errors in Practical Measurement in Science, Engineering, and Technology," B. Austin Barry, N. D. Morris, ed., 1978, John Wiley & Sons, New York.

8. “Handbook of Survey Notekeeping,” F. William Pafford, 1965, John Wiley & Sons, New York.

9. “Professional Practice of Surveying and Mapping within Civil Engineering,” American Society of Civil Engineers Manual No, 45A, 1965.

10. “Professional Surveying Practice,” 1965, California Council of Civil Engineers and Land surveyors.

11. “Surveying,” C. B. Breed, A. J. Bone, and B. A. Barry, 3rd Ed., 1971, John Wiley & Sons, New York.

12. “Surveying,” H. Bouchard and F. H. Moffet, 5th Ed., 1956, International Textbook Co., Scranton, Pennsylvania.

13. “Surveying for Civil Engineers,” Phillip Kissam, 1956, McGraw-Hill Co., New York.

14. “Surveying Instrumentation and Coordinate Computation Workshop Lecture Notes,” J. F. Dracup, C. F. Kesley, and R. W. Tomlinson, 1973, American Congress on Surveying and Mapping, Falls Church. Virginia.

15. “Surveying Practice,” Philip Kissam, 2nd Ed., 1971, McGraw-Hill Book Co., New York.

16. “Surveyor's Manual,” Service Pipeline Co., 1956, Service Pipeline Co., Tulsa.

17. “Taping Techniques for Engineers and surveyors,” Lufkin, 1971, Apex, North Carolina.

18. TM5-241-8, Department of the Army Technical Manual, “Universal Transverse Mercator Grid,” April 1973.

19. “American Law of Mining, Vols. 1 and 2 Public Domain,” Mathew Bender, The Rocky Mountain Mineral Law Foundation - University of Colorado, New York.

20. “Bibliography of Property Surveying Literature,” W. H. Bidridge, 1963, American Congress on Surveying and Mapping.

21. “Black's Law Dictionary,” 1961, H. C. Black, 4th Ed., West Publishing Co., St. Paul, Minnesota.

22. “Boundary Control and Legal Principles,” Brown, Wilson, and Robillard, 3rd Ed., 1981, John Wiley & Sons, New York.

23. “Clark on Surveying and Boundaries,” J. S. Grimes, 1976, Bobbs-Merrill Co., Indianapolis.

24. “Compass Land Surveying,” F. H. Sipe, 1970, Elkins, W. V., McClain Printing Co, Parsons, West Virginia.

25. “Evidence and Procedures for Boundary Location,” C. M. Brown and W. H. Eldridge, 1963, John Wiley & Sons, New York.

26. H.O. Pub. No. 9,. “American Practical Navigator,” Bowditch, U.S. Naval Oceanographic Office, 1962 (1966), Government Printing Office, Washington.

27. “Handbook of the Law of Real Property,” W. L. Burdick, 1914, West Publishing Co., St. Paul, Minnesota.

28. “History of Public Law Development,” P. W. Gates and R. W. Swenson, November 1968, Government Printing Office, Washington.

29. “Land Parcel Identifiers for Informational Systems,” American Congress on Surveying and Mapping.

30. “Land Survey Descriptions,” William C. Wattles, 1970, Title Insurance and Trust Co., Los Angeles, California.

31. “Land Titles,” R. G. Patten and G. Carroll, 1957, West Publishing Co., St. Paul, Minnesota.

32. “Manual of Instruction for the Survey of the Public Lands of the United States,” Bureau of Land Management, 1973, Government Printing Office, Washington.

33. “Metes and Bounds Descriptions,” Jesse E. Fant, Alver R. Freeman and Carlisle Madson, 1972, University of Minnesota, Minneapolis.

34. “Minimum Standard Detail Requirements for Land Title Surveys,” American Congress on Surveying and Mapping and American Title Association.

35. “Original Survey and Land Subdivision, A Comparative Study of the Form and Effect of Contrasting Cadastral Surveys,” Norman J. W. Thrower, 1966, Rand McNally & Co., Chicago.

36. “Policy on Matters of Professional Practice,” 1971, American Congress on Surveying and Mapping.

37. “Real Estate Law,” Robert Kratovil, 4th Ed., 1964, Prentice Hall, Englewood Cliffs, New Jersey.

38. “Restoration of Lost or Obliterated Corners and Subdivision of Sections,” Bureau of Land Management, 1963, Government Printing Office, Washington.

39. Serial No, 347, “Use of Coast and Geodetic Survey in the Surveys o
46. “Writing Legal Descriptions,” Gurdon Wattles, 1976, Parker & Sons Inc., Los Angeles, California.

47. “Analysis and Adjustment of Survey Measurements” Mikhail and Gracie, 1981, Van Nostrand Reinhold, New York.

48. “Land Survey Systems,” John G. McEntyre, 1978, John Wiley & Sons, New York.

49. “Geodesy,” G. Bomford, 3rd Ed., 1971, Oxford University Press, London.
f Farms and Other Properties,” U.S. Department of Commerce, Coast and Geodetic Survey, 1940 Revised, Government Printing Office, Washington.

40. “Shore and Sea Boundaries,” Aaron L. Shalowitz, Volume I, Publication 10-1, 1962, U.s. Department of Commerce, Coast and Geodetic Survey, Government Printing Office, Washington.

41. “Shore and Sea Boundaries,” Aaron L. Shalowitz, Volume II, Publication 10-1, 1964, U.S. Department of Commerce, Coast and Geodetic Survey, Government Printing Office, Washington.

42. “Technical Standards for Property Surveys,” American Congress on Surveying and Mapping.

43. “The Legal Elements of Boundaries and Adjacent Properties,” Ray H. Seklton, 1930, Bobbs-Merrill Co., Indianapolis.

44. “The Law of Subdivisions,” E. C. Yokley, 1963, The Niche Co.., Charlottesville, Virginia.

45. “The Public Lands,” Vernon Carstensen, 1963, University of Wisconsin Press.

50. Serial No. 624, “Computation of Traverse by Plane Coordinates,” Brittain, 1940, U.S. Department of Commerce, Coast and Geodetic Survey, Government Printing Office, Washington.

51. S.P. #8, “Formulas and Tables for the Computation of Geodetic Positions,” 7th Ed., 1963 Reprint, U.S. Department of Commerce, Coast and Geodetic Survey, Government Printing Office, Washington.

52. S.P. #138, “Manual of Triangulation Computation and Adjustment,” Walter F. Reynolds, 1955 Reprint, U.S. Department of Commerce, Coast and Geodetic Survey, Government Printing Office, Washington.

53. S.P. #145, “Manual of Second and Third Order Triangulation and Traverse,” 1957 Reprint, U.S. Department of Commerce, Coast and Geodetic Survey, Government Printing Office, Washington.

54. S.P. #193, “Manual of Plane Coordinate Computation,” Oscar S. Adams and Charles N. Claire, 1948, U.S. Department of Commerce, Coast and Geodetic Survey, Government Printing Office, Washington.

55. S.P. #235, “The State Coordinates Systems - A Manual for Surveyors,” Hugh C. Mitchell and Lansing G. Simmons, 1945, U.s. Department of Commerce, Coast and Geodetic Survey, Government Printing Office, Washington.

56. S.P. #247, “Manual of Geodetic Triangulation,” F. R. Gossett, 1959, U.S. Department of Commerce, Coast and Geodetic Survey, Government Printing Office, Washington.

57. “Practical Astronomy,” G. L. and J. M. Robbins, 4th Ed., 1948, John Wiley & Sons, New York.

58. “The American Ephemeris and Nautical Almanac,” (Annual Publication), Government Printing Office, Washing ton.

59. “The Elements of Astronomy for Surveyors,” J. B. Mackie, 7th Ed., 1971.

60. “The Ephemeris,” Annual Publication, U.S. Department of Interior, Bureau of Land Management, Washington.

61. “Glossary of BLM Surveying and Mapping Terms” - Cadastral Survey Training Staff, Denver Service Center.

62. “Classification, Standards of Accuracy, and General Specifications of Geodetic Control Surveys,” Reprint of June, 1980, U.S. Department of Commerce, N.O.A.A., U.S. Government Printing Office.

63. “Specifications to Support Classification, Standards of Accuracy, and General Specifications of Geodetic Control Surveys,” June 1980 Revision, U.S. Department of Commerce, N.O.A.A., U.S. Government Printing Office.

64. “Procedures and Standards for Multi-Purpose Cadastre,” National Academy Press, 2101 Constitution Ave. NW, Washington, D.C. 20418.

65. Specifications for descriptions of tracts of land for use in land orders and proclamations, 1979 (reprinted without charge); U.S. Government Printing Office, Washington, D.C. 20402, Stock Number 024-011-00117-4.

66. “Survey Measurements and Their Analysis,” R. B. Buckner, 1983, Landmark Enterprises, Rancho Cordova, California.

Contents for Chapter 1
Land Survey Planning

Chapter 1 Land Survey Planning

OBJECTIVES

Forest Service Manual 7150 provides objectives for land surveying activities. The purpose of this chapter is to provide planning information to assist in meeting those objectives.

BASIC PLANNING CONSIDERATIONS

Project planning to accomplish land surveys requires a careful coordination and analysis of present and future land management activities that may require a legal and visible location of a property line. Regardless of the size, complexity, or cost of the project, planning ensures the availability of adequate funding and qualified people to accomplish the project on time and to meet management’s objectives.

LAND LINE LOCATION PROGRAM PLANNING

A multiple-year (usually 5 or more years) prioritized listing of areas where resource management activities will require marked and posted property lines is essential to ensure efficient and effective long- range land surveying operations planning.

The long-range plan will define the time frame and critical activities (a critical path) for each project area to be surveyed. These critical land surveying activities are coordinated, correlated, and summarized into the District and Forest annual work plan. Accomplishing land surveying activities via critical path operations gives management greater flexibility to revise priorities, work areas, and activities based on current field information and organization constraints such as people and funding.

SCOPE of JOB

1. Inventory. Each Forest maintains a District inventory of the total number of acres within the District boundaries, the total acreage in private and Government ownership (by agency jurisdiction), the number of miles of Forest Service property lines, the number of Forest Service property corners, and the number of land corners on private land that control Forest Service property corners (section and quarter-section corners that control the subdivision of a section that contains National Forest System land). The inventory is both in map and tabular format. The information contained in the inventory assists with project planning and overall program management. Inventory information changes as landownership adjustment activities occur.

2. Status of the Land Line Location Program. Program status depends on the condition of the land corners and property lines. These conditions and the unusual problems associated with conditions vary according to quality and type of the original survey, the age of the original survey, the terrain, weather conditions, natural disasters, human activities, resurvey or maintenance activities, the type of monument (such as wood or stone), and the durability of the corner reference objects.

As land surveys are completed, land corners remonumented, and property lines marked and posted to standard, this information is tabulated and recorded in the inventory system.

3. Need for Land Line Location Activities. A realistic and factual evaluation of the status of land corners and property lines, along with administrative and resource management requirements, will define the complexity of land surveying problems, the limits of the project area, and the anticipated administrative or legal problems associated with the project.

OUTPUTS

Land line location (land surveying) program targets are defined in the annual budget. The target is “miles of property line marked to FSM standards.” Program objectives are stated in FSM 7152,02, Program policy is found in FSM 7152.03.

PRIORITY DETERMINATION

Land line location program priorities are established by FSM 7152.3.

PROGRAM DEVELOPMENT

This will consist of a schedule of planned land surveying activities to be accomplished to meet time requirements of resource management. Activities are planned over 3 to 5 years. Each activity (record search, corner search, field survey, and so forth) is an element in the critical path to accomplish the project. It is usually not possible to start a project and carry it through to completion without interruption. This makes critical path scheduling necessary to ensure that some activity is not missed. The total of planned activities for a number of different survey projects makes up the annual program of work.

Annual Work Plans

Each Ranger District will develop and submit work plans (containing activity planned, costs, and manpower requirements) to accomplish project work as a part of the budget preparation process. The Forest Supervisor will aggregate all work plans to develop a tentative budget request. Alternatives and priorities are established within the Forest budget and manpower constraints. This information is sent to the Regional Office as a budget submittal.

BUDGET SUBMITTAL

The budget information contains cost estimates and targets.

Each resource system (such as recreation, wilderness, range, and timber) has a line item for land line location activities. The Lands system has three separate line items for LLL activities:

1. Land surveys to support Lands activities.

2. Lands surveys to resolve encroachments and trespass.

3. Property line and land corner maintenance activities.

The budget submittal also should include the costs associated with cost-sharing activities with adjoining land owners, Bureau of Land Management reimbursable surveys, employee recruitment, and training.

PROJECT PLANNING

PROJECT SCOPE

Project planning requires a complete analysis of all factors, activities, and conditions that must. be considered to accomplish the project.

Project Mapping

The project map will be a 1/24,000 Primary Base Series Map that shows the land ownership network and the status of Land Line Location activities (LLL Progress Record Map). On this base map, indicate the area where resource activities are planned. With this information depicted on the map, the size of the project is defined by the location of known land corners and recent land surveying activities. All land corners to be established and property lines to be marked should be identified.

Project Activity Scheduling

The land surveying activities discussed in Chapter 2, Land Survey Operations, are outlined and planned in detail.

Work areas will vary. However, the following guidelines should be observed in setting up work areas:

1. The work area should be compact to minimize travel time and expense associated with operations within the work area.

2. If Bureau of Land Management collaboration is to be used, minimum project size should be about half a township but should be no more than can be completed in 2 years.

3. The size of the work area should be adjusted so that search and evaluation can be completed during a field season.

4. The work area's suitability for advanced survey methods, including photogrammetry, total stations, satellites, and inertial systems should be considered.

PROJECT COST

Realistic project cost estimates are essential for budget preparation and include program management and total cost of general administration. Costs will vary from one National Forest to another. Each project has unique problems and must be estimated separately based on control, terrain, and so forth. Amounts programmed for contract projects should include funds for timely contract administration. This amount will vary with the size, location, and complexity of the project.

PROJECT TIME FRAME

Survey projects must be completed in a timely manner. A survey project may take 1 to 2 years to complete. If the Bureau of Land Management is to execute the survey, 3 or more years must be planned. Project planning must be coordinated with resource plans and budget proposals so that the job is completed in time to meet timber and other resource activity needs.

Contents for Chapter 2
Land Survey Operations

Chapter 2 Land Survey Operations

OBJECTIVES

Land surveying activities are to provide legal and visible land corners and property lines for resource management activities and also provide support to other related Forest Service programs.

DEFINITIONS

Many terms commonly used in surveying have similar but different meanings that are often confused. The following terms are used in this chapter. For other survey terms, see “Definitions of Surveying and Associated Terms” by the American Society of Civil Engineers - American Congress on Surveying and Mapping, and “Glossary of Bureau of Land Management Surveying and Mapping Terms.”

1. <u>Cadastral, Boundary, and Land Survey</u>. The term cadastral survey is used to designate the surveys, including retracement surveys, for the establishment and restoration of property lines of the public lands of the United States.

The term “boundary survey” is usually restricted to the survey of boundary lines between political territories. For the survey of a boundary line between privately owned parcels of land, the term “land survey” is preferred.

2. <u>Control and Geodetic Survey</u>. A control survey is used to determine the relative positions of existing corners or points used in photogrammetry and other surveys. Geodetic surveys are control surveys that take into account the shape and gravity of the earth.

3. <u>Original Survey</u>. The first survey that establishes the monuments on-the-ground controlling property lines. If properly performed, the first subdivision of a section is an original survey.

4. <u>Retracement and Resurvey</u>. A retracement merely remeasures the lines of a former survey. A dependent resurvey is a retracement and reestablishment of the lines and monuments of an original survey in their true original position in accordance with the best available evidence of the positions of the original corners. An independent resurvey is a new original survey. The difference between an original survey and a resurvey is that the former creates parcels of land, while a resurvey merely locates what has already been created.

5. <u>Engineering and Route Survey</u>. An engineering survey is performed to gather topographic and other data, or establish points used for purposes of the planning, design, construction, operation and maintenance of a work. A route survey is an engineering survey for a transportation system.

6. Marking and Posting. Marking refers to the perpetuation of the location of a line with suitable means so that the lines can be relocated in the future without extensive survey. Posting is making a line visible by signs, posts, blazes, and so forth.

7. Reference Monument and Witness Corner. A reference monument is a monument with its spatial relationship to a property corner that is known and a matter of public record. It is used, for example, where the property corner falls in a road. A witness corner is used to reference a corner point that is inaccessible, Historically, witness corners are located on line.

8. Protraction and Projection. A protraction is a subdivision of land by unsurveyed lines. A projection is the plotting of corner locations by reference to a prior survey or other extraneous evidence, It is often a best guess.

9. Land Status. This is the condition of title of land and interests in land under the jurisdiction of the Forest Service, Status consists of a set of records that shows lands and interests in lands administered by the Forest Service, the manner in which these lands came into Federal ownership, encumbrances or restrictions that affect the administration of the land, the interest owned by the Government in private lands, and interests in Government lands held by others.

REFERENCES

1. Basic Surveying.

a. Surveying for Civil Engineers, Kissam. McGraw-Hill, 1956.

b. Surveying Theory and Practice, 5th Ed., Davis, Foote, and Kelly. McGraw-Hill, 1966.

c. Errors in Practical Measurement, Barry. John Wiley, 1978.

d. Route Surveying, 4th Ed., Meyer International Textbook Co., 1967.

2. Photogrammetry and Photo Interpretation.

a. Manual of Photogrammetry, 4th Ed. American Society of Photogrammetry, 1980.

b. Manual of Photographic Interpretation, ASP, 1960.

c. Elements of Photogrammetry, Wolfe. McGraw-Hill, 1974.

3. Land Surveying.

a. Manual of Surveying Instructions - Editions covering periods of original survey should be obtained, as well as the current (1973) edition.

b. Boundary Control & Legal Principles - Brown, Wilson and Robillard, 3rd Ed. John Wiley, 1982.

c. Black’s Law Dictionary, 4th Ed. West, 1961.

d. Clark on Surveying and Boundaries, 4th Ed. Bobbs-Merrill, 1976.

e. Boundaries and Adjacent Properties, Skelton. Bobbs-Merrill, 1930.

f. Land Survey Systems, McEntyre. John Wiley, 1978.

g. Evidence and Procedures for Boundary Location, Brown and Eldridge. John Wiley, 1963.

h. Legal Principles of Property Boundary Location. Tillotson. 1973.

4. Geodetic and Control Surveys.

a. Analysis and Adjustment of Survey Measurements, Mikhail and Gracie. Van Nostrand Reinhold, 1981.

b. Classification, Standards of Accuracy and Specifications of Geodetic Control Surveys. Department of Commerce, 1974.

c. Geodesy, Bomford. 3rd Ed., Oxford University Press, London, 1971.

5. Descriptions.

a. Writing Legal Descriptions, Wattles. 1976.

b. Land Survey Descriptions, Wattles & Wattles. 1974. Parker & Son, Inc. Los Angeles, California.

c. Specifications for descriptions for tracts of land, GPO, 1965.

6. Reprints.

a. Land Surveying, Hodgman. Buckner, 1976.

b. Public Land Surveys: History, Instructions, Methods. Lowell O. Stewart 1935, Collegiate Press, Inc.

c. Boundaries and Landmarks, Mulford. Carben, 1977.

SEARCH & EVALUATION

The recovery of the physical evidence of the survey system is prerequisite to all subsequent surveys. The recovery of field evidence depends on having a complete knowledge of the history and the records of the survey system and subsequent surveys contained in field notes, county records, court records, plats, and maps. The search and evaluation of the physical evidence found against the record information is described in this guide.

RECORDS SEARCH

Effective ground search for survey evidence requires complete information.

To provide this information, the survey notes and plats of the original survey that established the lines and corners on the ground and notes and plats of subsequent surveys that retraced the lines or affected the corners must be obtained.

Original Survey Notes & Plats

Survey notes and plats of rectangular surveys and of certain metes-and-bounds surveys, such as homestead entry surveys, exchange surveys, and mineral surveys, can usually be obtained without difficulty.

Information pertaining to a corner frequently is contained in several different sets of field notes. Survey notes pertaining to corners to be searched and the survey lines to or from these corners must be obtained and systematically arranged, indexed and cross referenced for convenient field use. Any system developed should ensure that no needed information will be overlooked inadvertently. It also should provide a reasonable amount of protection of the notes during field use.

Survey notes used for corner search must be reproductions from the official notes. Survey notes sometimes contain errors in such things as bearings and distances. Only by having reproductions from the official notes can the user be certain that any discrepancy found occurred in the original record and not in the copying of that record.

Aerial Photography

Aerial photographs and orthophotos provide valuable guidance to corner point locations. Precise photo-identification also provides an excellent record of the corner point location. Knowledgeable use of aerial photographs is one key to effective corner search and recovery work.

Recent stereoscopic aerial photography coverage at a scale not smaller than 1:24,000 is needed for this work. Information recorded on these photographs is valuable to the surveyor and cartographer. Separate photographs for cadastral purposes should be obtained. Cadastral engineering photographs should not be available for general use but will be made available for locating the land net as forest primary base series mapping is revised and updated.

When available, older photography of the search area should be examined. It often yields additional information that will help to recover survey evidence on the ground.

Photo scale and orientation should be determined in the field by measurement between identifiable ground points or by comparative scaling between Geological Survey quadrangle map points and corresponding photo points (see the section in this chapter entitled "Horizontal Control Surveys for Photogrammetry”). Section lines and section subdivision lines can be projected on the aerial print from known photoidentified corners, General Land Office field notes, maps, and occupation lines to localize corner search areas.

Land Status & Landownership Records

Forest Service status records should be examined to determine the nature of the title held by the United States. The status of the lands under Forest Service administration, including any partial interests in adjoining private lands, will affect the corner search pattern. Landownership information for the lands adjoining National Forest System lands is useful for gaining access and making landowner contacts.

Public Records (Subsequent Surveys)

Records of private land surveys, other than Bureau of Land Management surveys, often are hard to obtain. Many States lack regulations requiring systematic preparation and filing of land survey records.

In States having no prescribed method for recording and filing land survey or corner record data, personnel participating in land line location work must become familiar with the various kinds of records that are maintained.

In States where surveys are or were done in connection with the acquisition of land under the Weeks Act, the surveys usually were performed by land surveyors who were Forest Service employees, In the beginning of the program, the property lines were surveyed and marked on the ground. The corners were well monumented and complete notes and plats were prepared. However, as time passed, shortcuts were used to reduce survey time. These shortcut surveys have contributed to property line problems.

At that time, very few States provided for registration of land surveyors or for official filing of land survey data. Abbreviated survey data did appear on tract plats and tract descriptions filed in connection with deeds, It was a Forest Service responsibility to accomplish the surveys required for acquisition of land and to prepare, preserve, and keep available for reference the land survey notes and plats of these surveys.

With passage of time and changes in Forest Service personnel, knowledge of the importance of these records gradually faded, Instances occurred in which the Forest Service inadvertently lost or destroyed these land survey records. In such cases, the tract description and deed probably contain the only remaining records of these surveys. Consequently, lack of full descriptions of the lines, corners, and corner accessories is a serious handicap to line retracement and corner search.

Other sources of information may include deeds, grants, abstracts, title insurance records, private and county surveyor’s notes, State right-of-way records, utility company records, Bureau of Land Management surveys, court decrees, wills, and historical societies’ records.

FIELD SEARCH

Project Plans

Project plans should include--

1. Selecting project area (FSM 7153.12).

2. Selecting personnel for the work.

3. Estimating project costs.

4. Estimating time requirements and setting starting date.

5. Determining needed records.

6. Determining needed equipment and transportation.

Project Preparation

Before starting field work, the items required must be prepared for field use. Preparation will include obtaining the following:

1. Aerial Photographs, Orthophotos, Maps, General Land Office Plats, and Notes.

a. Obtain and transfer to these photographs all available reliable photoidentification of corners in and near the project area.

b. Select and mark on the photographs the search area for each of the corners that are to be searched for in the field.

Accuracy in marking the corner search areas on the photographs is important to the success of corner search efforts, Erroneous placement on the photographs of these search areas will mislead the user and seriously impede search progress.

2. Stereoscopes. A two- to three-power magnification lens stereoscope is best for this work.

3. Working Diagram. 1:24,000 Primary Base series map usually is best for this purpose. The following will be shown on it by appropriate symbol and colors:

a. Landownership (insert names of owners of tracts adjoining Forest Service land).

b. Corners to be field searched.

c. Property lines of land in the National Forest System.

d. Land status.

4. Corner Records. A "field-going" Form FS 7100-52 Corner Record File, is needed.

This will provide an orderly arrangement for field use of copies of corner card records pertaining to the project. New data are obtained and recorded on the forms in the field.

This file should be set up by using appropriate file guides, Form FS 7100-55 or FS 7100-56, in a file box suitable for field use.

Other pertinent data, such as 874 Forms, the old diary form “Corners of Property Survey," if available, also can be placed in this file.

5. Survey Instruments, Equipment, and Handtools. The staff compass usually will suffice for line retracement work required for corner search. However, even simple line retracement often can be done more rapidly, economically, and more accurately with higher order instruments. These should be available and used when warranted.

6. Transportation. The vehicle used should be arranged to provide protection, easy and orderly access to instruments, equipment, tools, material, and supplies. This may require building some special containers or compartments to adapt the vehicle to these needs.

On-the-Ground corner Search

The following discussion pertains to rectangular system surveys, but the principles are useful in all areas.

1. Before starting actual ground search, the crew should study the aerial photographs and the project maps to obtain a good general knowledge of the project area, including topography, vegetative cover, roads and trails, habitation, ownership patterns, distances from selected living quarters, and best travel routes.

2. Travel routes to the corner search area that have been premarked on the aerial photograph should be noted.

3. After arriving at the search area, the searcher, by stereoscopic examination of the aerial photographs, will compare the photographic images with ground objects to determine the ground location of the center of the search area previously marked on the photograph.

This point, when determined, should be flagged so it can be easily seen from the surrounding area during the search for the corner. A flag on a tree limb or bush or on a Jacob's staff or pole will usually suffice.

The survey notes and plats will be reviewed carefully to fix firmly in mind the objects for which the search will be made.

A thorough and systematic search then will be made of the area. With experience, searchers soon develop their own systems of search. Some prefer to crisscross in a grid pattern, others spiral out from the beginning point.

Regardless of the system used, it must ensure thorough search with effective use of time and information.

A ground search will be confined to the area delineated on the photograph unless there is reason to believe that corner evidence lies outside the area. Sometimes evidence of a survey line may be found outside the plotted area and followed to the corner.

The amount of time to be spent searching for any one corner cannot be stipulated; it will vary considerably with different conditions and must be left to the good judgment of the searcher.

4. Adequate action must be taken to mark up the recovered corner location so it will be readily apparent if a remonumentation crew must return to the corner to protect and preserve evidence of the corner and corner accessories until remonumentation is accomplished.

5. A complete record of evidence found must be made before leaving the corner search area. A complete description must be made of action taken to mark up the corner location to protect and preserve existing corner evidence.

Preparing this record in instances where no evidence is found is of equal importance. A statement of search techniques used and amount of time spent in the search should be included.

Form FS 7100-52, properly filled out on location, provides the most acceptable and reliable record.

6. To assist others who may need to return to the corner point location with minimum lost motion, it is important to describe fully how to reach the corner. It also is important to flag out the route of foot travel. Also, assigning a member of the crew that found the corner to the crew that will remonument the corner will assist the remonumentation crew in getting back to the corner with the least lost motion.

7. A precise photo identification of each recovered corner point will be obtained when feasible.

EVALUATION

Evaluation of survey evidence requires thoughtful comparison of the field note record with conditions on the ground. Is the evidence that is found original? Is it an unrecorded perpetuation, or is it where someone felt the corner should be? The habits of the original surveyor provide some clues.

1. Original Surveyor’s Work. The feel for a surveyor’s work is developed through use of the field notes during the search, When the species of the bearing trees were called out, were they correct? Is the direction of the ground slope correct every time? Perhaps the notes are full of detail, but nothing can be found on the ground that resembles them. The truthfulness of the notes makes it possible to develop a feel for the surveyor’s work.

a. Techniques of Scribing and Blazing. The height of the blaze and the manner in which it was made is often sufficient to identify the surveyor. Was the tool used for scribing fine or coarse? Was it a jacknife or scribe? Were Roman numerals used? Was the top of the T an arc or a slash? This is information that may determine whether a blaze is original or not. A blaze on a tree always stays at the same height. A bark scribe stays at the same height, but the letters expand as the tree increases in diameter. A measuring notch cut at the crown of the roots many years ago can be buried by accumulated duff and dirt.

b. System of Measurement. The system of measurement to bearing trees is not uniform among surveyors. Some measure from a measuring notch; some from the face of the blaze; others from the side center. Frequently, the surveyor measures on the slope, not horizontally. Only by test measurement from bearing trees can the system used by a surveyor be determined.

c. Applicable Special Instructions. The surveyor was issued special instructions as to what manual to follow and the manner in which to conduct the survey. Copies of the manuals, in effect since 1851, should be in every library for reference as needed.

2. Types of Evidence.

a. Monuments. A recovered monument in its original location as established by the original surveyor is the best evidence of a corner. The monument material used by the surveyor was usually local, native material that was readily available.

(1) Post. Woodposts 3 inches square and 4 feet long commonly were used to mark corners. Field notes frequently identify the species of wood used. If the field notes call for a redwood post, the remnants may be found. If native material was used, it was cut on the spot and squared up to some extent. Pitchy material usually survives longer than other wood.

(2) Rocks. If instructions called for durable stone with a volume of 1,000 cubic inches, the stone placed by the surveyor may not be as large as the notes indicate, Recovery of some corners will give an indication of the reliability of the notes. The field notes may call for notches, but the stone found at the corner position may have grooves or scratches. If the surveyor did not specify the setting of the stone to a certain depth, the probability of the stone lying on the surface increases.

(3) Other. Mounds and pits often were used to mark the position of a corner. In time, the mounds were washed away and the pits filled. If there is some stone material in the soil, a large concentration of pebbles may be found at the location of the mound; the pits may be filled with fine wind-blown soil. The soil in the pits is not as compacted as the native soil and usually allows better growth of vegetation. Charred stakes, charcoal, broken glass, or crockery often were used to mark the exact point. These objects are referred to as memorials.

b. Accessories to the Monument. The information recorded in the field notes can actually be regarded as accessory because bearing and distance to accessories cannot be determined without field notes. The value of the information is determined by the accuracy and truthfulness of the surveyor’s notes.

(1) Bearing Trees. Often, the best accessory to the corner is a bearing tree. Early surveyors frequently miscalled the species, If the species were miscalled in one township, the surveyor probably repeated the error elsewhere. In large old growth, the surveyor often would bark scribe instead of blazing. Bark scribing also was done on smooth-bark deciduous trees.

The surveyor was instructed to select hardy trees. In many cases, less than desirable species were used. In some cases, the species used no longer exists in the area. Care should be taken not to dismiss the notes as faulty without a thorough search for remnants of trees described.

(a) Species Determination. The species determination may rely on fragments of rotten wood, the smell of a freshly cut piece, and the visible cell structure under magnification. See “Retracement and Evidence of Public Land Surveys,” published by the Eastern Region, Forest Service, USDA.

(b) Age Determination. An increment bore is one of the better tools to remove a wood sample. Ring counting of overgrowth can give a fairly accurate estimate of the date that the tree was blazed. Dyeing the sample makes the count easier. For very accurate dating of blazing and scribing, the services of a specialized forester called a dendrochronologist should be secured.

(c) Stump Holes and Stump Patterns. Many times there is no surface indication of original bearing trees. The stump holes and patterns in the vicinity of the corner position often can be located by probing with a chaining pin. The soil is not as compact in the stump hole as in the nearby soil. A 1-inch-tube soil sampler can be pressed into the stump hole to pull out a sample of decayed wood without digging up the area.

(d) Reverse Image of Scribes. Where a tree has been blazed, a callus, or overgrowth, often will grow. The woody material often is more dense or pitchy than the parent material. When the tree dies or rots, this material is more resistant. The image of the scribing can be found as raised marks and letters on its surface.

(e) Opening Bearing Trees. During search and evaluation for corners, bearing trees should not be opened except under the direction of a licensed land surveyor. It is better to take an increment boring at the location of the blaze scar. The scribed surface should be identifiable in the core.

(2) Bearing Objects. The original surveyor may have selected bearing objects near a corner (a stone in place, cliff, or large rock). Markings were cut into the exposed face. The bearing object stays in place, but the surrounding surface may be altered in nature. The stone in place could be the tip of a large boulder; the cliff face may scale, but the relationship of the object to the corner stays the same.

(3) Topographic Calls. Topographic calls were to be made at the intersection of the natural feature with the survey line. The nearer the call is to the corner position, the more accurate the relationship. A call for a rock ledge on line at 6.25 chains (Gunter’s chain = 66.0 feet) is more definable than a ridgetop at 20 chains. The more distinctive the feature, the more definable it is.

(4) Use Lines. Use lines can be deceptive. Use lines often are established for convenience and not to show the limit of ownership. Old use lines established shortly after the original survey may be more reliable than those established in recent years. If the use line is supposed to be on the section line, walking it with field notes in hand and comparing the topographic calls can determine if it is of any value in locating the corner.

(5) Blazes. Early surveyors had peculiar, individual methods of marking their blazes, even though the blazes met the Government Land Office requirements for size and placement. Study of original blazes makes it possible to observe and recognize individual styles. The age of the blaze can be estimated by cutting a small plug and counting growth rings. Another identifiable feature of authentic blazes is the regularity of a pattern.

(6) Pits and Mounds. Pits and mounds were to be constructed in accordance with special instructions, In grassland country, the work was usually done faithfully. In rough land, the pits are impracticable and a mound of stone would be constructed. A mound of stone can consist of a few stones or it can be many stones laid skillfully. During a period of years, a stone mound will collect dirt and actually support brush growth in it. A scattered mound of stone often can be identified because of the concentration of stones in one spot.

(7) Ties to Auxiliary Points. Ties to auxiliary points (such as mining claims or homesteads) can be useful if the tie is on the section line intersection with the claim line. A tie call must give the point tied to. “48.50 chns, Corner 1 MS 955 bears N 73 E - 5.56 chns” is a call that can fix the position of a line better than

“48.50 chns, a building bears West approximately 18 chns.” The former call is measured to a point; the latter is estimated and ill defined.

(8) Parol Evidence (Testimony), Information concerning the location of a corner may be taken from local residents. The surveyor should have the resident comment under oath that he or she had knowledge of the following facts:

(a) What the corner looked like.

(b) Number of years of residence in the area.

(c) How they knew it was the corner.

(d) When they were last at the corner.

(e) Date of testimony.

(f) Name, address, and age.

This information should be entered in a fieldbook. The statement should be signed by the person. In addition, the surveyor should enter a statement that--

(a) The person was under oath.

(b) The statements were made by that person.

(c) The person showed the surveyor the location and what was placed there.
(d) The person was of good character and of sound mind.

The surveyor should sign and date the statement.

As soon as possible, the surveyor should file with the proper authorities a corner affidavit with a copy of the statement as recorded in the field book. When a survey record is filed, it also should show the statement.

3. Resolution of Conflicting Evidence. This requires an examination of the record notes and the evidence on the ground. The physical conditions described in the notes (for example, the slope of the ground and other topographic calls) should be met as nearly as possible. If the corner position does not agree with them, examine the evidence on which its position has been based. Use the original notes in examining conflicts. Some notes have been transcribed to typewritten form and contain errors.

CORNER MAINTENANCE & PERPETUATION

When evidence of a land survey corner is recovered, perpetuation of the evidence is necessary. Perpetuation can be done in several ways:

1. Documentation. A complete description of the recovered evidence should be entered in a field book and on a corner recordation certificate. The information should include the date, the actions taken, and who did the work.

2. Signing, Painting, and Flagging. Signing, painting, and flagging are acts that can be done to draw attention to the evidence. The appropriate signs can be nailed to the bearing trees, whether alive, dead, standing, or down, Paint must be used with care. The marks on the monument (stone or post) should not be painted over. Flagging may be tied in the vicinity of the corner.

3. New Accessories. The original accessories to a corner often are in very poor condition. Sufficient supplemental accessories should be established to ensure the recovery of the corner position.

a. Marked Trees or Other References. After determining the location of the corner point, the measurement and the direction to selected references should be made. At least three references should be taken, if possible. If a tree is used for a reference it should be marked in such a manner that it cannot be confused with the original surveyor's mark, In the notes, indicate the point on the accessory to which the measurements were made, For example, "the center of the root crown of a 6-inch fir bears S36°W, a distance of 31.2 feet,"

b. Guard Posts. When a guard post is set at a corner, set it near, not on, the corner. Record the bearing and distance to it from the corner point. The bearing should be taken by standing at least 10 feet from the corner point, looking through the corner point to the post.

4. Photo Identification. On existing aerial photography, a corner can be located by reference to photo- identifiable objects. Selection of three image points for each corner is preferable. Identifiable trees or objects near the corner can be chosen. After making the photo identification of the object, a bearing and distance should be taken from the identified object to the corner point.

5. High Stump Bearing Tree (BT). Many times a standing, recovered bearing tree is very decadent. Bearing trees in this condition should be cut off above the blaze. The cut should slope downward sharply from the top of the blaze, allowing moisture to run off. Covering the cut with plaster, paint, or tar paper will help preserve it. High stumping prevents wind throw and untimely destruction of the bearing tree.

6. Reference Monuments. Reference monuments must be placed with care. The markings should be distinct and not easily confused with corner markings. When two reference markers are set, the lines from them to the corner should be at 90 degrees. Markers should not be driven into the corner point location. Destruction of valuable evidence below the surface can occur.

7. Disposition of Necessary Forms. Recovery of corner point location and the perpetuation is not complete until the information is entered in the record.

a. Corner Record Cards. The Supervisor’s Office and the District Ranger’s Office should receive and file a copy of the corner record card. A card should be made out for all corners searched for, recovered or not.

b. Affidavits (Testimony). The affidavit of parol evidence of a corner should be kept in a permanent file by the cadastral surveyor. The corner record card should have a notation as to the file and book number for reference.

c. State Recordation Forms. When a corner has been perpetuated with parol evidence, the corner recordation form should have a copy of the affidavit attached. A copy of the corner recordation form should be recorded with the appropriate office. Copies will be retained in a permanent file at the Forest Supervisor’s Office. The District Ranger’s Office also will maintain a copy. A courtesy copy also should be forwarded to the State Office Bureau of Land Management Cadastral Engineer.

LAND SURVEY PROCEDURES

PREFIELD ACTIVITIES

Data Accumulation

After a surveying project has been defined and approved, data essential to the execution of the project are assembled for subsequent evaluation.

Data accumulation is one of the most important phases. It is essential that a thorough search of sources is accomplished. All other phases rest directly on information acquired during this phase. The following are some examples of useful data:

1. Descriptions from status records, deeds, other Federal agencies, State offices, county offices, and landowners.

2. Title searches for present and past ownership.

3. Private surveys in or adjacent to the project area from the Forest Service, other Federal agencies, county offices, city offices, utilities, and private industry.

4. Corner information from the Forest Service, county corner files, local landowners, and private industry.

5. Right-of-way descriptions from utilities, the Forest Service, the State, the county, and the city.

6. Control survey data from the Forest Service, National Geodetic Service, Geological Survey, Corps of Engineers, and State Highway agencies.

7. Original corner information from Bureau of Land Management-General Land Office plats and field notes.

8. Access, corner location, vegetative cover, and topography from aerial photos and maps.

Project Folder

A project folder for each proposed land survey project shall be established, It will consist of a field folder and a permanent file folder. As the data are accumulated, it is to be placed in the project folder, Necessary data for field work will be placed in the field folder and given to the party chief assigned to the project, Upon completion of the survey project, the field folder with the field notes, rough plats, and computation sheets will be returned to the project folder.

Evaluation of Data

All data received for the project folder will be reviewed by the land surveyor. Obvious conflicts and omissions will be noted, and remedies will be suggested, Special problems, such as double corners, riparian boundaries, correctional lines, amended surveys, prior private surveys, and lost corners, will be pointed out with suggested solutions. Problems that cannot be resolved by the land surveyor will be referred to the Regional Office for technical guidance. A check of the status of the Forest lands will be made, Public domain and acquired lands have separate requirements for survey. These requirements will be defined by the cadastral surveyor, based on statutory authority.

Survey Authority

It is necessary to determine the type of survey authority needed. Most Forest Service surveys are made under State authority. However, Federal survey authority may be required when any or all of the following conditions apply:

1. The original survey was conducted under Federal authority.

2. The survey is needed for an exchange and the selected parcel consists of unsurveyed public domain land.

3. The original surveys were fraudulently or erroneously done.

4. It is expected that the survey will result in litigation.

5. There is extensive loss of original corner monuments.

If it is determined that the survey is to be done under Federal authority, the procedures to be used are covered in the Memorandum of Agreement with the Bureau of Land Management State Director of the State in which the survey is located.

These survey projects must be coordinated and scheduled through the Regional Office.

Scheduling is dependent on climate, transportation, and housing for the survey party. Coordination between the cadastral surveyor and unit manager will facilitate scheduling of a survey project.

Survey Plan

A plan to execute the survey should be developed. A scheme to determine the positions of existing corners employing control survey procedures may be necessary (see the section of this chapter entitled “Control Surveys for Land Surveying”). Surveys to establish or reestablish corners and to locate lines may be combined or separate, if appropriate. The survey plan should consider all survey objectives, such as determining corner positions, setting out, and establishing lines between corners. The instrumentation and technique required to meet each objective should be analyzed and selected.

Permission To Survey

Before any survey across private lands is conducted, permission must be obtained, from the landowners (FSM 7153.7). The unit manager has the responsibility for obtaining consent, It will be sent to the cadastral surveyor and placed in the project folder.

FIELD PROCEDURES

Field procedures for land surveys are governed by the positional accuracy required and the field conditions present, Retracement techniques are controlled by the survey history subsequent and maintenance of the survey system. Measurement techniques are related to field conditions; instrumentation available; and the experience, knowledge, and skills of the surveyor. Efficient procedure will reduce costs, increase production, and comply with applicable rules and laws for land surveys. The use of photogrammetry and electronic survey systems and procedures will often accomplish the required work at reduced unit costs.

Project Analysis

An analysis should be made to determine the complexities of the field situation. This analysis will consider the following:

1. Topography and vegetative cover.

2. Survey procedures to be employed and accuracy required.

3. Method of accomplishment.

a. Bureau of Land Management accomplishment.

b. Forest Service utilization of Bureau of Land Management survey authority.

c. Force account.

d. Contract.

4. Identification of technical survey problems, legal problems, and procedures.

5. Project control (critical path). A complex survey will require the development of project time lines and check points listing all critical phases to be sure no item is overlooked that may cause a delay in project completion.

Project Cost Estimating

A project cost estimate should be developed, using Form FS 1900-4 (11/77). The form is largely self-explanatory.

Field Activities

Use of Technical References

Surveying texts are the primary sources of information for procedures to use in making survey measurements. Surveying texts and manufacturers” instructive literature are sufficiently detailed in the use and adjustment of conventional survey instruments.

Surveying texts are not sufficiently detailed in the art of retracement and recovery of the physical evidence of the survey system. It is an art that must be acquired in the field under the direct supervision of a well-qualified instructor.

Field Reconnaissance and Retracement

Access, topography, and vegetative conditions should be reviewed prior to the beginning of actual field work.

For survey and corner evidence evaluation, see the section in this chapter entitled “Search & Evaluation.”

All land surveys require field reconnaissance and some retracement for controlling corner and line evidence prior to and during the survey. Search and recovery is essential to determine the location of recoverable corners and the scope of the work required to complete the project.

Retracement to recover physical evidence is an art not readily learned from texts. An apprenticeship period is essential for learning how to recover and recognize evidence and how to develop proofs that can be supported by the rules and laws of evidence. Guides for retracement and the recovery of evidence are found in boundary cases, in manuals by the Bureau of Land Management, and in some surveying texts. Retracement remains an art learned through field experience by following the footsteps of original and subsequent surveyors.

Many surveys are retraceable from the record and from evidence. The record and evidence are not always reliable, depending on the care of the surveyor, the age of the survey, and loss of evidence through decay and destruction. Knowledge of techniques and survey habits of original surveyors must be acquired through experience in retracing their work. No attempt should be made to do retracement without having all pertinent records of the original and of subsequent surveys in hand.

Recovered corners must be consistent with the official records, Proof of the recovered evidence will depend on the skills and knowledge of the land surveyor. The land surveyor’s decisions and acceptance of evidence must be defensible in a court of law. Acceptance of evidence not supported by official and reliable records is not satisfactory. The laws and the rules of retracement and corner recovery will prevail.

Survey Instrument

Executing a survey requires assembling all survey instruments needed to effectively and efficiently perform the survey. Instruments must be in good working order and adjustment. The basic traverse instruments for angular and distance measurements should be optical reading theodolites and electronic distance meters, but staff compasses, transits, and calibrated steel tapes shall be available for use if conditions warrant.

The use of digital readout optical theodolites is encouraged because of ease of reading and for checking results.

Portability should be a consideration in the selection and use of electronic distance meters. Available manpower for transporting equipment affects the type of equipment that should be employed.

True bearing will be determined by astronomical observations, use of geodetic stations, or by use of the north-seeking gyrotheodolite.

The laser range pole should be employed under appropriate conditions. Its use will be limited on unstable ground, such as marshes and swamps, under heavy tree canopies where clearing is a major undertaking, and under low cloud conditions and rain that will affect the transmission of signals.

Areas of practically any size with sparse control are ideal for the use of photogrammetry. The direction should be toward larger project areas employing aerotriangulation measurement by photogrammetry to the fullest extent of qualified manpower and facilities.

Measurement

Land-surveying measurements establish the spatial relationship of land corners. The accuracy of measurement can be expressed by relative error of closure (precision) or by positional accuracies. The techniques of measurement must yield precision (such as 1:5000) or positional tolerance (such as -l foot) as established by law or through an analysis of value and risk. It is poor practice to expend time making unnecessary, repeated observations for refinements not needed. Checks are needed to show that measurements are free from blunders and mistakes in reading and recording and from unacceptable errors from instrument sources. The check is to show reliability of measurement and position.

One set of readings of a theodolite will provide the accuracy, but not the check. A second set of readings on another part of the horizontal circle is needed to compare the results of the two sets of readings. Caution is in order in recording only two sets of readings. Mentally knowing the answer from the first set of readings can lead to a sympathetic check for the second set of readings.

In angulation, consider the precision required. For example, in a distance of 1 mile, a minute of angle subtends only 1.54 feet. A second of angle subtends only 0.026 feet. Angular precision should be consistent with linear precision. One popular electronic distance measuring device (EDM), properly calibrated, specifies a mean square error of 0.02 feet in 1 mile. It would not be prudent to attempt to use a theodolite of less than one second to be compatible with this electronic distance measuring device at this distance.

Distance measurements with certain electronic distance meters require care in recording the slope distance and the vertical angle. The same holds for taped measurements.

In closed traverses, the closure will determine the precision. Precision significantly less than expected by the technique indicates blunders in angular or distance measurements. Angles are rarely the cause of a blunder if the cumulative angle technique is followed to check the angle turned at each traverse station. A clue to the location of distance measurement blunder is in the closing difference in latitude or departure. Obviously, a major difference in the latitude will indicate that the error or blunder was made in one of the latitude measurements. It will narrow the source of field rechecking to find the blunder, With care and attention in reading instruments and recording the data, rework is avoided.

Check measurements of spur lines can be accomplished by following normal measurement procedures in one direction and making rough chainage check in the reverse direction.

The mathematical check of the angle measurements of a closed traverse is to compare the sum of all the interior angles with (n - 2) times 180 degrees, where n represents the number of sides on the traverse.

On east-west traverses, astronomical observations at the ends of the traverse will have to be adjusted for meridian convergency to check bearing closure. The convergency of the meridians at a given latitude can be found in the standard field tables prepared by the Department of the Interior Bureau of Land Management.

Most land surveys are made on an assumed plane coordinate datum, Meridian convergency is not a consideration for surveys of 1 mile or less in departure. Using an astronomic reference line, the bearings of all lines east and west of this reference become grid-bearing lines, On large survey projects, and where not less than two geodetic stations are located within or near the project, State plane coordinates shall be established for corner positions.

Traverse Techniques

1. Turn all angles cumulatively clockwise.

2. Traverse in a counterclockwise direction to make all interior angles clockwise. This will simplify angular closure checks, Similarly, all spur lines and corner positions established or restored from a control traverse line will have all angles turned clockwise as a matter of custom and so as not to leave any question or doubt as to which direction was used.

3. Traverse continuously in one direction back to the point of beginning to simplify note-keeping and to simplify following the survey notes when the data are being used for computations and for ready reference.

4. Traverse along the route of least resistance but near the boundary line to be able to retrace the footsteps of the original surveyor and to compare stationing of record and natural feature calls.

5. Make astronomical observations on one of the traverse courses where the sight distance is long and one end has an opening for Sun or star sighting. Make a second observation for closure check near the opposite side of the traverse. This checks the angulation of the traverse and the first astronomical observation.

6. Make bearing and distance ties to corners, targets, and natural and man-made features that are not within the main traverse circuit, but that are needed as part of the survey.

7. Compute traverse coordinates in the field to assist in the search of corner positions not found in initial search.

8. If electronic distance measuring device equipment is not available or malfunctions during field surveys, distances across inaccessible areas can be measured by triangulation. The baseline should be double measured and all angles of the triangle should be carefully measured. The included angles should not be less than 30 degrees in order to attain strength in the triangle. The measured baseline should not be less than 200 feet or a distance that will intercept a 30-degree angle.

Field Documentation

1. Field Notes. The recorder has the obligation to write in a clear, legible, and orderly manner so that the notes are as understandable to the user as to the recorder. The entries shall include notes, sketches, and other pertinent entries, all indexed. The use of dates, names, and the notekeeper’s signature shall be standard practice. The corner recoveries and corner monumentations shall be made part of the notes.

Field notes shall be entered in standard field books for permanent records. Each field book shall be identified by the basic land unit in which the survey was made. In the rectangular system, this would be the township, range, and section(s). In areas of grants and in metes and bounds surveys, reference will be made to warrants, grants, lots, and divisions, as needed to readily identify the location of the survey.

2. Corner Cards.

3. Field Photographs.

a. Evidence Photographs. Photographs of evidence and field conditions are an excellent method of preserving field evidence.

Photographs should be taken on color print film in all stages of recovery. If evidence is enhanced by the use of chalk, include before-and-after pictures. Also include a ruler or some other device so that a scale can be determined.

b. Aerial Photographs. As surveys are completed, land corners should be photoidentified on a set of forest resource photographs to enable better land net control for Forest Service base map production. This is accomplished by photo identification of one or more image points with bearing and distance ties made to the true corner, In no case should an attempt be made to prick the corner point unless it can be seen on the photograph.

Basis of Bearing

All Forest Service land surveys will be based on the true meridian. The true meridian is determined by astronomic observation gyrotheodolite or geodetic tie, Numerous textbooks and pamphlets are available that give step-by-step procedures for making observations or calculations.

Monumentation

All land corner positions identified by survey will be Monumented, referenced, and maintained, See the section later in this chapter entitled “Monumentation” for markings and referencing procedures.

Property Line Markings

Refer to the section entitled "Boundary Identification" for line marking procedures.

Field Computations

Field calculations should be performed only by persons who are knowledgeable and skilled in mathematical applications used in land surveying.

Photogrammetric Land Surveys

Aerotriangulation is another technique for obtaining coordinates of corner positions.

The primary advantage of photogrammetric measurements is in cost savings compared to conventional survey techniques. These savings are found in the reduction of control surveys required to retrace and subdivide sections. However, the project areas must be evaluated for the ease or difficulty in placing control around the perimeter and targeting corners within the project area, Roads through or near the project will substantially reduce the time required to establish targets.

The time and cost of target placement, aerial photography, and aerotriangulation often are considerably less than the cost of conventional ground surveys. Generally, photogrammetric control requirements range from one-half for smaller projects to one-third for larger projects, compared to conventional techniques for locating controlling corners and establishing subdivisional corners.

Before starting any photogrammetric project planning, a field search should be made to determine the location of existing corners needed to control the positions of any lost corners and new subdivision corners to be established.

Procedures are the following:

1. Complete all corner search for recoverable corners.

2. Plan flight line coverage over the project area 2 to 3 months prior to time for photography. Determine, with the advice of the photogrammetrist, photo scale considering accuracy required.

3. Place ground targets on or offset from known corner positions when required because of tree cover. Field tie offset targets to corners. Control stations should be targeted directly. Offset targets on control stations are not recommended.

4. Notify aerial photographer when targets are in place and the project is ready for photography. Normally the photographer should be selected up to 3 months in advance of the notice to proceed.

5. Complete control traverse, Include known corner positions where possible.

6. Compute coordinates of the control positions and provide those selected to the photogrammetrist. The coordinates of selected control targets may be withheld from the photogrammetrist as a check on the accuracy of aerotriangulation.

7. The photogrammetrist will perform aerotriangula- tion, computing coordinate values for all targets. A listing of coordinate values for all targets with a standard error statement (RMSE) will be furnished to the surveyor.

8. Evaluate the error statement for acceptability. If the error statement is not acceptable, a review of the control survey computations and aerotriangulation work will be necessary to isolate the error.

9. Using coordinates of the known corner positions, compute the coordinates of all corners that are to be established. Compute bearing and distance between the corners to be established and the respective targets.

10. Set positions of corners in the field from respective targets.

11. Make additional search at each restored corner position for evidence that may have been overlooked in the initial corner search.

Land surveying using aerotriangulation is a correlation of the art of retracement and the rules and principles controlling land surveys with the science of photogrammetry. Aerotriangulation using precise photograrnmetric and field control equipment is a reliable and accurate tool for measurement for land surveys. Aerotriangulation will reduce control requirements significantly compared to exclusive traverse techniques. The key is good planning, proper placement of targets, and establishing ground control at locations that will provide a strong base for aerotriangulation. A useful byproduct is a topographic map.

Specialty Equipment

Recent developments have created highly sophisticated specialized equipment. This equipment usually will require special training. New equipment includes the following:

1. Laser Range Pole. This is used to identify a straight line between corner positions and for triangulation to establish the position of corners.

2. Total Station. This is used for traverse, triangulation, trilateration.

3. North-Seeking Gyrotheodolite. This is for meridian determination.

4. Satellite Positioning Systems.

5. Inertial Positioning Systems.

Equipment Calibration

Forest Service electronic equipment and measuring tapes should be tested periodically over a known calibration range. National Geographic Survey has established many calibration baselines throughout the country. The locations and contacts for these baselines are published each year in the "Federal Survey Plan," a publication of the Federal Geodetic Control Committee. Theodolites, transits, and compasses should be tested periodically for adjustment.

POSTFILED ACTIVITIES

Survey Review

It is important to review the results of a survey prior to final platting and recordation. Independent reviews by qualified personnel often result in the discovery of mistakes that must be corrected prior to final filing or recording of survey documents.

All notes, sketches, recordation forms, computations, aerial photos, and other supportive and related data will be filed in the permanent project folder. This information should be assembled in a manner that will allow any competent surveyor to follow the project easily from field notes to final plat.

Plat Preparation

The plat is a scaled drawing depicting the surveyed lines. Plats must be neat and orderly. FSM 7153.81 requires that plats be prepared for all land surveys. Federal, State, and local law and regulations will determine the format and content.

Plat Content and Drafting Requirements

The plat is a permanent, historical record of evidence of ownership lines and for this reason must have the following minimum characteristics:

1. The plat must be prepared on a durable, easily reproducible drafting base.

2. Lettering must be done with permanent ink, neatly, clearly, and of sufficient size to allow the plat to be reduced to "letter size" without loss of legibility.

3. Overall size of the plat will be governed, in most cases, by State or local statutes, If not specified, it shall be of sufficient size to show all of the required elements clearly without crowding.

4. In the absence of Federal, State, and local law(s) to the contrary, the plat shall have a border of at least inch on the top, bottom, and right side, with at least 1½ inches on the left for binding purposes.

5. The plat elements shall be arranged on the sheet to present a pleasing and well-balanced appearance.

6. North direction shall be oriented toward the top of the sheet.

7. Line weight and lettering should have contrast in order to emphasize the important elements of the drawing and notes.

8. Legends will be used to define the status of surveyed points and lines.

A plat should clearly and accurately depict the intent and result of the survey. The surveyor has the responsibility to ensure that sufficient information is included on the plat to allow correct interpretation by a user. The following elements should be contained on plats:

a. Record or certificate of survey.

b. Township, range, meridian (HES, MS, and so forth).

c. County and State.

d. National Forest Lands labeled by name of National Forest or Grassland or labeled "National Forest System Lands” for administrative units not within a National Forest.

e. History of prior surveys.

f. Purpose of survey, date of survey, instruments and methods used.

g. Surveyor’s certificate and seal, and date.

h. Basis of bearing and north arrow (north at top of sheet).

i. Scale bar and fractional scale (number of parts on map compared to equal parts on the ground).

j. Corner status indicated by notes and by standard symbolization.

k. Record dimensions in record units, labeled or in parentheses.

l. Found, measured, or calculated dimensions labeled.

m. Decimal units of measure consistent with precision.

n. Precision statement.

o. Found gaps, overlaps, encroachments.

p. Topographic features shown and named.

q. Geodetic or control stations shown and coordinates given.

r. Recorder’s certificate or county approval block.

s. Peer review approval block.

t. Statement signed and dated by Forest Supervisor certifying the survey was made at the request of a Line Officer.

u. Sheet number of number.

v. Contract number.

w. Aliquot parts and lots or parcel identification labeled.

Plat Recording

After a plat has been completed it should be checked for completeness against the list in the preceding section by someone other than the drafter.

The Regional Forester can require a review and acceptance procedure (FSM 7153.04.2f).

After all reviews and acceptances, applicable State recordation forms and plats will be filed in the appropriate Federal, State, local, and Forest records (FSM 7153.42 and FSM 7153.71-.73).

MAINTENANCE of SURVEY EQUIPMENT

The "Surveyor's Manual" of the State of California Department of Transportation is a good reference.

It contains information on the following:

1. Care of survey equipment.

2. Servicing surveying equipment.

EASEMENT SURVEYS

This provides instructions for surveying, preparation of plats, and writing legal descriptions for easements to be acquired or granted by the Forest Service.

CHARACTERISTICS of EASEMENTS

An easement for a road or other specific use is an interest in land consisting of the right to a specific use, otherwise unprivileged, on the land of another, Easements may be created by the following:

1. Conveyance or deed grant.

2. Reservation or exception in a deed.

3. Condemnation by an agency of government and certain public service corporations.

4. Prescription (long, adverse use).

Generally, the Forest Service acquires easements by deed or condemnation--occasionally by reservation and very seldom by prescription.

Easements may be granted for a definite time period. A deed for an easement must be executed with the same formalities as any other deed so that it may convey such an easement.

The wording describing the easement must contain a legally and technically adequate description of the land covered by the easement. An adequate description is one that enables the property to be located with reasonable accuracy on the ground by a competent land surveyor, either with or without extrinsic evidence, both at the present time and in the future.

SURVEYING & PLATTING EASEMENTS

Easements are surveyed and platted for the following reasons:

1. To determine the position of an existing or proposed easement in relation to land monuments and property lines in order to prepare a legal description for a conveyance.

2. To mark the location of the easement on the ground, as necessary. To make visible and to segregate the easement estate.

3. To provide a record from which a satisfactory retracement of the limits of the easement can be made at some future date.

4. To determine the size of the easement for value estimates and appraisal purposes.

Normally a plat is the end product of an easement or right-of-way survey. A plat contains a visual representation of the easement with the survey data needed to permit retracement on the ground. The majority of easements written should use the plat for the legal description of the property taken. When a written legal description is required, a plat still is necessary for appraisal purposes.

The surveyor charged with providing a right-of-way plat should make every effort practicable to ensure that the road shown on the plat is consistent with the road that exists or will be constructed. Since the easement is normally acquired prior to construction and the deed with the plat attached is formally recorded in the appropriate county, it becomes difficult to change the contents of the plat. Any extensive realignment during construction will render the plat and monuments on the ground useless and necessitate expensive and time-consuming correction deeds.

PLANNING PRIOR to RIGHT-of-WAY SURVEY

Coordination With Action Plans

The right-of-way acquisition program on a Forest is coordinated with long- and short-term plans for transportation system development and resource development programs. The surveyor in charge of a right- of-way survey should satisfy himself that the survey will conform to these plans. The survey must be scheduled with sufficient lead time to allow right- of-way procurement prior to construction. When the location is dependent on the right-of-way, the right- of-way survey should be completed prior to the road design.

Route Selection

A route first must be selected to determine the land crossed so that the record and title search and preliminary road construction cost estimates can be made. This involves locating the route on a suitable map or aerial photographs in sufficient detail to identify the ownership of the lands to be crossed. The final route selected should consider the least impact on the private landowner while still meeting the management needs and economic constraints of the Forest Service.

Records Search

The status and ownership of the lands to be crossed by the proposed road are determined by a search of the county records or by securing preliminary title evidence from a title insurance company.

When a search of the records discloses complex ownership patterns or title infirmities that would be difficult and time-consuming to clear, or if owners are known to be hostile, the feasibility of alternate routes or shifts in general alignment should be investigated through transportation system analysis.

A records search is necessary before right-of-way negotiations are commenced. It should be done as early as possible so the information can be used throughout the rest of the process. Failure to accomplish this step in its proper sequence will result in continued difficulty during the whole process of surveying and acquiring the right-of-way. This is normally a function of a Lands Staff officer or his delegate, but the surveyor should ensure that this information is as complete as possible before the survey is started.

Survey Method Selection

A decision on which survey method is best suited for the particular right-of-way must be made at this time, as it will influence the remaining steps. For instance, if photogrammetry is chosen, a larger and much more comprehensive corner search program could be undertaken, as photogrammetry can provide ties to several corners as economically as it can to one corner. In high-value land, it may be desirable to undertake a complete property survey and section subdivision rather than chance a boundary dispute over road location. Good judgment on the selection of the survey method by the surveyor in charge will ensure that the purposes of a right-of-way survey and plat are served at the least cost and are consistent with values and risks involved.

Right of Survey Entry

Permission for ground surveys must be obtained from the landowner. No field work should begin until this is done. The landowner’s views as to the road location and design must be ascertained and recorded for later use. No attempt at negotiation for right- of-way should be made at this time. The District Ranger should secure permission to enter private property as he has the primary responsibility for contact with adjoining landowners.

Corner Search

Usually the search for property corners of the private land crossed by the road should be conducted as an operation separate from the survey work necessary to determine the position of the corners. The corner search should be done by one or two of the more knowledgeable people available to the Forest Engineer. The corner search is the most important step in the right-of-way survey, and the time allotted to it should be adequate. Coordination with land line location activities on the Forest is desirable. The corner search technique is covered in the section entitled “Property Corner Location.”

Flag Lines

After careful study of the information gathered, a competent road locator should flag the proposed road. It is uneconomical in most cases to flag the line until the preceding steps have been accomplished and that information considered.

Landowner’s Approval of Flag Line

This step may not be possible, but if achieved, it may eliminate costly resurvey and redesign work. This step should be accomplished if at all practical.

Flagline Clearance With Ranger District Personnel

This step is necessary to ensure that the road location finally flagged is in agreement with the District plans and intent.

PROPERTY CORNER LOCATION

Corners Required

The number of property corners required to be located for a right-of-way is dependent on several factors:

1. Complexity of Ownership Pattern and Trespass. If the ownership pattern is simple in relationship to the road, a field tie to a property corner upon entering the property and another upon leaving will generally be sufficient. If the right-of-way passes close to the property lines where two or more ownerships meet, the controlling corners necessary to define those ownerships must be located and tied, (See page 85, sections 3-87 through 3-92, of the 1973 "Bureau of Land Management Manual of Instructions" for a discussion of the corners necessary to define different ownerships within most sections,) An attempt must be made to locate the controlling corners and define their actual location in the ground by survey because their location often is considerably different from that shown on the public land survey system (PLSS) plat. By law, the ground position controls over the plat position.

2. Value of Land Traversed. High-valued land may be subdivided, in which case the corners of the lots traversed should be tied, If the right-of-way misses the lots but passes adjacent to them, several ties to lot corners should be made to ensure that the right-of-way does not invade the lots, It is good practice to monument rights-of-way in high-value lands, regardless of the method used in making the survey.

3. Number of Corners Recoverable. Obviously, corners cannot be tied if they cannot be recovered. It then follows that the optimum standards cannot be met. If such is the case and if practical, other more remote recoverable corners should be tied, In addition, occupancy lines, corners, and fences should be surveyed and represented correctly on the plat. If corners are not recoverable,

occupancy evidence may be used to settle the question of ownership, but as a last resort. If there is a scarcity of recoverable legal corners, it becomes even more important to tie other existing monuments along the right-of- way line and to monument the right-of-way itself. When no corners can be found--for example, on a mineral patent that has been considerably disturbed by placer activity--it may be advisable to have a cadastral resurvey done under proper authority.

4. <u>Corner Remonumentation</u>. All public land survey corners within the right-of-way shall be searched for and, if found, suitably referenced and remonumented. If remonumentation is impracticable, they shall be permanently referenced. In either case, a recordation form shall be prepared and filed (see the section entitled "Action Necessary When Property Corner Is Found").

Corner Search Aids

1. The technique of searching for corners using aerial photography is described in the earlier section of this chapter entitled "Aerial Photography."

2. The use of stereoplotters or orthophotos in projecting corner information from reliable maps to photos should not be overlooked. Many Forests now have these plotters or orthophotos available. Some Forests have photography with corner projections already shown. However, it may be necessary to run a compass line and chain or pace to find a corner because of dense tree cover.

3. Public Land Survey System township plats and original survey notes always should be used in corner searches. They are available from the Bureau of Land Management State offices in the State in which the project is located.

4. Obtain and use reliable maps when searching for corners. The best is the primary base series topographic quadrangle. Figure 1 illustrates the distinctive symbol for corners found and accurately positioned during map construction.

5. Make use of the corner card file (Form FS 7100-52) that is maintained on all Districts and at most Supervisor's offices. This file should be checked before any corner search is begun.

6. Check the County courthouse's certified land corner recordation file. It is a repository for land-survey records made by State-licensed land surveyors. The form is self-explanatory.

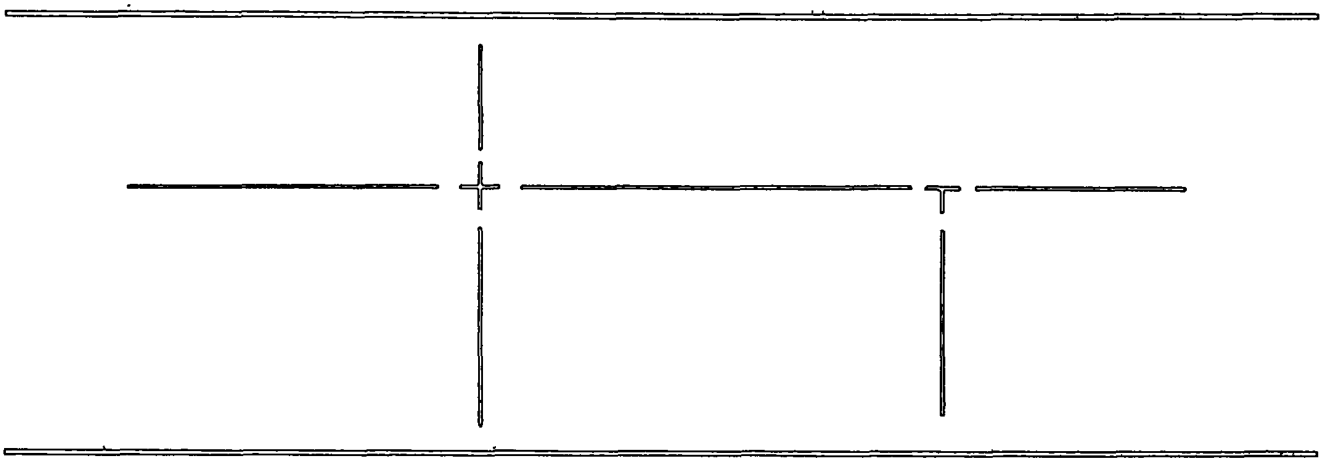


Figure 1.--Symbol for corners found and accurately positioned during map construction.

7. If there has been any private survey activity in the area of interest, check other county records, such as plans of subdivisions and deed records. This should include a visit to the county surveyor.

Action Necessary When a Property Corner Is Found

1. Unless an adequate corner card, Form FS 7100-52, exists prior to the search, it is mandatory that a card be filled out and placed in the District and Supervisor’s office files, Include a card for those lost corners that are known to have been destroyed.

2. Erect the necessary signs to protect the corner and its accessories.

3. Make a precise photo identification of the corner on existing photography. If new photography is planned for the survey, pretarget the corner.

4. Rehabilitate or remonument the corner monument and accessories as necessary.

5. Whenever the existing monument and accessories are altered in such a way as to render the original record changed, it is necessary to fill out and file with the County clerk and recorder a “Certified Land Corner Recordation” form. This form must be reviewed and signed by a registered land surveyor with legal authority.

6. Paint or flag the corner for easier recovery later.

SURVEY PROCEDURES

Surveys for easements are property surveys because they are used to prepare a description for a deed or other legal document. The survey must locate the property being conveyed by the document and show its relationship to surrounding properties to an accuracy consistent with the value of the land and the risk of loss. Any method of measurement, including photogrammetry, that produces the required accuracy is permissible. Survey procedure must conform to applicable State and Federal law for property surveys. Retracements of property lines and subdivision of sections must be executed in accordance with Bureau of Land Management Manual methods or applicable State requirements. The survey must show where an easement enters a given parcel, where it leaves the parcel, and its location within that property. It usually is not necessary to monument the perimeter of the property crossed by the easement. Those boundaries are the concern of the property owners, but the location of the easement is the concern of the Forest Service and the grantor. The essential point to consider is that the easement must be retraceable by a competent land surveyor.

If a ground survey is made, sufficient ties to improvements that are within the right-of-way corridor, such as fences, buildings, and wells, should be made. Information on location of improvements is needed for appraisal and platting purposes.

Survey Standards

Standards of precision for easement surveys are not absolute, but they must be based on the values of the land traversed by the easement and proposed improvement and the risk of future adverse consequences because of the inability of the grantor or grantee to identify the limits of the easements.

Identification involves both title and survey sufficiency.

The following are some elements of risk:

1. The quality of the existing survey to which the easement is tied, including its age, type of monuments used, and legal standing. An original public land survey is usually capable of withstanding any legal challenge, whereas a private survey may not be.

2. Present ownership--whether public or private. If private, the nature of the owning party; that is, risk is higher if the land is owned by a development corporation and lower if owned by an organization engaged in agricultural or timber production.

3. Likely future use. This element considers the likely possible future use of the land, such as agricultural, recreational, industrial, or residential.

4. Adjacent property use--present and likely future.

5. Danger of the acquired easement encroaching on private land not owned by the grantor.

6. Likelihood of the basic land value appreciating, such as land underlaid by significant mineral resources that probably will appreciate in value.

7. Likelihood of condemnation procedures being required. Survey standards are represented by a two-dimensional array combining the elements of value and risk.

Table 1 shows minimum standards for error of closure for traverses (before adjustment) in a matrix which arrays land and improvement value against risk.

Table 2 shows maximum positional error (probability elipse) in feet for points determined by traverse or photogrammetry arrayed in a value and risk matrix.

Once the amount of the maximum positional error has been decided based on an analysis of risk and value, a survey method with sufficient precision can be selected.

Table 1.--Error of closure.

	Value		
Risk	High	Medium	Low
High	1:10,000	1:5,000	1:3,000
Medium	1:5,000	1:3,000	1:2,000
Low	1:3,000	1:1,500	1:1,500

Table 2.--Positional error.

	Value		
Risk	High	Medium	Low
High	± 0.3′	± 1′	± 2′
Medium	± 1′	± 2′	± 3′
Low	± 2′	± 5′	± 5′

Table 3 contains precision values for several different survey methods commonly used and is included as a guide in selecting a survey method.

Survey Methods

A variety of survey methods are satisfactory for easements. The survey method chosen must ensure that the four objectives listed in the section of this chapter entitled “Surveying and Platting Easements” are achieved. The road geometry must be measured; it must be related to sufficient property corners to show where it enters a given ownership, where it is located while in that ownership, and where it leaves that ownership. The width and changes in width of the easement must be shown in order to calculate the area of easement.

The relative value of the land traversed by the road and the value of the facility should be estimated. The elements of risk listed in the section entitled “Survey Standards” should be evaluated in combination with the estimated values, and a minimum precision should be selected from tables 1 and 2. The precision desired may be used to select a survey method from table 3. Combinations of survey methods may be used if the methods chosen will achieve the desired precision. The method chosen may be dependent on whether the road is in existence or is to be built after the easement is acquired.

Existing Roads

Where easements for existing roads will be acquired without reconstruction or realignment, the surveyor’s task is to measure the road’s horizontal geometry and relate it to the private property that it traverses. This can be accomplished by ground survey methods or by photogrammetric methods.

When a ground survey method is used, the normal process is to traverse the road, establishing station of the traverse at reference and angle points (APs) along the road, For sharp curves, points of intersection (PIs) and circular curves are used. When the PIs are not accessible because of trees or other obstructions, the traverse may include point of curvature (PC), point of tangency (PT), or point on the curve (POC). The external distance from the P1 to the midpoint of the curve may be measured and recorded. This will enable the surveyor to describe the geometry of the curve.

Method	Instruments	Procedures	Precision
Transit and Tape	1-minute transit and standardized tape.	Angles to 1-minute. Tape with standardized pull and temp. Angles doubled.	± 2 feet per mile of traverse.
Electronic	1-second theodolite and EDM.	Two sets of direct and reverse angles Electronic distance with vertical angle slope reduction.	± 0.3 foot per mile of traverse.
Photogrammetry	C-8 or fully analytic methods. Metric camera.	2nd-order control. 1:12,000-scale photos. Targeted corners. Block adjustment.	± 2 feet or better.

Photogrammetry	C-8 or fully analytic. Metric camera.	Usable PLS control 1:12,000-scale photos. Targeted corners. Short strip.	± 5 feet.
Compass	4" min. diameter staff compass and tape.	Angles to 1/4 degree. Slope taping.	Variable

It may not be necessary to use curve data to describe the easement. The easement may be a strip centered on the road if the road prism remains entirely within the strip. The surveyor should note outs and fills that may fall outside the easement strip and decide if extra width is necessary to protect the Government's interest in the road.

Photogrammetry also may be utilized to delineate an easement on an existing road. The photography should be obtained after the land survey corners are targeted and the necessary field control has been obtained. The points of intersection or angle points of the road are picked and their coordinate values are obtained by a photogrammetry consultant or a force account geometronics unit in the Regional Office. The bearing and lengths of the road tangents will be provided to the Forest for platting of the easement. This approach is usually most cost-effective on the long projects, those over 1 mile in length (see the section entitled "Photogrammetric Right-of-Way Surveys").

Raw Land Easements

Easements for new roads crossing private land must be obtained before the road may be built. The proposed location (P) line survey is the normal method of obtaining the information necessary to design the road. The information obtained during this survey also may serve to satisfy the right-of- way requirements.

Transit and chain or theodolite and electronic distance-measuring equipment should be used for this purpose. When the P line survey also will be used for right-of-way acquisition, it is necessary that the surveyor tie the minimum number of property corners to delineate the private property crossed. Improvements falling within the easement limits and evidence of occupation also should be tied into the route survey.

Photogrammetry also may be used to provide a right-of-way plat for raw land easements, When photogrammetry is used, it usually will be necessary to pretarget at least two, preferably more, of the survey points of intersection and all the requisite property corners before obtaining the photography. A control survey will be necessary. Fortunately, it often is possible to use the P line survey as the control survey.

When condemnation is a possibility, consultation with Regional Office Geometronics and Lands Staff should be initiated regarding the acceptability of a photogrammetric plat for a raw land condemnation case prior to gathering survey data.

Table 4 is a guide to assist in selecting a survey method for different representative land types.

MONUMENTATION of RIGHT-of-WAY SURVEYS

A perfectly legal right-of-way can be acquired by practically any method of surveying, if the boundaries of the tract are monumented and the monumentation is noted in the deed and on the plat. It is Forest Service policy (FSM 7155.03) to monument road and other improvement rights-of-way suitably. This is interpreted to mean that it is not necessary to monument all roads.

It is impractical to monument all easements being acquired at this time, but those that cross high- value land, where the exact location of the easement is important, should be monumented. The surveyor, in consultation with the Lands Staff, should decide which properties have high value or may become valuable in the near future. Monumentation then should be considered. There are two most common applications of monumentation:

1. Surveying the road by establishing a series of straight tangents and angle points. The monuments are offset on both sides of the angle points along the bisector of the angles formed by the tangents. No curve data are necessary.

2. Surveying the proposed location (P) line and office design of the location (L) line with monumentation of the edges of the desired tract. The monuments should be placed at all points of curvature (PCs), points of tangency (PTs), and at least every 1,000 feet on tangents, and at all changes in right-of-way widths. This method can be used on raw land or existing roads that are being redesigned.

Table 4.--Suggested survey methods and accuracy requirements for representative land types.

Land Type Example	Survey Method	Closure Ratio[a]	Maximum Positional Error[b]
Commerce and Business or any condemnation action.	Electronic Distance Measuring Device and 1-second theodolite (EDM)	1:10,000	±0.3 foot
Subdivided homesites	Electronic Distance Measuring Device and 1-second theodolite (EDM).	1:10,000	±0.3 foot
Patented mining	EDM or tape with 1-minute	1:5,000	±1 foot

claims	transit. Photogrammetry with ground control.		
H.E.S. or small private agricultural lands	EDM or tape with 1-minute transit. Photogrammetry with ground control.	1:4,000	±2 feet
Small private timberlands	Transit and tape or photogrammetry with ground control.	1:3,000	±3 feet
Forest industry timberlands with cooperative road use agreements	Staff compass and tape or photogrammetry with useable PIS control.	1:1,500	±5 feet
Nonmineralized rangeland	Staff compass and tape or photogrammetry with useable PLSS control.	1:1,500	±5 feet

[a]precision of measurements closed on same or higher order survey.
[b]Maximum difference between actual and theoretical position of easement.

PHOTOGRAMMETRI C RIGHTS-of-WAY SURVEYS

Survey measurements by photogrammetry offer a variety of rights-of-way problem solutions ranging from simple methods using available photos to complex methods involving pretargeting, new photography, electronic traverses, aerotriangulation, and data processing; or any combination of these necessary to produce the desired standards for the best plat.

Several aspects of photogrammetry, including the most commonly used techniques for producing right-of-way plats by photogrammetry, are discussed in the sections “Advantages of Photogrammetry Plats,” “Photo Identification,” “Photo Editing,” “Horizon Control Surveys for Photogrammetry,” and “Photogrammetric Survey Methods.”

Advantages of Photogrammetry

A plat prepared from aerial photography can portray a wealth of information, including natural, artificial, and cultural features, that is pertinent to a good plat. Many of these may be located beyond the limits of the usual route survey. For example, a one-fourth corner within 500 feet of the road may not be recoverable, but the section corners on either side may be recoverable and photo-identifiable. Thus, for a small investment in time compared to the amount that would be necessary to field tie both relatively remote section corners, the projected position of the one-fourth corner can be strengthened and the platted position of the property lines can be shown more accurately, Photogrammetry can show use or occupancy lines, such as fences, hedges, roads, trails, and other features, that are difficult to portray by other methods, Such information is invaluable in the negotiation procedure and as an aid to future retracement of the easement.

Photo Identification

Several methods of constructing photogrammetric plats utilize photo identification of property corners and control points on existing photos as the means of establishing the horizontal scale of the piat or as a means of positioning the corners in relationship to the road easement, Obviously, if the photo identification is not accurate, the results will be in error. Only precise photo identification should be used.

Approximations are useless. Property corners and control points are precise points on the surface of the Earth that seldom are visible on an aerial photograph, unless they happen to be marked by a natural or cultural feature, such as a fence corner. If they are, then it is a simple matter to identify them and describe the corner and fence corner as having the same position.

Most points will not be visible and must be tied by survey to an identifiable object that is visible on the photograph. The following procedures should be used for precise photo identification:

1. Locate at least one identifiable object (preferably two), such as a lone tree near the corner, to be identified.

2. Make the smallest pinhole possible in the face of the photo, centered in the object being identified.

3. Circle the pinhole on the back of the photo and note what object was pinholed (pinholed 10-inch diameter-at-breast-height fir).

4. Make a staff compass and tape tie from the object identified to the corner monument. For bearings on long ties--those over 200 feet--a transit tie based on a solar bearing should be used.

5. Give the bearing and distance from the corner monument to the object identified such as “image point bears N 45° H and 17.5 feet from corner.” The bearing can be from the image point to the monument, but whichever direction is measured should be definitely stated.

6. Identify the monument found, such as “monument is General Land Office brass cap 1917 for corner common to sections 1, 2, 11, and 12 of T. 11 N., R. 7. E., PM.”

7. Add photo identifier’s name and the date because they may be necessary for future needs.

If a corner cannot be identified accurately, its location should not be guessed. An inaccurate identification is more harmful than none! The general area can be circled and labeled as an approximate identification. No pinhole should be made in the photo because this is the identifying mark of a precise identification. The circle and notation may help someone recover the corner later.

Photo Editing

The photogrammetrist is aided by a careful edit of the area on the face of the photograph. Such features as powerlines, named drainages, residences, fences, and abandoned roads, pipelines, and other natural and cultural features should be labeled; they may be useful on the final plat. Photogrammetrists can compile any feature that is visible on the photography, but they can do it more effectively if they know what the feature is and that it is more important to the final product. Any information from the man on the ground is a definite aid to the production of a more complete plat.

Horizontal Control Surveys for Photogrammetry

Whenever plats or maps are constructed from aerial photographs, the horizontal scale of the photographs must be established by field survey measurements between identifiable points on the photographs.

The vertical scale also is desirable, but a satisfactory planimetric solution can be made by leveling photos to elevations picked from available maps or by leveling to drainage gradients. Horizontal scale can be established by several methods:

1. Identified public land survey corners on the photos with the distances and bearings shown on the original plats. The original Government land surveys were done by private contractors using rather crude methods and, consequently, the overall accuracy is low.

The later brass-cap surveys done by Government employees are better, but the required closures were still only one part in 452 for combined latitude and departure, If these orders of accuracy are sufficient, and if the survey is consistent, a very economical solution of horizontal scale is available. This method will place the easement in its relative position accurately, but linear measurements may be imprecise.

2. Short measured base lines between identifiable features on the photos with the bearings established by compass or solar observation. Three or more are preferable; however, there should be at least one in each photo “model” (the area of overlap between photos in a strip).

3. A closed traverse between several identifiable objects on the photography, preferably over the entire length of the proposed right-of-way. Transit and tape or electronic distance and theodolite angles should be used with closures commensurate with land values. Solar observations can provide a basis of bearing between two identified points on the photo.

4. Surveys performed by other agencies, such as highway agencies, the U.S. Geological Survey, the National Oceanic and Atmospheric Administration, or reliable surveys. Triangulation stations, set to first, second, or third orders of accuracy by Government agencies, can be used to close control traverses very economically by utilizing electronic measurements to connect the two surveys.

5. Long easements controlled by aerotriangulation. A minimum of five stations should be provided by triangulation or electronic distance measurements spread over the entire project. The intermediate control for individual photographic models can be “bridged” or aerotriangulated using a Zeiss C-8 stereoplanigraph, US-2, or comparable first-order photogrammetric equipment.

Photogrammetric Survey Methods

There are four basic methods of making right-of-way plats using photogrammetry:

1. Method 1, Over Existing Roads. A plat is made from existing medium-scale photos that show the road in question, using Pubic Land Survey System (PLSS) for horizontal control. This method normally makes use of resource photography. It is only suitable for short projects within one PLSS survey area. PLSS surveys of different townships or by different surveyors will seldom join together with any usable accuracy. It is best confined to single-section projects. Proceed as follows:

a. Definitely determine that the road in question is on the existing photos and, by ink or other method, mark the road on the photo face so the photogrammetrist will have no doubt as to the road to be platted.

b. In the field, identify as many PLSS or other property corners as possible, making necessary survey ties to photo-identifiable objects, noting them on the back of the photos.

c. Submit photos and other data to the Regional Office Geometronics Group or a photogrammetric consultant and ask to have a manuscript compiled at a fairly large scale (200 or 300 feet per inch). They will provide coordinates for each identified land survey corner based on an arbitrarily chosen point with one PLSS line chosen for a bearing basis. They also will select photo-identification points or angle points along the road centerline and furnish coordinate values for them from which a centerline description of the road may be written.

d. When the manuscript and coordinate listing are returned to the Forest, a plat may be constructed by overlaying the manuscript with drafting medium and copying the pertinent details. Property lines, scaled or computed ties, and other information can be added.

2. <u>Method 2, Over Existing Roads</u>. A plat is made using new project photography for roads that do not appear on any existing photography, with PLSS survey for horizontal control. The same limitations and procedures apply as in method 1, except that land survey and property corners are premarked with targets prior to photography. Proceed as follows:

a. Make arrangements for aerial photogrammetry.

b. Premark the necessary corners with a suitable target. Offset targets are permissible, but careful measurements between target and corner should be made; and accurate, understandable field notes should be prepared. Reference all targets for later recovery.

c. Notify the Staff Engineer of the Geometronics Group by telephone that the project is ready for photography. Continue to monitor the situation and be prepared to maintain the targets until photography has been flown.

d. When the new photography is returned to the Forest, locate the route and identify all targets on the photography.

e. Submit the field notes, landownership, and photos to the Geometronics Group for photogrammetry and manuscript compilation as outlined in method 1.

f. Compile the plat as outlined under method 1.

3. <u>Method 3, Over Existing Roads</u>. A plat is prepared using new project photography and field control surveys for horizontal control. This method is used for long projects and for projects that require medium to high accuracy. Proceed as follows:

a. Follow the same procedure for requesting aerial photography as outlined in method 2a.

b. Select and target control points during corner targeting operations. The minimum number of horizontal and vertical control points for a strip of photography is shown in figure 2. When properly located within the strip, PLS corners may be targeted and may serve as both section control and horizontal control points.

c. Notify the Staff Engineer of the Geometronics Group that the project is ready for photography. Continue to monitor the situation and be prepared to maintain the targets until photography has been flown.

d. When new photography is returned to the Forest, locate the route and identify all targets on the photography.

e. Measure a closed traverse between targeted control points. Record horizontal and vertical angles, the height of the instrument above ground, the height above ground of objects that were observed for vertical angles, and the station name at each control station. Record the slope distance between stations. Electronic distance measuring equipment and a theodolite reading directly to 1 second of arc are necessary to achieve the desired precision. Each horizontal and vertical angle must be read in both the direct and inverted position of the telescope at least two times, Each set of angles must be within 5 seconds of the other or they should be rejected and remeasured, Electronic distance measuring instruments should be read to the hundredth of a foot and at least two measurements should be taken to check for blunders.

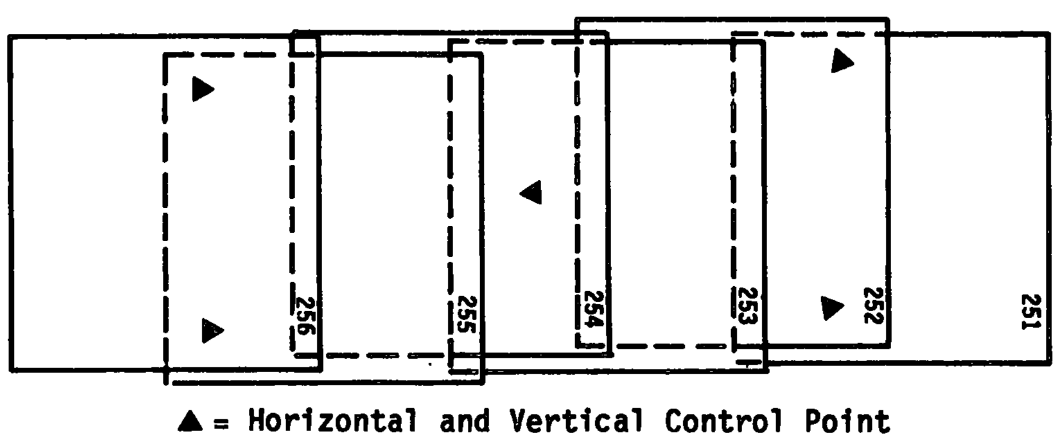


Figure 2.--Minimum number of horizontal and vertical control points for a strip of photography.

f. Compute X, Y, and Z coordinates of each control target and prepare a listing of coordinates. Assign a name or number to each control target and ink this information on the back of the photographs. State the origin of the coordinate system and the basis bearings used, such as “local coordinate station with station 2819 assigned X = 10,000, Y = 5,000, Z = 3,000. Bearing basis is compass bearing of N. 13°30’ E. from station 2819 to station 2820.”

g. Submit the field notes, computations, landownership, and photos to the Geometronics Group for photogrammetry and plan compilation as outlined in method 1.

h. Complete the plat as outlined under method 1 when it is returned.

4. Method 4, Over Raw Land Using New Strip Photography. Several PIs along the P line should be targeted prior to photography. The PLS corners necessary to delineate the private ownership being crossed should be searched and targeted. Horizontal control for the strip of photography will be necessary. Follow the instructions outlined in method 3 for locating and surveying control, It may be possible to use all or part of the P line survey as horizontal control.

Targeting a few P line stations, the public land survey corners, and the control stations permits the photogrammetrist to place them all on a common coordinate base. Figure 3 illustrates a typical situation of this type. The result is a precise drawing of the P line survey in proper relation to the surrounding ownership lines. The coordinates of all targeted points will be supplied to the Forest and also, if desired, a precise planimetric map or plat of the area, Of course, the road will not be on the map, as it did not exist when the photography was obtained. The L line can be plotted on this base map by the Forest, along with the right-of-way limits.

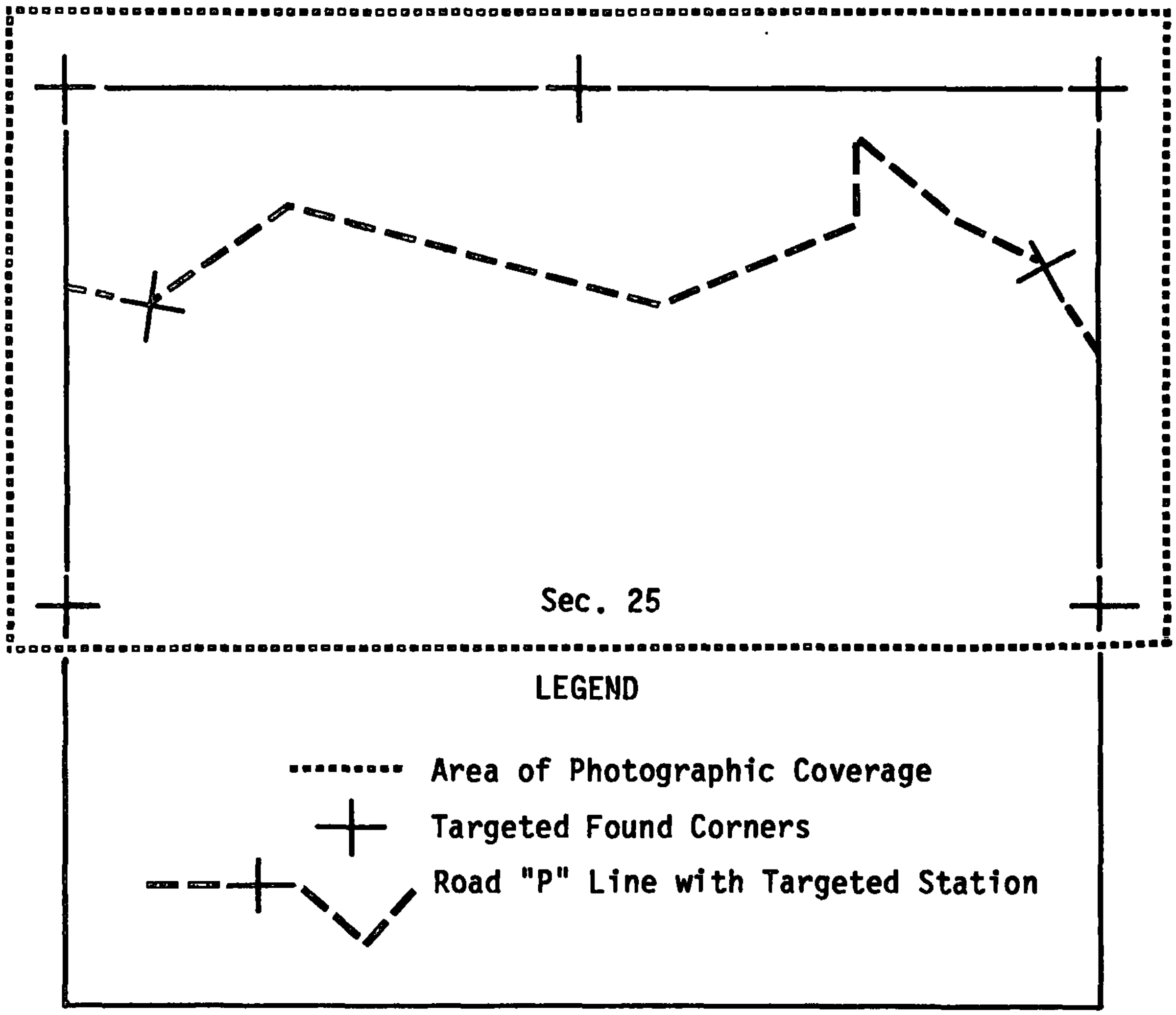


Figure 3.--Targeted P line stations on a common coordinate base.

Cadastral Surveys

Occasionally it will be necessary to legally subdivide a section or retrace a property boundary to ensure that the parcels crossed by the road are the actual parcels shown on the plat. Cadastral surveys should only be performed by State-licensed land surveyors or the Bureau of Land Management when public domain land is involved. Cadastral surveys may be done by licensed surveyors who are employees of the Forest Service or under contract. The subject of requests for cadastral surveys by the Bureau of Land Management is detailed in the Forest Service Manual and in Regional supplements. When acquiring rights-of-way across small valuable tracts surrounded by land in Federal ownership, such as Homestead Entry Surveys and Mineral Surveys, it is often advantageous to solve both the easement and boundary problems simultaneously by means of a complete cadastral survey. The missing property corners and monuments delineating the easement can be set, and plate showing both can be prepared. By using this procedure, many future administrative problems can be avoided.

PLATTING EASEMENTS

Purposes of Survey Plat

The following are purposes of the survey plat:

1. To represent the correct size and shape of a property to scale.

2. To define by dimensions the correct size and shape of a parcel of land.

3. To specify locative points (physical monuments, including cultural features).

4. To show title identity (record monuments).

The essential difference between a map and a plat is that a plat has dimensional data (bearings and distances) shown on most lines, while a map relies on scale for distance and direction.

Orthophoto Plats

Excellent right-of-way plats can be constructed on orthophoto bases. The four purposes of a plat mentioned earlier can be served by orthophoto plats. Obviously, these plate present a superior method of showing the relative position of features, Dimensions and record monuments of adjoiners can be overlayed on the orthophoto. Since the scale of the photo is constant, the correct size and shape of the properties traversed by the right-of-way can be shown. The right-of-way limits can be drawn in ink to illustrate the exact route. This type plat has great appeal to landowners because it is easily read and can be quickly related to surrounding property and improvements. The disadvantages of orthophoto plats are that they cannot be reproduced easily, some counties are reluctant to file them, and they may not microfilm well.

For detailed information on orthophoto production and cost, contact the Geometronics Group.

Plat Contents

Size.
Plat shall be a size that meets the requirements established by State or county statute. Letter size and line weight used by the drafter shall be large enough to withstand a reduction to letter size and remain legible. This will enable reductions to be used for file and work copies.

Scale

The scale of plate will vary. The objective in choosing a scale should be to show the true shape and size of property acquired for the easement in relation to the parent property. Locative and dimensional data should be legible and unambiguous at the scale chosen. Scaling angles or lengths of lines normally should not be necessary on a properly prepared plat. A scale bar and fractional scale shall be included on each sheet. Scales shall not be expressed in feet per inch because the relation will be destroyed on reduced plate.

Direction

By convention, maps and plate of real property usually show north direction to the top of the sheet. Road stationing may, therefore, proceed in any direction (right to left or left to right) depending on the project. The convention used on Federal-aid sheets of increasing stations from left to right does not necessarily apply to right-of-way plats. The basis of bearing used for lines on the plat should always be stated. North as determined by a staff compass is permissible if a specific line is chosen as a bearing base, stated on the plat, and assigned a bearing from staff compass observation along that line. For compass surveys, the declination shall be shown. If grid bearings based on one of the plane coordinate systems are used, the zone must be shown clearly and the mapping angle and direction left or right of astronomic north shown. A north arrow always should be included on every sheet.

Angles and bearings shown on the plat should be consistent with the accuracy obtained and the least count of the vernier or micrometer on the instrument used to measure them.

Distance.

Measured or computed distances should be shown in feet or meters to the appropriate number of significant places indicated by the field measurements. See standard textbooks on mathematics or surveying for an understanding of significant figures.

Public Land Survey System record units that are chains or feet should not be converted to equivalent feet or metric units for display on the plat.

Dimensions should be indicated as “Record,” “Measured,” or “Computed.”

Acreage

The acreage of the land occupied by the easement should be shown clearly for each ownership.

The number of significant figures shown for acreages should be consistent with the precision of the lengths of lines and angles shown on the plat. Normally, if lines are measured to a hundredth of a foot and angles to 30 seconds, acreage may be shown to three decimal places.

Small parcels severed by the easement from the remaining unencumbered land may need a separate acreage figure shown. This situation may be handled on a case-by-case basis to suit the needs of lands in acquiring the needed easement.

Title and Approval Block

Each sheet of the plat should have a title block that should contain the f 01 lowing;

1. U.S. Department of Agriculture, Forest Service.

2. Region and Forest.

3. Right-of-way plat.

4. Name and number of project.

5. Location of project by section, township, range, and meridian, or other acceptable system in non-Public Land Survey System States.

6. State and county or other local government unit.

7. Date of plat.

8. Date of survey.

9. Approval block for Forest Engineer’s signature.

10. Approval block for registered land surveyorus signature (FSM 7154.41).

11. Name of surveyor.

12. Sheet number and number of total sheets in project.

Legend

Each plat should contain a legend showing the following:

1. The meaning of symbols used to depict corners, roads, buildings, trails, streams, fences, and so forth.

2. Shading or hatching symbols used to show the easement area.

3. Line weight and style used to show road centerline, right-of-way limits, section lines, one-fourth-section lines, and so forth.

4. The photo symbols and place of filing, if done photogrammetrically.

Ownership

The name of each grantor should appear on each parcel or one-fourth section or Government lot exactly as it will appear on the deed. Ownership names should be checked against preliminary title insurance policy to ensure that they are correctly stated. Lands administered by the Forest Service should be labeled by their correct National Forest (or Grassland) name, or as National Forest System lands (NFSL) elsewhere. National Park Service and Fish and Wildlife Service lands should be named. Lands administered by the Bureau of Land Management should be labeled “U.S. Public Land.”

Vicinity Map

The first page of multiple page plate may contain a vicinity map showing the coverage of each sheet; the overlap between sheets, if any; and the relationship of the grantor’s land to surrounding lands, towns, cities, highways, and so forth. The use of a separate title sheet should be avoided.

Legal Description

Most plate will not require a written legal description on the face of the plat. The language used in the deed refers to the plat and the plat becomes part of the deed. In some instances, a written description of the parcel to be granted is needed. In those cases, the legal description of the road centerline should be added to the face of the plat.

Additional Information

The following is some additional information that is useful on easement plate:

1. An explanatory note detailing the survey methods and instrumentation used to perform the survey.

2. A note explaining where field notes, computations, and photography for the project are filed.

3. An estimate of the positional accuracy of features shown on plat. The estimate should be based on the precision obtained by angle and distance measurements, together with other factors that degrade that precision. The following are some of these factors:

a. Precision of starting bearing and basis of bearing.

b. Closure of traverses.

c. Accuracy of photogrammetric measurements.

4. Items added to clarify intent such as “adjoins existing county right-of-way.”

Protraction and Projection

The terms “protraction” and “projection” often are used interchangeably. For the purposes of this guide, they should be considered to have different meanings, as defined here:

1. Protraction

Protraction is the portrayal of the subdivisional lines of a section that have not been surveyed and monumented in the field. They are properly and legally located in the plat in accordance with the official record and the rules for survey of the public lands, Examples are one-fourth lines, one-sixteenth lines, and Government lot lines. The legal presumption is that when these lines are established by a field survey, they will be located as shown on the plat.

To properly protract subdivisional lines on a plat, it is necessary to start from the correct controlling corners, such as one-fourth corners, section corners, or township corners. These corners must exist on the ground and must be located by a reliable survey. The next step is to locate the intervening corner positions properly between controlling corners and connect them with straight lines. This must be done by using the proper proportion ascertained from the original PLS record. See sections 3-77 through 3-84 of the “Manual of Surveying Instructions,” 1973 edition, for the proper protraction of one-sixteenth lines and lot lines. Also, see the Bureau of Land Management pamphlet on restoration of lost corners and subdivision of sections.

Surveyed lines may never be protracted. The position of the corners and lines, once they have been established on the ground, are fixed forever by law. If a surveyed line is a property line where ownership changes and the easement crosses that line, it is necessary to locate the actual position of that line on the ground. It is useless to protract such lines because the law states that the true line is the line that exists on the ground--not the line shown in the plat.

2. Projection

When the survey corners that define property lines that need to be located for easement plate have been destroyed or cannot be located, it may be necessary to project their location. Such projections are little more than an educated guess because they will be changed if the corner is located, It is often necessary to project corners because the cost of reestablishing them is excessive for easement purposes. Such lines should be labeled “projected” to indicate their uncertainty.

When corners are approximately located in order to project lines, it is necessary to use the best location that can be developed from the evidence at hand. This may involve single or double proportionate measurement between nearby found monuments. See sections 5-1 through 5-42 of the Bureau of Land Management Manual for instructions in locating lost or obliterated corners. Follow section 44 of that manual when calculating the position of a lost mineral survey or homestead entry survey corner.

Checklist for Plats

All right-of-way plats shall be checked for accuracy and completeness and signed by the Forest Engineer. The check should be made by the person with overall Forest responsibility for surveying and platting easements. A sample plat is shown in figure 4 and a sample checklist is shown in figure 5.

LEGAL DESCRIPTIONS of EASEMENTS

Where written legal descriptions are required, such as for schedule A in condemnation cases, they should be prepared by the surveyor. The scrivener must ensure that the legal description is unambiguous and that there is complete agreement between the plat and the description. It should be as simple and straightforward as possible. The normal practice is to prepare the written description from the plat.

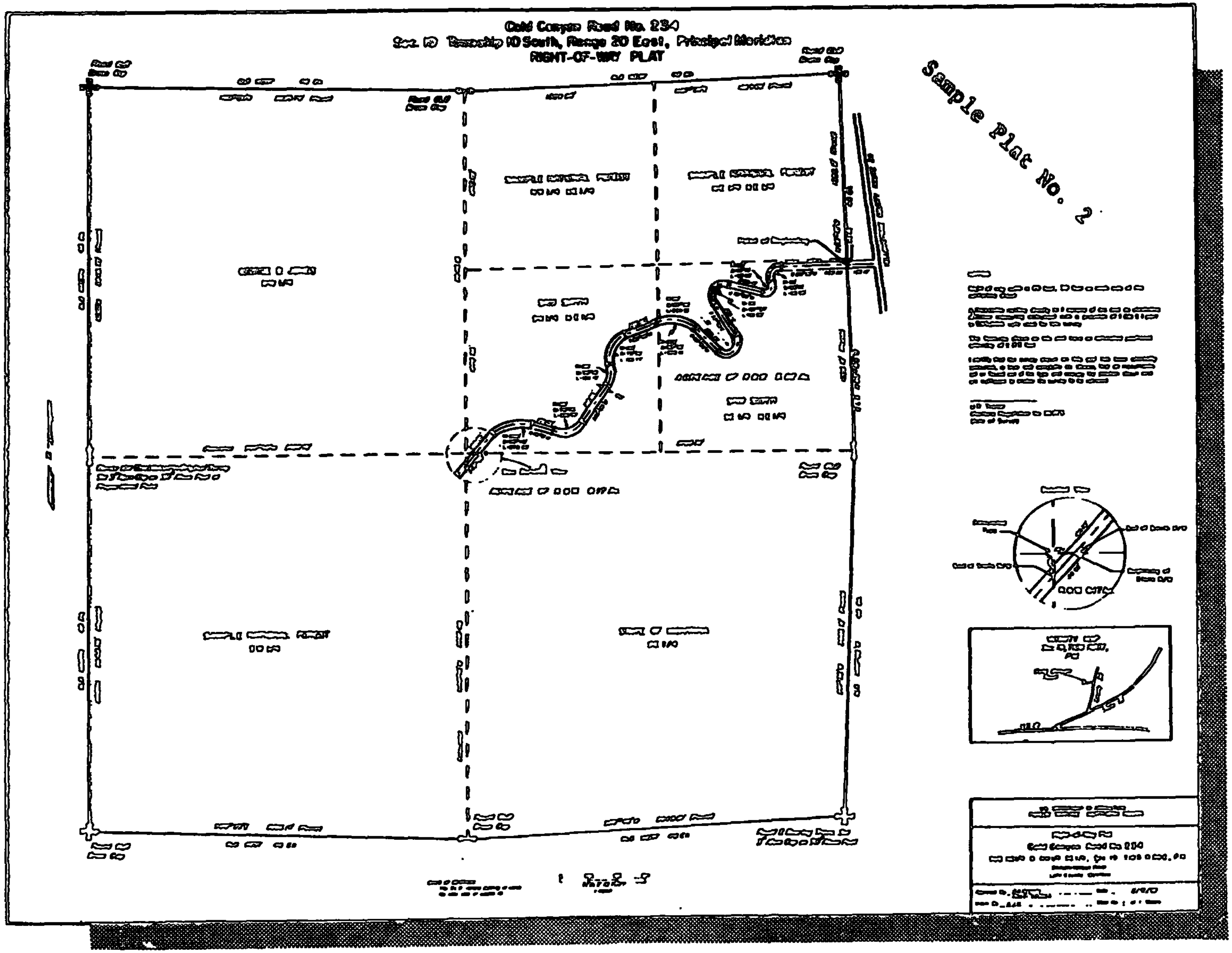


Figure 4.--Sample plat.

USDA - FOREST SERVICE

RIGHT-OF-WAY CHECKLIST

Project ______________________________ Number __________
Ownership (optional): ______________________________
INSTRUCTIONS: Use this form as an aid in preparation and checking of right-of-way plats. All questions should be answered by placing an "X" in the box, or if the question is not applicable, indicate by drawing a line through the box.

1. Is the following information shown in the title block of the plat?

   A. U.S. Department of Agriculture
   B. Forest Service
   C. _________ Region
   D. Name of Forest
   E. Right-of-way plat
   F. Description of land crossed
   G. Name of county
   H. Name of State
   I. Name and number of project
   J. Name of surveyor
   K. Date of survey
   L. Scale of plat (Use bar scale)
   M. Date of plat

   ☐ YES

2. If there is more than one sheet, is there an index map showing the relation of the right-of-way to the four corners and PLS subdivisions, mineral survey, or homestead entry survey? Is each sheet numbered? ☐ YES

3. Is a north arrow shown on each sheet of the plat? ☐ YES

4. Is the origin of bearing shown? ☐ YES

5. Has the survey been closed? ☐ YES

6. Are the legal corners labeled as found and tied or, if not found, as projected? Are the found corners adequately described? ☐ YES

7. Are the property lines marked projected where corners are not found, or if one corner along a line is found? ☐ YES

8. Are the property lines correctly labeled with PLS record bearings and distances in record dimensions, and found Forest Service bearings and distances? ☐ YES

Figure 5.--Sample right-of-way checklist.

9. Are all pertinent occupancy lines including existing right-of-way lines correctly labeled? ☐ YES

10. Is the number of corner ties shown commensurate with the value of the land and ROW improvement? ☐ YES

11. Are ties to found corners shown and properly labeled at each change of ownership? ☐ YES

12. Is the station and the bearing of the tangent to the P.O.C. shown where there is a change of ownership on a curve? ☐ YES

13. Are the L and P lines properly labeled? ☐ YES

14. Are existing natural monuments and cultural improvements shown, with ties when appropriate? ☐ YES

15. Are appropriate subdivisions and/or Government lots shown and correctly labeled? ☐ YES

16. Are the full names of the property owners shown on all subdivisions and other parcels of land crossed or closely approached by the right-of-way? Are corporate landowner's names legally correct? ☐ YES

17. Is the right-of-way width dimensioned on each sheet and at each change of width, and do the dimensions tie the right-of-way to the centerline? ☐ YES

18. Is the right-of-way acreage properly shown? ☐ YES

19. Have all survey data and survey computations been checked? ☐ YES

20. Has all plotting been checked? ☐ YES

21. Is the ROW plat approved and sealed by an RLS of the jurisdiction? ☐ YES

22. Is the ROW plat approved by the Forest Engineer? ☐ YES

Figure 5. (cont.)--Sample right-of-way checklist.

23. Has the plat been checked for copying errors and omissions; have all bearings and distances been checked with protractor and scale? ☐ YES

24. Is the plat legible, neat, and can it be readily folded to 8½- x 11-inch size for filing? Have you considered reducing the plat photographically to letter size? ☐ YES

CHECKED BY:	APPROVED BY:
Signature________________	Signature________________
Date________________	Date________________

Figure 5. (cont.)--Sample right-of-way checklist.

The use of road stationing should not be used in writing legal descriptions because the normal practice in the Forest Service is not to monument road stationing, and it becomes impossible to retrace stationing that is not recoverable. Legal descriptions should begin on a public land survey corner that was recovered and tied to the road survey.

Written descriptions should always be preceded by the “caption limit” that locates the easement and establishes its gross bounds. They should likewise always be followed by modifying, explanatory, and clarifying statements, such as “bearing basis,” “acreage,” and “side line treatment,” Strip, perimeter, or parcel descriptions may be used as appropriate. They may be in narrative or chart form. Examples follow:

1. Narrative Form - Strip of Uniform Width.

A strip of land, 66 feet wide, 33 feet on each side of the following described line, in sec. 35, T. 7 N., R. 15 B., P.M.:

Beginning at a point on the east line of sec. 35 which is S. 01° 03’ W. along the section line 909.1 feet from the NE corner of said section;

Thence S. 81° 4V W., 22.5 feet;

Thence along a curve to the left with a radius of 100 feet, through an angle of 65° 06’, a distance of 113.6 feet;

Thence N. 33° 07’ W., 105.9 feet;

Thence . . . , etc.;

Thence S. 88° 22’ W., 397.0 feet to the west line of the NE NE , sec. 35, said point is 1,328.6 feet west and 386.5 feet south of the NE corner, sec. 35.

The boundary lines of said easement shall be prolonged or shortened to begin or end on and conform to grantor’s property lines.

Contains _______ acres.

Bearing basis is the record bearing of the east line of sec. 35.

2. Chart Form - Strip of Variable Width

A strip of land of variable width on each side of the following described line in sec. 35, T. 7 N., R. 15 E., P.M.:

Beginning at a point on the east line of sec. 35 which is S. 01° 03′ W. along the section line 909.1 feet from the NE corner of said Section; thence along the following courses and distances:

Bearing	Tangent Distance In feet	Curve L-R	Central Angle	Radius in feet	Arc Distance in feet	Width of R/W from C/L R --- L
S. 81° 47′ W.	22.5					33 --- 33
		R	65° 06′	100	113.6	47 --- 33
N. 33° 07′ W.		105.9			.	33 --- 44
		L	09° 00′	400	62.9	33 --- 33
N. 42° 07′ W.		142.5				33 --- 33
		L	79° 46′		139.2	41 --- 33

3. Narrative Form - Perimeter Easements. (Note: This can be used for small corners, slivers, or awkwardly shaped easements.)

A parcel of land in the NE sec. 35, T. 7 N., R. 15 E., P.M.:

Beginning at the NE corner of sec. 35;

Thence south along the section line 19 feet;

Thence N. 38° 16′ W. to the north line of said Section;

Thence east along the section line to the, point of beginning. Contains _____ acres, etc.

MONUMENTATION

These instructions apply to corner monuments set as a result of an official land survey. This includes monumentation of new corners, lost corners reestablished, and recovered corners found in disrepair and in need of remonumentation.

The following are excerpts from chapter IV of the 1973 Bureau of Land Management “Manual of Surveying Instructions”:

The monumentation is intended to establish a permanent marking of the lines and to fix the corner positions so that the location of the surveyed lands may always be definitely known.

The law provides that the original corners established during the process of the survey shall forever remain fixed in position, even disregarding technical errors which may have passed undetected before acceptance of the survey.

The courts attach major importance to evidence relating to the original position of the corner, such evidence being given far greater weight than the record relating to bearings and lengths of lines. The corner monument is direct evidence of the position of the corner.

Forest Service land survey corner monuments must be made of durable material, be uniform in design, and be set in a way that ensures permanence of location.

Corner monuments will be made of proper material and adequately installed so they can reasonably be expected to endure, unless disturbed by acts of man, flood, or shifting of the earth.

Adverse conditions, such as swamp, alkaline soils, salts, saltwater marshes, blow sand, and steep slopes may exist at the corner points and will require special measures for monumenting the corner or use of special corner materials to ensure that the corner monument will endure. Materials and methods used at these problem corner locations will be designed to meet the needs imposed by these conditions.

Reducing quality of corner-monument material, design of the monument, or workmanship in setting the monument is inexcusable. It causes excessive maintenance cost and requires the time and expense of premature replacement. It could result in complete loss of the corner location, thereby requiring survey costs for corner relocation. Loss of survey monuments often leads to controversy with adjoining landowners concerning the location of the property lines controlled by the corners.

MONUMENT SPECIFICATIONS

Corners monumented by or in cooperation with the Bureau of Land Management will be monumented with the official BLM monument. Corner monuments installed under State land-survey authority are to meet the requirements established by applicable State or local law where such requirement exists, but in no case will they be of less quality than those described here.

Depending on local custom, the cap or top of the monument may have a U.S. Forest Service logo cast into the tablet or cap to identify the monument as being set as a result of a Forest Service activity. This is the generally accepted monument throughout the Western Regions; the Eastern Regions prefer to use monuments without the Forest Service logo. Reinforcing bars, reinforcing bars with plastic caps, iron pipes, copper rods, galvanized pipe with a plumber’s cap, and automobile axles are examples of unacceptable monuments for property corners.

Corner monuments installed by the Forest Service either under force account or by contract will conform to one of the monuments described in the sections entitled, “Dug-In Monuments,” “Corner Trees,” and “Tablets and Driven Monuments,” depending on which best meets the needs created by conditions at the corner location. If conditions at the corner require even more durable monuments than those described here, suitable monuments that will meet the need will be designed and used.

Dug-In Monuments

These monuments will be set in a predug hole that is backfilled and compacted.

Brass-Capped Iron Pipe

This monument will be a galvanized iron pipe with a 2-inch inside diameter not less than 30 inches long, with a brass cap no less than 2½ inches in diameter solidly and permanently attached to the top. The brass cap will fit tightly over the iron pipe and will be secured in position with a substantial rivet extending completely through both the cap and the pipe, a solid-metal weld, threading, a combination of these, or a stemmed brass tablet with the pipe filled with concrete, Use of undersized pipe (either in diameter or length), inferior material, attaching the cap to the pipe with glue or epoxy resin is not acceptable. The bottom of the pipe will end in a 5-inch flange, flared or 5-inch square footplate firmly attached to anchor the monument in the ground when it is set. Durability of this monument can be increased by filling the pipe with properly mixed Portland cement. Under certain conditions, it may be permissible to substitute the brass cap with the stem-type brass tablet secured by a double wire the length of the pipe passing through a hole drilled through the stem of the tablet. The wire is twisted together its entire length and the monument is filled with concrete. However, this is considered inferior to the cap that fits over the pipe and is secured as described.

Precast Concrete

Precast concrete monuments will be no less than 36 inches long. If round, they will be at least 6 inches in diameter. If square in cross-section, they will be at least 5 by 5 inches. They will be reinforced with at least two number three steel reinforcing bars. Brass tablets will be properly embedded in the top of the concrete posts. The twisted wire technique mentioned previously will also assist in securing the tablet to the concrete post.

Aluminum

Manufactured aluminum monuments of various lengths and styles are now available on the open market. Those aluminum monuments have a magnetic capsule and can be purchased with a plain or logo cap. The cap will conform to the standards in the section entitled “Brass or

Aluminum Tablets”. The monument pipe will be of 6063-T6 aluminum alloy or equal, schedule 10, not less than 2 inches outside diameter, at least 30 inches long, solidly and permanently attached to the cap. The cap will fit tightly over the tube and be affixed with a single rivet completely through both tube walls or by a solid weld. The bottom of the tube will end in a 5-inch flange, flare, or a 5-inch-square footplate.

Aluminum monuments should not be used in salt marshes or in highly acidic or alkaline soils.

Corner Trees

Trees sometimes are used as land corners or are found to occupy the exact location of the corner position. When this occurs, the tree should be marked with identifying marks and a “witness corner” monument set at some convenient place close to the corner tree. It is difficult to determine the exact point for the corner when a tree occupies the point. Traverses through the corner usually are impossible so the witness corner or reference monument must be used instead.

Tablets & Driven Monuments

Brass or Aluminum Tablets

The tablet will be 3 inches in diameter with a stem inch in cross-section and 3 inches long. This tablet may be used as the corner monument when a rock outcrop prevents satisfactory setting of the iron pipe or concrete post monument. The stem will be set in a drill hole in the rock and secured in position with cement grout. These tablets may also be set in the top of concrete monuments. Aluminum tablets will be ALMAG 35, Alloy 535.0, or equal.

Driven Monuments

To conserve time and expense, driveable monuments may be used in lieu of the standard Forest Service-approved dug-in monument for one-sixteenth and lower order property corners. The monument must meet the following specifications:

1. 3-1/4-inch minimum diameter cap.

2. 3/4-inch minimum diameter rod.

3. When rod and cap are fabricated from nonmagnetic metals, the design must include a magnetic capsule.

5. A fin or series of fins or barbs are required on the rod to provide an anchor for the monument.

6. Minimum overall length of 24 inches.

Driveable monuments will be used in all cases where soil conditions will permit a reasonably secure installation. Rods driven to refusal may be cut off and capped, provided there is a minimum penetration of 12 inches. To prevent displacement or removal, caps shall be installed flush with the surface.

Line Marker Monuments

Monuments to preserve the location of property lines in addition to or in place of line posts and line trees are useful. This is true especially in areas that are esthetically sensitive or where posts are liable to destruction or removal. A line marker will be a metal marker with a minimum diameter of 1/2 inch and a minimum length of 18 inches. They shall be magnetic or have a magnetic capsule implanted in the monument or cap. The cap must be a minimum diameter of 1 inch and shall be stamped “Line Marker.”

SETTING MONUMENTS

Pipe or concrete monuments will be set in holes dug for that purpose. The best protection to the monument is afforded when no more than 4 to 6 inches of the top of the monument extend above the ground. However, this is not always possible.

If at all practical, rock should be packed on the monument flange and in the hole around the corner monument along with soil to help hold the monument firmly in place. A protective collar and mound of rock should be built around the monument above ground. If rock has to be “imported” for this purpose, its use is all the more effective because of being the only rock in the vicinity. The stone mound surrounding the corner monument will be improved by first digging a circular trench 6 to 8 inches deep for an outer ring, placing the larger stones in the trench, and building the stone mound within and upon the foundation thus formed. When adverse or unusual site conditions exist, special methods of installing the monument to ensure permanence of location will be devised and used. Conditions that may destroy metal monuments, such as soil acidity, must be ascertained in. advance so monuments can be obtained and used that will withstand these conditions. Durable material, such as broken glass and pottery, can often be used to advantage by placing substantial amounts in and around the monument as it is being set. If duly recorded in the survey notes, recovery of this material will help prove the corner-point location even though the monument may have disappeared.

In areas of heavy public use, it often is desirable to pour a substantial amount of concrete or concrete and rock around the corner monument to prevent its dislocation and removal. The hole in which the monument is being set should be enlarged at the bottom to accommodate the extra material.

Corners set by or in cooperation with the Bureau of Land Management will be set to specifications of that agency. Under the Bureau of Land Management Forest Service cooperative remonumentation program, the Forest Service provides labor, transportation, and any additional material such as concrete and extra rock needed to provide extra permanence to the corners installed. Action needed to provide extra permanence in addition to those measures normally used by the Bureau of Land Management is a Forest Service responsibility. Most Bureau of Land Management surveyors want to attain permanence for corners installed and will cooperate fully in extra measures needed. The Forest Service should manage these additional measures so as not to delay the corner monumentation progress unduly.

When a tablet is used in solid-rock outcrop, a hole will be drilled and the stem solidly anchored in the hole with cement grout of high quality. Premixed grout is available in dry form. Sulfur also can be used for this purpose (see the section entitled “Brass or Aluminum Tablets”).

In remonumentation of existing corners, if an old monument is being replaced with a new one, such as substituting an iron pipe for an old marked stone, the stone should be placed in the hole alongside the new iron-pipe corner monument that replaces it. The stone should be set below ground level to avoid any uncertainty as to whether the new corner post or the old rock monument now marks the true corner point location. An old post can be buried or placed on the ground beside the monument. If the stone is large and unmovable, drill a tablet into the existing rock.

MONUMENT MARKING

Letters and figures pertinent to the survey or monument location will be stamped with steel dies into the cap or tablet at the time the monument is set. Approximately 1/8-inch- to 3/16-inch-high letters will be used. Data to be stamped on the monument will be such items as tract and corner number; township, range, and section numbers; date of monumentation; and registration number of the surveyor executing the survey or remonumentation.

Monuments in areas covered by the public land survey system will be placed to be read while facing north. Monuments placed in areas covered by the metes-and-bounds survey system may be stamped to be read from Government land.

Monument Stamping Format

Rectangular Survey System

The Bureau of Land Management Manual of Surveying instructions of 1973 contains detailed information in sections 4-20 through 4-46 for stamping monuments.

In addition, the Forest Service requires the State registration number of the surveyor setting the monument to be stamped below the date on the cap.

The stamping shall include a center punch hole or angle point or cross to indicate the exact instrument station.

Metes-and-Bounds Survey System

1. Colonial Corner. The colonial States National Forest land corner identification system consists of Forest Service tract numbers and corner numbers. Any given corner may be a corner to more than one tract. The stamping will include the tract number and the corner number and show the general direction of the National Forest property line, If the corner is common to more than one tract, the additional tract and corner numbers will be shown.

2. Homestead Entry Survey Corner. The Homestead Entry Survey (HES) corner is a land corner within the Public Land Survey System. The HES number and the corner number are stamped on the monument, as shown in figure 6.

3. Mineral Survey Corner. The Mineral Survey (MS) corner is stamped the same as an HES corner (see figure 7).

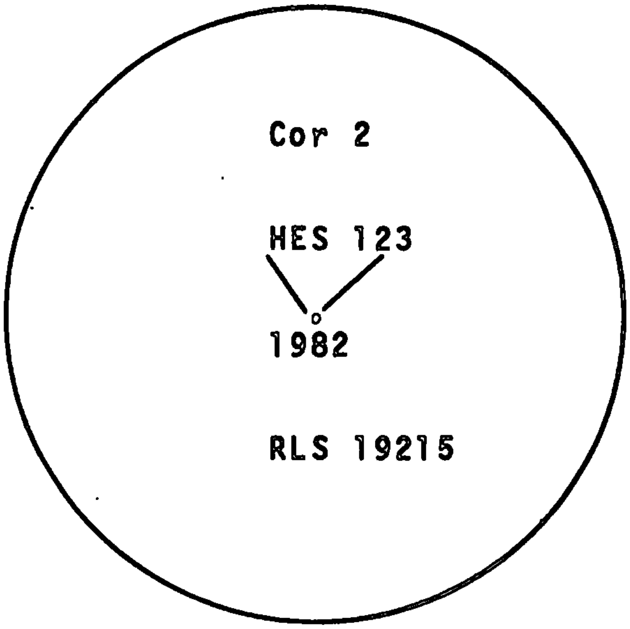


Figure 6.--Example Homestead Entry Survey corner.

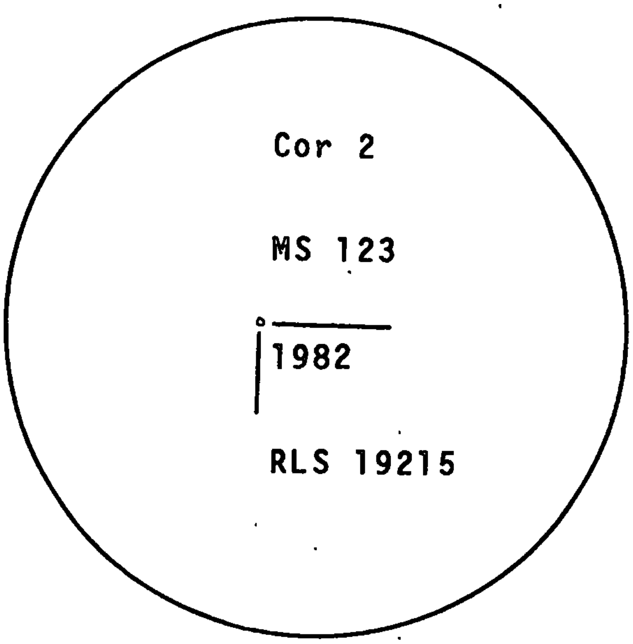


Figure 7.--Example Mineral Survey corner.

CORNER ACCESSORIES

Accessories to corner monuments are physical objects adjacent to corners to which the corner position is referred for their future identification or restoration without the need for a resurvey. Thus, if the monument is destroyed or removed, its position may be restored by referance to the accessories. Two accessories should be established for each corner, if possible. A full description of each accessory should be given in the field notes, including an exact direction and horizontal distance from the corner monument to the accessory. Accessories include bearing trees, posts, auxiliary monuments, mounds, pits, ledges, rocks, and other natural features to which the distance and direction from the corner monument are known. Such accessories are actually a part of the monument.

Auxiliary Monuments

Witness Corner

(See also Bureau of Land Management Manual of Instructions, section 4-15.) A witness corner is a monument usually placed on a survey line near a corner. It is established only when it is impracticable to occupy the site of the true corner.

When the true point for a corner falls at an inaccessible place, such as within an unmeandered stream, lake, pond, or marsh, or upon a precipitous slope or cliff where the corner cannot be occupied, a witness corner is established at some suitable point on the property line where the monument may be constructed permanently.

Usually only one witness corner is established. The field notes should show the relationship of the witness corner to the true corner position.

1. Rectangular Survey System. Stamping of a witness corner is arranged in t e same manner as a regular corner with the addition of the letters “WC” on the north (see figure 8).

2. Metes-and-Bounds Survey System. Stamping of a witness corner is arrange to show the identity of the corner by corner number and tract number and how to proceed to the exact true corner location (see figure 9).

Reference Monument

(See also Bureau of Land Management Manual of Instructions, section 4-16.) A reference monument is an accessory monument that is set at some convenient location and is employed in situations where the site of the corner is such that a regular permanent monument cannot be established or where the corner monument would be liable to destruction and where bearing trees or other bearing objects are not available. Reference monuments may be used when the corner falls in roads, streams, cliffs, talus slopes, trees, and buildings. Reference monuments are described with the accessories to the corner in the field notes and plate.

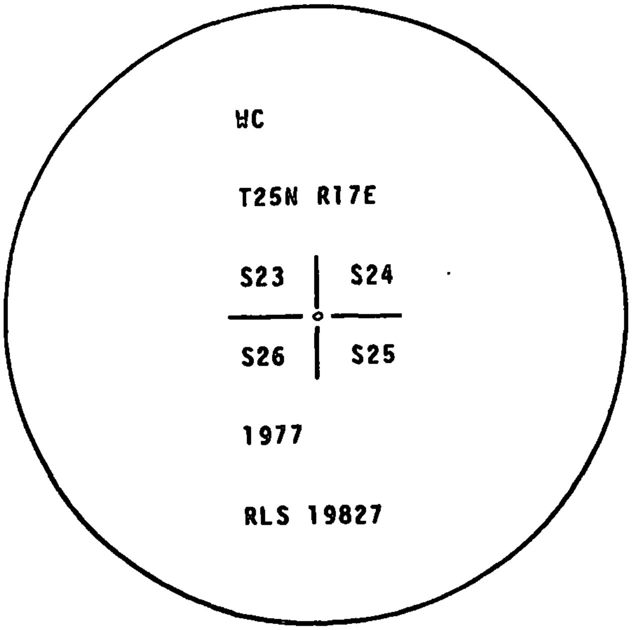


Figure 8.--Rectangular Survey System corner.

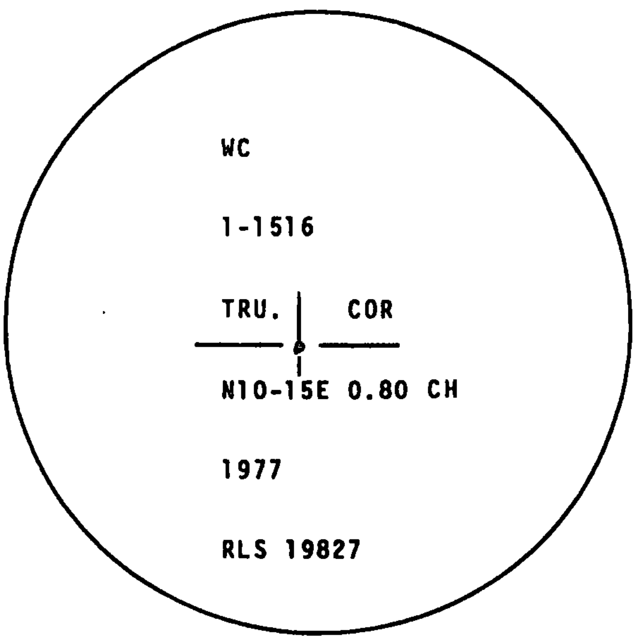


Figure 9.--Example Metes- and-Bounds Survey System corner.

Reference monuments are stamped in the same manner as witness corners by replacing the letters “WC” with “RM” in the Public Land Survey System States and substituting the words “REFERENCE MONUMENT” for “WITNESS CORNER” in the colonial States.

Bearing Trees

A bearing tree is a tree used as a corner accessory.

1. Bearing Tree Selection.

a. Trees should be selected within 3 chains of the corner; in unusual cases, greater distances may be used.

b. Trees should be selected so the lines to the corner are near a right angle for the best strength of position.

c. Long-lived trees and durable wood species should be selected. If only nondurable and short lived trees are available, placement of a witness corner or reference corner monuments should be considered. Bearing trees should not be selected on private property without the written consent of the owner. See the Bureau of Land Management publication entitled “Durability of Bearing Trees.”

2. Tree-Identifying Marks and Accessories. Identifying marks should be made on the side of the tree facing the corner monument, below stump height, and with an ax and scribing tool.

A smooth face, shaped to drain away moisture, is cut through the cambium layer of the tree. This is called a basal blaze. The face is then marked with a scribing tool. Local custom dictates the marks scribed to identify the tree as a bearing tree. Sections 4-85 to 4-114 of the BLM “Manual of Instructions” contain the scribing data. The blaze may be painted red, In areas where esthetics are not a problem, a 6-inch red band also should be painted around the tree at about breast height to make the tree more noticeable. Red enamel, when applied with a brush, gives the best results.

3. Reference Measurements. Reference measurements are made and recorded.

a. Reference Bearings. These are true bearings measured from the monument to the corner accessory. If the measurements are made with a compass, a staff compass of 4-inch minimum diameter should be used, and true bearing measured to the nearest whole degree.

b. Reference Distance. This is a horizontal distance measured to the nearest tenth of a foot (0.10 feet).

c. Bearing Tree Records Information. A full description of each bearing tree shall be given in the field notes and other record documents. This includes the species of each tree, its diameter at breast height, the exact direction from the monument to the tree, and the horizontal distance counting from the center of the tree at its root crown to the monument and the exact scribing marks found on the tree, Mineral survey instructions require measurements to be made from the face of the blaze.

4. Other Accessories.

a. Corner Posting. A post will be set near each corner monument for a guard post. The post should be about 6 feet long and be made of metal, fiberglass, treated wood or other approved material. They are to be firmly set, with about 4 feet extending above the ground. Wood and metal posts may be painted with red enamel. Placement of the post should be on the property line and far enough away to allow working room around the corner monument. About 2 to 5 feet is a good working distance.

Appropriate signs will be attached to the post.

(1) The “Property Boundary” sign (sign 54-2 and 54-2a) will be placed on top and will be placed to indicate the property line.

(2) The Land Survey Monument” sign (sign 54-9) will be placed below the property boundary sign and face the corner.

The description and the bearing and distance ties to the post will be included in the field notes.

b. Chiseled Marks in Rock. A cross (X) and the letters “BO” (bearing object) may be used on a bed rock, cliff, or boulder. The field notes should fully describe where the marks will be found and contain the bearing and distance from the corner to the bearing object. Rock bearing objects are the most permanent of all accessories and should be used whenever possible. The rock should be painted to call attention to its location. In esthetically sensitive areas, the paint may be omitted.

c. General Accessories. A connection to any permanent artificial object or improvement may be included in the general class of corner accessories. The field notes should be explicit in describing such objects and should indicate the exact point to which a tie is made. (Example: “The southwest corner of the foundation of the Jones house.” Describe the house in detail in notes.)

DOCUMENTATION

All monumentation, remonumentation, and corner monument accessory information is to be found and maintained in the survey field notes, corner certificates, surveys of record, corner cards and land corner status records. These permanent public records are fully discussed in chapter 6.

PROTECTION & MAINTENANCE of LAND CORNER MONUMENTS

This section provides instructions on protecting and preserving existing authentic land survey evidence until needed official action can be taken. It is in no way intended that these procedures will be used to take the place of, or to avoid, obtaining needed official cadastral surveying services, Only authentic land survey lines and corners will be perpetuated.

Many Forest Service property line problems are a direct result of failure to properly protect, maintain, and perpetuate authentic surveyed property lines and the corners that control them. Adequate measures will be taken to ensure that Forest Service property lines and property corners once officially established or reestablished will not be obliterated again. To accomplish this, each Forest Supervisor will--

1. Require all field-going Forest Service personnel, regardless of division, headquarters, or functional activity, to effectively protect and preserve authentic Forest Service property lines and survey corners encountered in their daily field activities.

2. Provide, on a planned project basis, for scheduled inspection and maintenance of marked property lines and the corners that control them. This will include periodic travel along the property lines to inspect previous work and to perform additional work needed, Required frequency of this programmed inspection and maintenance will vary considerably with different localities, but it will be done often enough to provide adequate inspection and proper maintenance and perpetuation of Forest Service property lines.

The activation of the Forest Service land line location program in no way excuses Forest Service employees not directly connected with the program from a continuing responsibility for the proper protection and maintenance of property corners and property lines, However, the through availability of technical guidance and assistance and provision for preparation and maintenance of orderly records, this program does enhance the opportunity for maximum effectiveness in meeting this obligation.

Employees not specifically engaged in land line location work may not have all of the tools and equipment needed to do a complete protection and maintenance job. in this case, they will do what they can with the tools they have and make specific arrangements for followup action to complete the job.

Protection

Many people are ignorant of, or indifferent to, the importance of land survey corners, corner accessories, property lines, and land survey records. However, Forest Service people must recognize the continuing need to preserve and perpetuate survey evidence on the ground and survey records in the office.

Forest officers must insist that people who use Forest Service facilities or work on Forest Service land do not damage or destroy land survey corners, corner accessories, or property line marking.

Maintenance

Normal Conditions

Forest Service employees have the authority and the obligation to protect and maintain authentic Forest Service property lines, property corners, and corner accessories.

The preservation of authentic survey lines and corners will not be postponed until a crash program is required to save them from complete obliteration. Preservation is a continuing effort that starts at the time the cadastral survey is completed.

Official remonumentation of property corners by the BLM or a licensed surveyor eventually will be required. However, current maintenance can help extend the life of corner monuments and accessories, Such maintenance work can preserve remaining evidence and provide time needed to organize remonumentation programs for better cooperation and efficiency. It also can help salvage critical corners in danger of being lost. Current maintenance often will prevent development of adverse claims.

All corner maintenance must be documented properly to ensure an unbroken chronological record of the corner and its accessories.

To prevent loss resulting from deterioration, maintenance work will be as follows:

1. Corner Monuments. Action to preserve corner monuments may include--

a. Resetting a dislocated corner monument back in its original location as verified by measurements from remaining authentic corner accessories according to the official survey notes.

b. Straightening a leaning corner monument that is still in place and reinforcing it as necessary to keep it in position.

c. Placing protective material, such as stones, around the corner monument. In areas of heavy public use it may be desirable to install a substantial mass of concrete, or concrete and rock in the ground around the corner monument to prevent its dislocation or removal.

In cases where the official corner was a wooden post that has rotted off, the decayed portion of the stake remaining in the ground, together with the size and shape of the hole it occupies, furnish definite proof of the original corner location, Under no circumstances will such evidence be disturbed until off icial remonumentation is accomplished. In such cases, the temporary pipe or rod should be driven near the point but not in it. The record then must state the distance and direction from the corner point to the object used.

d. Setting metal or wood (most durable available) guard post with appropriate signs near the corner point.

e. Applying liberal amounts of red paint to bearing tree blazes and painting a 6-inch red band around the bearing tree about 6 feet above the ground.

f. Attaching red plastic tape to tree limbs and branches.

g. If the bearing trees are in poor condition, establishing reference points to assist in later recovery of the corner point location. Trees can be used for this purpose. Distinctive hacks or blazes can be made at breast height to mark the trees, Marks should be of such a nature that they will not be confused later with official bearing trees. For these new reference marks to be of any value, a record that gives a complete description of the reference mark established and the distance and. direction from it to the corner point location, and between it and remaining bearing trees, must be prepared. This record must be readily available for reference as needed.

Indiscriminate blazing around bearing trees and property lines is to be avoided. Such blazing may obliterate evidence and create confusion.

If the adjoining landowners object to Forest Service signs and paint on bearing trees situated on their land, only bearing trees on Government land should be painted and signed.

3. Records. Land corner records will be maintained at each administrative office level as described in chapter 6.

a. Corners and Accessories. Form FS 7100-52 or a regionally accepted corner card form will be filled out and filed according to FSM instructions and will be used for recording maintenance work accomplished on survey corners and corner accessories. The FS 7100-52 or Regional corner card form properly filled out on the spot as the work is accomplished provides the most acceptable and reliable record.

When new reference marks are established to ensure recovery of a corner point location, special care must be taken to obtain a complete and clear record of distance and direction between the new reference points and any monuments or accessories still in place.

b. To Prevent Loss Due to Destruction. Timely action will be taken to prevent destruction of property survey lines, corner monuments, and corner accessories in areas where such activities as road construction and maintenance, logging, range revegetation, clearcutting, controlled burning, dam construction, and water impoundment are to occur.

Property corners, corner accessories, and property line markers must be made readily apparent to avoid inadvertent destruction by machinery.

Adequate work will be done as required to keep fire in controlled burns from damaging survey markers and corner accessories.

Bearing trees that are dead or not wind firm and are left exposed by clearcutting may blow down. To preserve this type of corner accessory, it is desirable to fell the tree and preserve the stump. The cut must be above the scribing on the tree and the remaining stump should be at least 4 feet high to distinguish it from other stumps in the area. A sloping cut heavily painted or covered with other protective material will help preserve the stump and make it easier to find (FSM 2442.7).

Anyone, including other Federal Government agencies, State or local governments, companies, individuals, or the Forest Service, who builds dams or impounds water on land in the National Forest System will be required to protect, preserve, and perpetuate land survey lines and land survey corners in the areas affected.

Cadastral work done to comply with this requirement, including the preparation and filing of cadastral survey notes and plats, will be done under appropriate Federal or State survey regulations.

Form FS 7100-52, filled out and filed according to the FSM instructions, will be used for recording corner maintenance work, If bearing trees are felled to preserve the stump, state the reason this action was necessary. The Form FS 7100-52 properly filled out on the spot as the work is accomplished provides the most acceptable and reliable record. Cadastral survey work required because of dam construction or water impoundment will require complete official survey records to be prepared according to applicable Federal or State regulations.

c. To Prevent Loss Due to Unavoidable Destruction. Removal of the survey marker or accessories occasionally is unavoidable, If this must occur, adequate provision will be made to preserve the exact corner point location and the “on line” position of property line markers. Corner accessories that are removed will be replaced by suitable substitutes. This work will be done under appropriate surveying authority and official records prepared and preserved.

(1) Corner Monuments. When practicable, subsurface markers will be set at the corner point when a corner monument must be removed. The monument may be set before or after construction. The original corner monument, if of durable material, may be reset as the subsurface mark. If a new marker is used, the original monument should be set alongside or under the new subsurface mark.

Suitable metal buried with the subsurface mark will facilitate locating the corner point by magnetic dip needle. Durable reference marks must be set so the subsurface corner monument location can be readily recovered when needed.

If subsurface marks cannot be used, preservation of the corner point location will depend entirely on suitable reference marks.

(2) Corner Accessories. When corner accessories must be destroyed they will be replaced by suitable substitutes. Additional reference marks will be installed when needed to ensure recovery of the corner point if the corner monument must also be removed. The new corner accessories will be set in locations that will not be disturbed. They will be durable objects, such as brass-capped iron pipes, concrete posts with brass caps, and suitable trees. Capped reference marks will be stamped with appropriate identifying marks, including the letters “RM” (reference mark), an arrow pointing to the corner point, and the distance from the reference mark to the corner point. Trees used for reference marks will be blazed below stump height, with the blaze facing the corner point and scribed “RM.” The blaze will be painted red and a 6-inch red band will be painted around the tree about 6 feet above the ground.

(3) Records. Adequate records of work done to preserve corner point locations and to install new reference marks must be prepared and preserved.

Most States have laws that regulate preparation and recording of official survey work done by State authorized surveyors. If Forest Service requirements for recording and filing of these records are met by action specified by these laws and the surveyor complies with the law, further official Forest Service action may not be needed.

In States in which such laws are inadequate, or do not exist, the Forest Service will act to obtain and to preserve adequate official records.

For each corner where the corner monument has been removed and a subsurface mark or new reference marks installed, the Forest Service will obtain from the surveyor a properly executed certified corner restoration record form, and provide for official recordation of this form as a public record, or for its retention and preservation in the Forest Service survey office until recording of filing can be effected. The Forest Service will furnish blank certified corner restoration forms to surveyors for this purpose as needed.

A Form FS 7100-52 card record also will be prepared and filed so corner card records will be kept current.

Emergency Conditions

Situations may occur in which corners will be destroyed before action can be taken to have them perpetuated.

A second generation corner is much less likely to be challenged if its location has been perpetuated by official action, However, unofficial action may preserve evidence of the corner location and will be resorted to when circumstances preclude obtaining official surveying services. Participation of an adjoining landowner in this work is especially desirable.

By virtue of its being the best remaining evidence, corner locations unofficially perpetuated may later be accepted by an authorized surveyor and regain official status. This will depend to a considerable extent on the quality of the perpetuation work accomplished and the records that are prepared. These records must be preserved and remain available for inspection by all interested parties.

Work procedures and record preparation for this official action will be similar to that for official corner perpetuation described in chapter 6.

The record will be prepared on certified corner restoration record forms.

In addition to the information called for by the form, this record will state the reason for resorting to unofficial action rather than having the work done under proper surveying authority.

Since a surveyor’s seal and signature will be lacking, the signature of two witnesses to the work will be included along with the signature of the person who did the work, If at least one of these witnesses is an adjoining landowner, it will add considerable weight to official acceptance of the work. The date of the work and the date of affixing these signatures will be included on this record.

A Form FS 7100-52 card record also will be prepared and filed so the corner card record will be kept current.

PROTECTION & MAINTENANCE of OTHER SURVEY MONUMENTS

There are many other survey monuments located on National Forest System lands, such as bench marks, geodetic control stations, and right-of-way monuments. These monuments often are shown by symbols on topographic maps. As a Federal agency, the Forest Service is charged with the care and maintenance of these monuments. When these monuments are found in place, care should be taken to prevent destruction by Forest Service activities.

If destruction is necessary, the Regional Land Surveyor should be notified so that the proper authority can be notified and actions taken to maintain the monument location. If destruction has occurred, a record of destruction should be filed with the Regional Land Surveyor.

BOUNDARY IDENTIFICATION

LOCATION & MARKING

Lines will be located to within 2 feet of the true line between corners. Any direct or indirect method may be used, so long as the method will achieve the accuracy standard.

The picket method of determining property boundary lines should be used only on the approval of the cadastral surveyor in charge of line location work for the Ranger District. When carefully executed, this method will give adequate accuracy with economy. The picket method is described in "Land Surveying" by F. Hodgman.

The permanent marking of all landownership lines is the main objective of land survey operations, so the line can be relocated in the future without extensive cadastral resurvey. Marking should be done as the survey progresses or soon thereafter so that it can be done from survey evidence.

Line markers will be placed within 2 feet of the true line between consecutive property corners. They may be monuments, posts, or marks on line trees, or any suitable combination.

Marking Standard

All lines surveyed will be marked permanently at intervals specified by the Regional Forester.

POSTING STANDARDS

Posting is the act of placing appropriate signs along a property line to aid in recognition of the line.

1. Lines may be posted to three standards of visiblity:

a. Laterally Visible (Class A). Readily obvious to a person approaching the line at or near a right angle from either side, and easily followed by a person walking the line in either direction.

b. Longitudinally Visible (Class B). Readily obvious to a person following the line in either direction.

c. Subdued Visibility (Class *C).* Adequately marked but not signed and, therefore, not readily visible laterally. May require simple instruments to follow between line markers.

A particular line between corners may be posted to all standards of visibility, depending on management’s needs, topography, vegetation, and so forth, Lines should be laterally visible where they intersect roads or trails. They may only need to be longitudinally visible against industrial forest lands. They may be subdued in esthetically sensitive areas.

Lines defined by "section linen roads may be posted on the right-of-way limit.

The person viewing the posted boundary line will be able to identify the location of the true line, Government lands, and the lands of the adjoining owner by the signs on the posts and the blazes on the trees.

2. The following general instructions shall be followed in posting property lines to standard:

a. Accessories used to identify the line must not be placed outside of a corridor of 3 feet on either side of the true line between two consecutive property corners.

b. All boundary signs mounted on trees, fences, or posts and all line monuments must be placed within 2 feet of the true property line.

CLEARING

Except lines posted for subdued visibility and in areas where vegetation regrowth will quickly obscure the line, the property line is to be cleared of small trees, brush, and debris for a distance of about 2 feet on each side of the line, unless the line is defined by such features as a hedge, fence, lane, or road. The maximum size of small trees to be cut must be determined by a Regional, Forest, or District official. Under certain conditions, mechanized equipment or chemical sprays may be used to facilitate the clearing and control of vegetation. Owners of private land seldom object to having their side of a boundary line cleared; however, it is advisable to obtain written agreement when there is reason to believe objections may be raised. Under no circumstances should clearing be done on private land if the owner objects.

LINE BLAZING

These are the marks made on trees with an ax in such a way that they will remain as long as the trees exist. A blaze is made by cutting off, at breast height, a vertical strip of bark and a very thin layer of the underlying live wood tissue. The strip should be about 6 to 8 inches long, 2 to 4 inches wide, and the top and bottom ends should be smoothed out.

A hack is a single horizontal cut made with an ax slanted upwards. Hacks should be located about 4 inches above and below the blaze. The cut should go through the bark and penetrate well into the wood.

The following are examples of how the Forest Service uses the two kinds of markings on trees along property lines, referred to as face and quarter blazes (in these terms, hacks are considered part of the blaze):

Face or quarter blazes will be used as follows:

1. Trees on Property Line. Place face blazes on opposite sides, along the direction of the line, so that the blazes face a person proceeding along the line in either direction.

2. Blazes on Forest Service Side of Property Line. Place quarter blazes on suitable trees within 3 feet of the line. They should be easily visible to persons traveling in either direction along the property line.

3. Trees on Opposite Side of Property Line From Forest Service Side. Place a face blaze on suitable trees within 3 feet of the line on the side of the tree facing the line, Written permission should be obtained from adjoining owners before trees on private lands are marked.

There will be instances when it will be obvious that clearing or marking should not be done on private land, Examples include property owned by persons known to be hostile to the Forest Service, property lines of resorts, and summer home sites.

PAINTING

All tree blazes, except when using Class C, Subdued Visibility standards, will be painted with a heavy-base red enamel implement paint.

If desired, an insecticide may be mixed with the paint to protect the blaze from insects and diseases.

A very good red enamel implement paint can be purchased from the General Services Administration.

POSTS

These should be at least 6 feet long and must be made of metal, treated wood, or other approved material. They are to be firmly set, with about 4 feet extending above the ground, Posts with the appropriate signs attached will be set near corner points and on property lines as follows:

1. As a guard post near each corner monument, If the corner monument is a tree, a post is not required.

2. Where property lines cross roads or trails, Generally, wood posts should be used at road crossings.

3. At all other locations where property boundary signs are needed and there are no trees to which the signs can be attached.

SIGNS

Many different signs are used to identify land corners and property lines. The signs are metal sheets, or adhesive decals, having black lettering on a yellow background.

Attaching Signs

1. Trees and wood posts will require the use of nails compatible with the sign metal; for example, use aluminum nails with aluminum signs. When nails are placed in a tree, the nail should not be driven flush to accommodate future tree growth.

2. Metal or glass posts will require the use of “pop” rivets or nuts and bolts. Holes should be drilled in the signs and posts before going to the field.

Available Signs

1. <u>Sign 54-2, Property Boundary - National Forest Land Behind This Sign</u>. This sign will be used at all property corners. It also is to be attached to line trees and to line posts set between corners. This sign always must be placed on the property line, never behind or away from the true property line.

2. Sign 54-3, Bearing Tree. A supply of this sign will be carried and placed as needed on official bearing trees not previously so signed and to replace deteriorated signs.

3. Sign 54-5, Location Poster - Township (Rectangular Surveys). When appropriate, this sign, with indicated data added, will be attached to the line posts at road and trail crossings and at corners of the rectangular survey system. A nail is driven at the proper place to indicate the corner position being identified.

4. Sign 54-6, Location Poster - Section (Rectangular Surveys). This sign serves essentially the same purpose as sign 54-5, except that this sign is intended for sectional subdivisional corners.

5. Sign 54-7, Property Boundary - National Grassland Behind This Sign. Use on National Grasslands in the same manner that sign 54-2 is used on National Forest land.

6. Sign 54-8, Location Poster (Metes and Bounds Surveys). Use for metes and bounds surveys in the same manner that sign 54-5 is used for rectangular surveys.

7. Sign 54-9, Land Survey Monument. Attach to property corner guard posts or trees in the vicinity of property corners.

ONLINE MONUMENTS

It is good practice to set online monuments along the property line, see the section entitled “Line Marker Monuments” for monument specifications.

This type monument should be stamped “LINE MARKER” and should be identified in the survey field notes, with distance ties. These monuments also may be referenced.

MAINTENANCE & PROTECTION of PROPERTY LINES

Maintenance activities are performed only on lines previously marked and posted to FSM standards.

Maintenance should be performed on a periodic basis. The maintenance interval depends on local conditions, but should never exceed 10 years, Maintenance should never be postponed until a crash program must be undertaken to save the line from complete obliteration, Maintenance records are maintained as described in chapter 6.

Normal Conditions

1. To Prevent Loss Due to Deterioration. Action to preserve the location of property lines may include:

a. Replacing deteriorated property line signs and posts.

b. Repainting line posts, line markers, bearing trees, and line tree hacks and blazes.

c. Placing additional line posts and signs in areas where increased or changing activity has created a need.

d. Clearing out brush and debris along the property line and around the corner points and bearing trees. Care must be taken to avoid disturbing existing survey evidence.

e. Securing cooperation of adjoining landowners in listed activities.

2. To Prevent LOSS Due to Unintentional Destruction. Timely action will be taken to prevent destruction of property lines in areas where such activities as road construction and maintenance, logging, range revegetation, clearcutting, controlled burning, dam construction, and water impoundment are to occur.

Property line markings must be made readily apparent to avoid inadvertent destruction by machinery. Class A and B marking and posting normally will be sufficient to avoid such unintentional destruction. Class C posting may not. Adequate work as required will be done to keep fire in controlled burns from damaging line markers and corner accessories.

3. To Prevent Loss Due to Unavoidable Destruction. Removal of survey markers or accessories is occasionally unavoidable. If this must occur, adequate provision will be made to preserve the exact corner point location and the “online” position of property line markers. Corner accessories that are removed will be replaced by suitable substitutes. This work will be done under appropriate surveying authority and official records prepared and preserved.

Action will be taken to ensure that property line markers that are to be disturbed can be replaced accurately online.

Emergency Conditions

Situations may occur that W1.LJ. destroy corner monuments and property line markers. When this occurs, every effort should be made to rehabilitate the area as quickly as possible. In every emergency situation (fires, flood, landslide, and so forth), the Forest Service makes a damage assessment and requests funds to repair the damage. Remember to include land corner and property line marking. see the section entitled “Monumentation” for corner maintenance procedures.

CONTROL SURVEYS for LAND SURVEYING

Most land surveys involve some control surveying activities. It is necessary to know the spatial relationship of corners to others in the survey. Surveyors use control surveys to evaluate the position of monuments or other physical evidence found in the field. They also use control surveys to place new monuments in their lawfully defined or desired location. Control survey techniques also are used to obtain scale and azimuth for photo9ram- metric surveys. It often is desirable to utilize stations of the National Geodetic Network to verify the accuracy of land survey work or to place the survey onto a State plane coordinate grid system. When this is done, control survey techniques must be used.

PLANNING

In the past, most control surveys were done by triangulation. The development of electronic distance measuring equipment changed that situation. During the past 2 decades most control surveys used traversing and some trilateration. These techniques now are being challenged by satellite and inertial positioning equipment.

Planning for control surveys often centers on the best location of traverse stations and the travel routes and logistics of the survey. In addition to these, planning also should consider other survey techniques, new technology, and the actual accuracy necessary. Planning should include the following analysis as a minimum:

1. The reason a control survey is necessary.

a. To form a closed loop.

b. To close a traverse using geodetic stations at the terminals.

c. To provide control for photogrammetry.

d. To obtain geodetic or State plane positions for boundaries defined by coordinates (such as wilderness).

2. The accuracy that is absolutely necessary.

a. To tie the controlling corners.

b. To place the new or lost corners.

c. To position the property line.

d. To obtain, for the desired end (items a, b, or c), the accuracy that will be required for the control survey.

3. The alternative combinations of instruments, equipment and observation techniques that will obtain the required accuracy.

4. An economic comparison of acceptable alternatives.

a. Equipment costs.

b. Manpower costs.

c. Transportation costs.

d. Per diem costs.

5. The decision to use force account versus contract methods considering available manpower, skills, and time constraints.

6. Preparation of instructions to crews or specifications for procurement.

7. Logistics.

a. Equipment repair, purchase, or lease.

b. Transportation.

c. Lodging.

<u>SPECIAL NOTE</u>: The information contained in the section entitled “Accuracy” through the section entitled “Principle of Least Squares” is reprinted with the knowledge and consent of the Department of Transportation of the State of California. The information was published in the “Caltrans Surveys Manual” dated March 1976.

We wish to extend our recognition and appreciation to the California Department of Transportation for allowing the use of this excellent chapter on a complex subject.

ACCURACY

Accuracy is the degree of conformity with a standard or a measure of closeness to a true value.

Accuracy relates to the quality of the result obtained when compared to a standard. It is distinguished from precision, which relates to the quality of the operation used to attain the result.

The standard used to determine accuracy can be:

1. An exact value, such as the sum of the three angles of a plane triangle is 180 degrees.

2.   A value of a conventional unit as defined by a physical representation thereof, such as the international meter.

3.   A survey or map value determined by refined methods and deemed sufficiently near the ideal or true value to be held constant for the control of dependent operations.

Precision

Precision is the degree of refinement in the performance of an operation (procedures and instrumentation) or in the statement of a result. The term “precise” also is applied, by custom, to methods and equipment used in attaining results of a high order of accuracy, such as precise taping.

Precision is indicated by the number of decimal places to which a computation is carried and a result stated, However, calculations are not necessarily made more precise by the use of tables or factors of more decimal places. The actual precision is governed by the accuracy of the source data and the number of significant figures rather than by the number of decimal places.

Relative Precision

One of the most firmly entrenched institutions in surveying is the concept of relative precision. Back in the compass-and-chain days, and even in the transit-tape era, it was probably the most convenient means available for assessing the quality of surveys performed.

Relative precision is simply computed by dividing the total length of survey by the total mathematical misclosure. The result is assumed to be the distance in which an error of one unit occurs for the particular survey, and is supposed to be a measure of the accuracy of the survey. Unfortunately, the underlying assumption is not valid. Errors do not accumulate in direct proportion to distance, Relative precision does not distinguish between random or systematic errors, nor does it hint at the precision of small discrepancies.

In bygone days, the difference between a 1:2000 and a 1:5000 survey was probably real, and the relative precision hinted at this difference. Moreover, consistent technique yielded fairly consistent relative precisions, therefore a precision significantly lower than usual indicated a blunder, Nowadays, however, with the advent of EDM and more precise angle-measuring capability, relative precision is not a reliable indicator of significant differences in the results of surveys. What is the significant difference between a 1:20,000 survey and a 1:60,000? Is the second three times better or more precise than the first? It is not unusual to find tremendous spreads in relative precisions when using the same modern instruments and techniques. The expression is essentially meaningless and therefore invalid as an indicator of accuracy, but because of habit and lack of knowledge of anything better, the term continues to be used.

Accuracy Versus Precision

The accuracy of a field survey depends directly upon the precision of the survey. Although through luck surveys with high-order accuracies might be attained without high-order precision, such accuracies are meaningless.

Therefore, all measurements and results should be quoted in terms that are commensurate with the precision used to attain the results. Similarly, all surveys must be performed with a precision that ensures that the desired accuracy is attained. However, surveys performed to a precision that excessively exceeds the requirements are costly and should be avoided. In other words, do not oversurvey.

Significant Figures

The significant figures of a numerical value are those digits that are known plus one doubtful digit following the known digits. Zeros that are used merely to locate the decimal point are not significant features. For example, the number 5,630 has three significant figures--digits 5, 6, and 3 is the one doubtful digit. Digits 5 and 6 are known and digit 3 is doubtful because the exact value of the example could be any value between 5,625 and 5,635. The zero is not a significant figure in this case because it is assumed that it merely locates the decimal point. Other examples are shown in table 5.

The general rules of significant figures are as follows:

1. Recorded numerical values, measured and computed, must contain only those digits that are known plus one doubtful digit. Zeros may be used to indicate the location of the decimal point. A minor exception to this rule is stated in item 3c below.

Table 5.

Numerical Value	Significant Figures
49.	2
1,600. [a]	2
0.1284	4
0.21	2
00.000213	3
129.85	5
11.00 [b]	4
10,000.0001	9
5,280 ft/mi[c]	“infinite”

[a]Generally, in such cases the zeros merely place the decimal point. Thus, they are not significant figures. However, if they indicate a

true zero value they are significant and should be counted as such. In this example, if 1,600 happens to be the height of a tower measured to the nearest foot, this number would have four significant figures.

[b]If correct recording procedures are being followed, the zeros are significant because they indicate a true zero value. For example, 11.00 could be the distance measured between two points as measured with an engineer's tape.

[c]All values which are exact by definition have an "infinite" number of significant figures.

For example, the length of a line must be determined by adding three measurements of different accuracies.

DI-10 Distomat	301.46	meters[1]	=	989.04	feet
Cloth tape	4.10 feet =			4.10	feet
Stadia distance	210.00	feet =		210.00	feet
	1,203.00	feet			

2. Recorded field measured values should never indicate a precision greater than that used in the actual survey. For example, when measurements are made with a cloth tape, values should be "recorded to the nearest 0.1 foot; not 0.01 foot.

3. Computations.

a. Multiplying or Dividing. The result must.. not have more significant figures than the term with the least number of significant figures.

Example: 12.182 x 11.1 = 135

Exception: If one term has a beginning numeral that is close to a double digit number, such as eight or nine, another significant number may be used. For example, 9.2 x 2.11 = 19.4 not 19.

b. Adding or Subtracting. The number of significant figures in the result is determined by the position of the first doubtful digit to the right of the known digits. That is, the result must not contain any significant figures to the right of the first column containing a doubtful digit.

---

[1]The metric value of this distance, to the nearest centimeter, is accurate to the nearest 0.03 foot. Thus, the conversion to 989.04 feet indicates precision that is inflated. However, if such

conversions were reduced by one significant figure, for example, 989.0 feet, this would indicate precision that is considerably farther from the true precision than the inflated precision indicated by 989.04 feet. Surveyors must be aware of such limitations when recording field data and computing and establishing resolved values thereof.

(First column containing doubtful digit)

Example: 10.001
9.2
306.2954
87.82
413.3

c. General, When calculations involve several steps, it is advisable to use one extra significant figure throughout the intermediate steps, However, the final result must always be rounded off to the appropriate number of significant figures according to items 1 and 2.

Zeros should be used only to indicate a true zero value or for locating the decimal place. Extra zeros are to be avoided, (Exception: When the number is less than one, one zero should be placed to the left of the decimal point--0.21.) Extra zeros cause confusion. For example, if a value were recorded as 29.0 when it really was 29, those that use this value will receive the misconception that the precision is three significant figures. Conversely, if a value were actually measured as 85.00, do not omit any significant figures. State the value of 85.00, not 85, so those using this value will realize it was determined to the nearest one hundredth rather than to the nearest whole number.

ERRORS

General

1. Likelihood of Error. Statistically speaking, field observations and the resulting measurements are never exact. Any observation can contain various types of errors. Often some of these errors are known and can be eliminated by applying appropriate corrections. But, even after all known errors are eliminated, a measurement will still be in error by some unknown value, Usually, the greater the precision used in making the observations, the less the magnitude of the unknown error. But, a measurement is never exact, regardless of the precision of the observations.

2. Responsibility of Field Personnel. Although this handbook contains many guidelines and standards, the ultimate responsibility for providing surveys that fulfill desired accuracies remains with

field personnel. To meet this responsibility, the party chief and his assistants must understand errors, including--

a. The various sources of errors.

b. The effect of possible errors upon each observation, each measurement, and the entire survey.

c. Economical procedures that will eliminate or minimize errors and result in surveys of desired accuracies.

Blunders

1. Definition. A blunder is an unpredictable, human mistake. It is not an error, although a small blunder may remain undetected and have the same effect as an error. The following are examples of blunders:

a. Transposition of two numbers.

b. Neglecting to level an instrument.

c. Misplacing the decimal point.

d. Misunderstanding a callout to be “7” when it is “11.”

2. Cause and Prevention. Blunders are caused by carelessness, misunderstanding, confusion, or poor judgment. They are avoided, for the most part, by alertness, common sense, and good judgment.

Blunders are detected and eliminated by using proper procedures, such as--

a. Making independent check observations and measurements.

b. Checking each recorded and calculated value.

c. Closing each survey.

All blunders must be eliminated before correcting and adjusting a survey for errors.

Definition of Error

Error is the difference, after blunders have been eliminated, between a measured or calculated value of a quantity and the true or established value of that quantity.

Types of Errors

Errors are of two general types: systematic and accidental.

1. Systematic Error

a. Definition. A systematic error is an error that will always have the same magnitude and same algebraic sign under the same conditions.

b. Causes. In most cases, systematic errors are caused by physical and natural conditions that vary in accordance with fixed mathematical or physical laws, However, some result from the observer’s personal observing habits--his or her tendency to react mentally and physically in the same way under similar conditions.

c Effect. A systematic error of a single kind is cumulative. However, several kinds of systematic errors occurring in any one measurement could compensate for each other.

d. Examples. Some examples of systematic errors are:

(1) Thermal contraction and expansion of a steel tape.

(2) Refraction.

(3) A particular chainman’s tendency always to overpull a tape slightly.

e. Detecting and Minimizing. Some systematic errors can be difficult to detect. Therefore, the surveyor must recognize the conditions such as instrument imperfections, atmospheric temperature, pressure, and personal habits that cause such errors, Once the conditions are known, the effect of these errors can be minimized as follows:

(1) Use procedures that will automatically eliminate systematic errors. The following are examples of these procedures:

(a) Balancing foresights and back- sights when leveling.

(b) Turning angles direct and reverse.

(c) Using standardized tapes.

(2) When systematic errors cannot be eliminated by procedures, corrections are applied to the measurements. These corrections are computed from the fixed relations between the systematic errors and the conditions of the observations. A simple example would be the temperature correction applied to a taped measurement.

All systematic errors must be eliminated before any adjustment of a survey for accidental errors.

2. Accidental Error.

a. Definition. An accidental error, also called a random error, is an error that does not follow any fixed relation to the conditions or circumstances of the observation. For a single measurement, it is the error remaining in the measurement after eliminating all possible systematic errors.

b. Causes. Accidental errors are produced by irregular, complex causes that are beyond the control of the observer. Their occurrence, magnitude, and algebraic sign cannot be predicted because each is truly random.

c. Analyzing. Since accidental errors are random, they obey the laws of chance. Therefore, they are analyzed according to the mathematical laws of probability.

d. Effect. Theoretically, an accidental error has an equal chance of being negative or positive. Thus, errors of this type tend to be compensating. However, since the magnitude also is a matter of chance, accidental error to a small degree remains in every measurement.

e. Example. An example of an accidental error is an instrument man’s inability to point a theodolite exactly, however, if his personal habits make him consistently point off to the same side of the sight line, this error becomes a systematic error.

f. Compensating. Corrections cannot be computed for accidental errors as for systematic errors. Accidental errors must be compensated for by adjustments.

(1) Least Squares Adjustment. Of the many different methods used by surveyors, this method provides the "most probable" values, Prior to adjustment, all possible systematic errors must be eliminated because the least squares adjustment (and other adjustment methods as well) is applicable only to truly random accidental errors.

(2) Adjustment Results. The surveyor should remember that any adjustment only provides what he believes to be the best solution for the total survey. Even after proper adjustment, each individual value (such as the position of a specific point) is in error by an amount depending on the precision of the survey. It is possible that an adjustment could increase the error for a specific point. Collectively, however, the errors have been reduced and the total survey is improved.

Sources of Errors

There are three general sources of errors: personal, instrumental, and natural.

1. Personal Errors.

a. Causes. These errors are caused by the physical limitations of the observer and by his or her personal observing habits. They can be either systematic or accidental.

b. Personal Systematic Errors. These errors are caused by the observer’s tendency to react the same way under the same conditions. For example, a chainman may measure slightly long on every measurement because he always stands in a certain position when taping. Each observer makes a personal systematic error of a small degree on each individual observation, Fortunately, such errors are minimized by proper procedures.

c. Personal Accidental Errors. Because of the human limitations of sight and touch, exactly correct observations are impossible. Some error remains in a measurement even after all systematic errors are eliminated. For example, regardless of the amount of care a chainman uses to mark a taping point, the distance will be in error by some amount. Sometimes it will be slightly short, other times slightly long. The magnitude of these errors also will vary. Errors caused by the physical limitations of the observer are called personal accidental errors.

2. Instrumental Errors.

a. Causes. Instrumental errors are caused by imperfections in the design, construction, and adjustment of instruments and other equipment. The following are examples of some such imperfections:

(1) Eccentricity of theodolite circles.

(2) A tape that is too short or too long.

(3) Misadjustment of level vials.

b. Type. In an individual observation, instrumental errors are systematic because they will be of the same magnitude and sign under the same observing conditions. However, if several observations are made of the same value, such as observing an angle at different positions of the theodolite circle, the systematic error of each observation could have the effect of an accidental error on the resulting measurement, the arithmetic mean.

c. Eliminating/Minimizing. Most instrumental errors are eliminated by using proper procedures, such as observing angles direct and reverse, balancing foresights and backsights when leveling, and repeating measurements. Instrumental errors that are not eliminated by procedures must be minimized by maintaining a regular program of periodically checking and adjusting, or calibrating, instruments and other equipment.

3. Natural Errors.

a. Causes. Natural errors, or external errors, result from natural physical conditions, such as atmospheric pressure, temperature, humidity, gravity, wind, and atmospheric refraction.

b. Type. Natural errors are systematic. However, if undetected and thus not eliminated or if incorrectly determined, they can have the same effect as accidental errors.

c. Correction. Natural errors are removed from measurements by determining corresponding corrections from known relationships between an error and the natural phenomenon. A familiar example is the correction for atmospheric temperature and pressure that is applied to electronic distance measuring device measurements.

Generally, the least certain value used in figuring a correction is the measurement of the natural phenomenon. For example, in an electronic distance measurement device measurement, atmospheric temperature usually is measured at each end of the line. But temperature along the line might not be constant, especially if the height of the line above the ground varies considerably. However, sufficient accuracy usually is obtained by assuming a constant natural condition, if proper procedures are used.

d. Minimizing. Natural errors can be controlled to some extent by making observations only when natural conditions are most favorable (that is, when they are most constant). The following are some examples of this:

(1) Precise taping at night or in cloudly weather (the temperature is more constant at these times).

(2) Turning vertical angles other than in early morning or late afternoon (refraction is changing most in the early morning and late afternoon).

Sometimes the effect of natural errors can be eliminated by using certain procedures, such as balancing foresights and backsights when leveling. This eliminates the effect of curvature and refraction.

PROBABILTIY for SURVEYORS

General

1. Scope. The theory of probability is a complete study in itself. It is thoroughly covered in many textbooks and other publications. Thus, this guide only briefly summarizes those principles that are essential to the surveyor. The attempt has not been made to derive or fully explain the given formulas. For additional discussion of probability as related to surveying, see the references.

2. Applicability. The laws of probability are applicable only to accidental errors. Blunders and systematic errors are not random; thus, they must be eliminated before applying the mathematical laws of probability to a measurement or a survey.

All discussion and formulas included in this guide apply only to accidental errors. Whenever the term “error” is used, it refers to accidental error.

3. Error Versus Residual. Scholars make a fine definition of error:

Error = true value - measured value (or observed value).

The true value is the absolute value for a quantity. For example, the sum of the three angles of a plane triangle is 180 degrees. In surveying, the true value rarely is known. This is because an accidental error of some magnitude occurs in every measurement. Therefore, an assumed best value is used in place of the true value. For a measurement determined by a series of observations and involving only accidental errors, the most probable value (and thus the best value to assume) is the arithmetic mean. The arithmetic mean is the sum of all observations in a series divided by the number of observations in that series. In this guide, the term “mean” is used synonymously with the term “arithmetic mean.”

The difference between the best value of a quantity and an observed value is called a residual:

Residual = best value - observed value.

For the purpose of simplification, the term “error” will be used, and its use is to be considered synonymous with that of the term “residual.”

Distribution of Errors

1. Normal Distribution Curve.

a. Definition. It can be demonstrated both mathematically and experimentally that the distribution of accidental errors follows a bellshaped curve as shown in figure 10. The ordinate (Y-distance) of a point on the curve represents the frequency of occurrence of an error, and the abscissa (X-distance) is the size of the error. This curve is called the “normal distribution curve.” Other terms used for this curve are “probability curve,” “normal probability curve,” “bell curve,” and “normal error distribution curve.”

2. Characteristics. Important characteristics of this curve are:

a. The curve is symmetrical around the Y axis.

b. The ordinate (Y) has a maximum value at X = 0.

c. The curve stretches to infinity in each direction. Thus, the ordinate (Y) equals zero at X = + infinity and at X = - infinity. For practical purposes, only the curve’s central portion is considered between the points where the curve is close to the X axis.

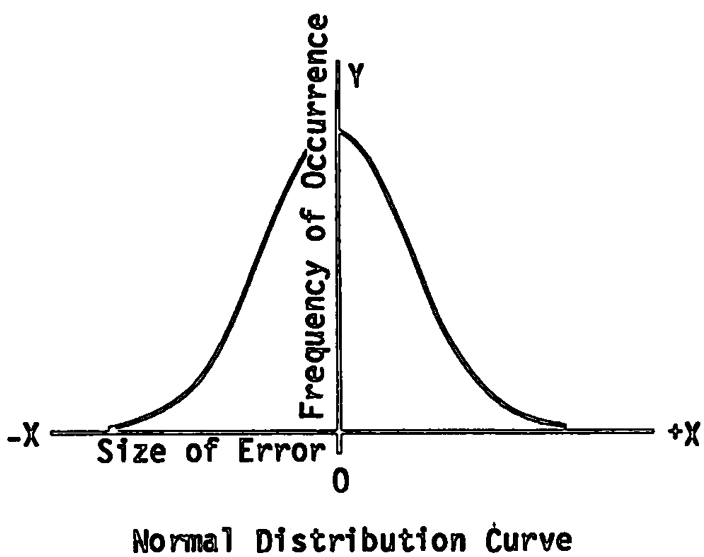


Figure 10.--Normal distribution curve.

3. Shape/Standard Deviation. The shape of the curve is a function of a constant that must be determined for each type of observation or measurement. This constant is called the standard deviation. It also is referred to as the mean square deviation, root mean square error, and mean square error. The lower-case Greek letter sigma usually designates the standard deviation. In this guide, sigma will be shown as SD.

The standard deviation is an indication of variance in the observation or measurement. It is determined from the size and frequency of accidental errors occurring in a series of observation or measurements. See “Standard Deviation Computations.”

Statistically speaking, standard deviation refers to the precision of a single observation of a series. However, for simplicity, this term also has been +sed in this section as an indication of the precision of a mean of a series of observations and a result of a series of measurements. Thus, three standard deviation types are included:

a. Standard deviation of a single observation, SD_s.

b. Standard deviation of a mean (standard error), SD_m.

c. Standard deviation of a result, SD_r.

4. Curve Values. Once the standard deviation is known, the entire curve can be computed from the equation for the normal distribution curve. However, it is simpler and easier to obtain the values from tables. Such tables are available in handbooks and statistics textbooks.

Except to help understand accidental errors, the actual plot of the normal distribution curve is seldom necessary in surveying. Specific points on the curve are determined from known relationships rather than from direct use of the plotted curve.

Probability of Errors

1. Principles. Inspection of the normal distribution curve reveals three important principles of accidental errors.

a. Small errors occur more frequently than large errors. Hence, the probability of an error is a function of the size of the error.

b. plus-and-minus errors of the same size have the same frequency of occurrence.

c. Large errors may occur, but only rarely.

2. Computations. The normal distribution curve represents all possible errors for an observation or measurement. Thus, the probability of any particular error being included in the curve is 100 percent. Furthermore, it can be shown that the area under the curve between selected values of X represents the probability of the occurrence of an error within that size range. That is:

$$\text{Probability} = \frac{\text{Area bounded by selected values of X}}{\text{Total area under the curve}}$$

For example, in figure 11 the probability of the occurrence of an error, whose size is between +SD and -SD, is equal to the crosshatched area divided by the total area. Tables are available in handbooks and statistics textbooks that tabulate the probability versus the size of the maximum error in terms of SD. For an error range of +SD to -SD (example in figure 11) the probability is 68.3 percent.

The following are representative probabilities:

Error range (+)	Probability
0.25 SD	19.7 percent
0.50 SD	38.3 percent
1.00 SD	68.3 percent
2.00 SD	95.4 percent
3.00 SD	99.7 percent

3 Maximum Error. For practical purposes, it can be said that all possible errors are included in the range of +3.0 SD to -3.0 SD (see figure 11). Therefore, many consider the maximum error as approximately three times the standard deviation.

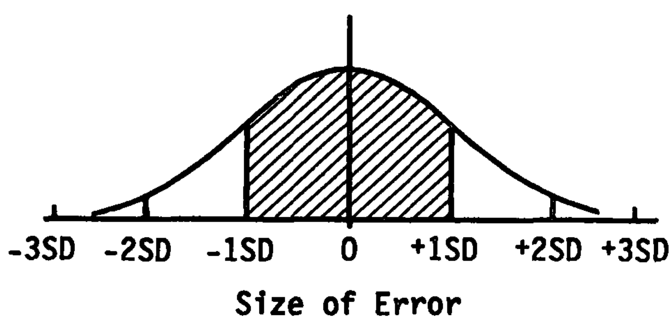


Figure 11.--Size of error (range *of +SD to -SD).*

For example, with an electronic distance measuring device of 0.02-foot standard deviation, it is safe to assume the maximum random error that would occur with this instrument would be about 0.06 foot because this size error would be expected only about three times in 1,000 measurements.

4. Exact Error. The statistical probability of the occurrence of an exact error, such as 2 centimeters, is zero. This is illustrated by the normal distribution curve. It can be seen that the area under the curve for an absolute number is zero because the area’s width is zero. Thus, the probability equals zero.

If the probability is quoted for an absolute error, such probability must refer to any error within the range of plus or minus the quoted error. For example, if it is stated that the probability of a 2-centimeter error is 50 percent, it means that the probability of the occurrence of an error between plus and minus 2 centimeters is 50 percent.

Standard Deviation Computations

1. Single Observation.

a. How Determined. To determine the standard deviation of a single observation, SDs, a series of such observations must be made with like precision.

b. Formula. The standard deviation for any one of the observations, in a series of equally precise observations, is computed by the following:

$$SD_S = \sqrt{\frac{\Sigma v^2}{n - 1}}$$

where

v = *error or residual;*

Ev^2 = *the sum of the squares of the errors; and*

n = *number of observations.*

c. Example. An instrument man observes an angle 12 times with the following results:

Observation number	Observed angle	Error(v)	Error(v^2)
1	72°22°23″	+ 1″	1
2	21″	- 1″	1
3	21″	- 1″	1
4	25″	+ 3″	9
5	24″	+ 2″	4
6	22″	0″	0
7	19″	- 3″	9
8	20″	- 2″	4
9	26″	+ 4″	16
10	22″	0″	0
11	20″	- 2″	4
12	21″	- 1″	1

-------- -----

Arithmetic Mean 72°22′22″ E = 0 E = 50

(Best value)

$$SD_s = \sqrt{v \frac{50}{12 - 1}} = \pm 2.1", \text{ say } \pm 2"$$

Thus, the standard deviation would be 2 seconds for any single observation made under the same conditions by this instrument man. This means that about two-thirds of his observations will be in error by less than about 2 seconds. The standard deviation of 2 seconds represents both the errors inherent in the instrument and those made by the instrument man. Another instrument man using the same instrument under the same conditions might have a smaller or a larger standard deviation.

d. Best Value. In the example in item 3, the arithmetic mean was used as the best value and the errors were computed from it. But if another value is established as the best value, the errors should be computed using this value.

e. Checking. When an established value is used as the best value (instead of the mean), the algebraic sum of the errors must be checked before computing the squares of the errors. If the errors are truly accidental errors, this sum should be approximately zero. When the algebraic sum does not approximate zero, a systematic error exists in each observation. This error must be eliminated before the standard deviation is computed. The value of the systematic error is the algebraic sum of the errors divided by the number of observations.

2. Single Measurement. In surveys, a single measurement is obtained either by making a single observation or by making a series of observations and using the mean value as the result. An example of the first case is taping one tape length or less. The second case is illustrated by angular measurement, which is normally based on a mean value.

a. Single Observation. In this case, the measurement and the observation are one and the same. Thus, the standard deviation of the measurement is the same as that of the observation.

b. Mean Value/Standard Error.

(1) Definition. The standard deviation of the arithmetic mean of a series of observations is called standard error, SD_m.

(2) The Equation for Computing the Standard Error.

$$SD_m = \pm SD_s \div \sqrt{n}$$

or

$$SD_m = \frac{SD_s}{\sqrt{n}}$$

where

SD_s = standard deviation for the individual (single) observations; and

n = number of observations.

(3) Example. In the example given previously under Single Observation in this topic, the mean angle was found to be 72°22′22″ and the standard deviation of an individual observation was ± 2.1 seconds. Since there were 12 individual observations, the standard error of the mean for this example would be the following:

$$SD_m = \pm \frac{2.1}{\sqrt{12}} = \pm 0.61'', \text{ say } \pm 0.6''$$

(4) Optimum Number of Observations. The effect that the number of observations has on the precision of the mean is illustrated readily by plotting the equation for the standard error. This has been done in figure 12 using the value "1" for the standard deviation of the individual observations, Inspection of the curve shows that the effect is a case of diminishing returns. For example, between four and eight repetitions SD_m drops 0.15. To again drop 0.15, 17 more repetitions must be turned.

3. Result of Series of Measurements. Usually survey values are the result of many measurements, For example, the bearing of one course of a traverse depends upon all measurements which precede that course, Each individual measurement has a particular standard deviation which might, or might not, be equal to the standard deviations of the other measurements in the series. As might be expected, the standard deviation of the result (SD_r) is a function of these individual standard deviations.

a. Results Determined by Adding or Subtracting.

(1) Basic Rule and Formula. When the result is determined by adding or subtracting individual independent measurements, the standard deviation of the result is computed according to one basic law of probability, which is:

The standard deviation of the sum of a series of individual independent measurements is equal to the square root of the sum of the squares of the standard deviations of the individual measurements.

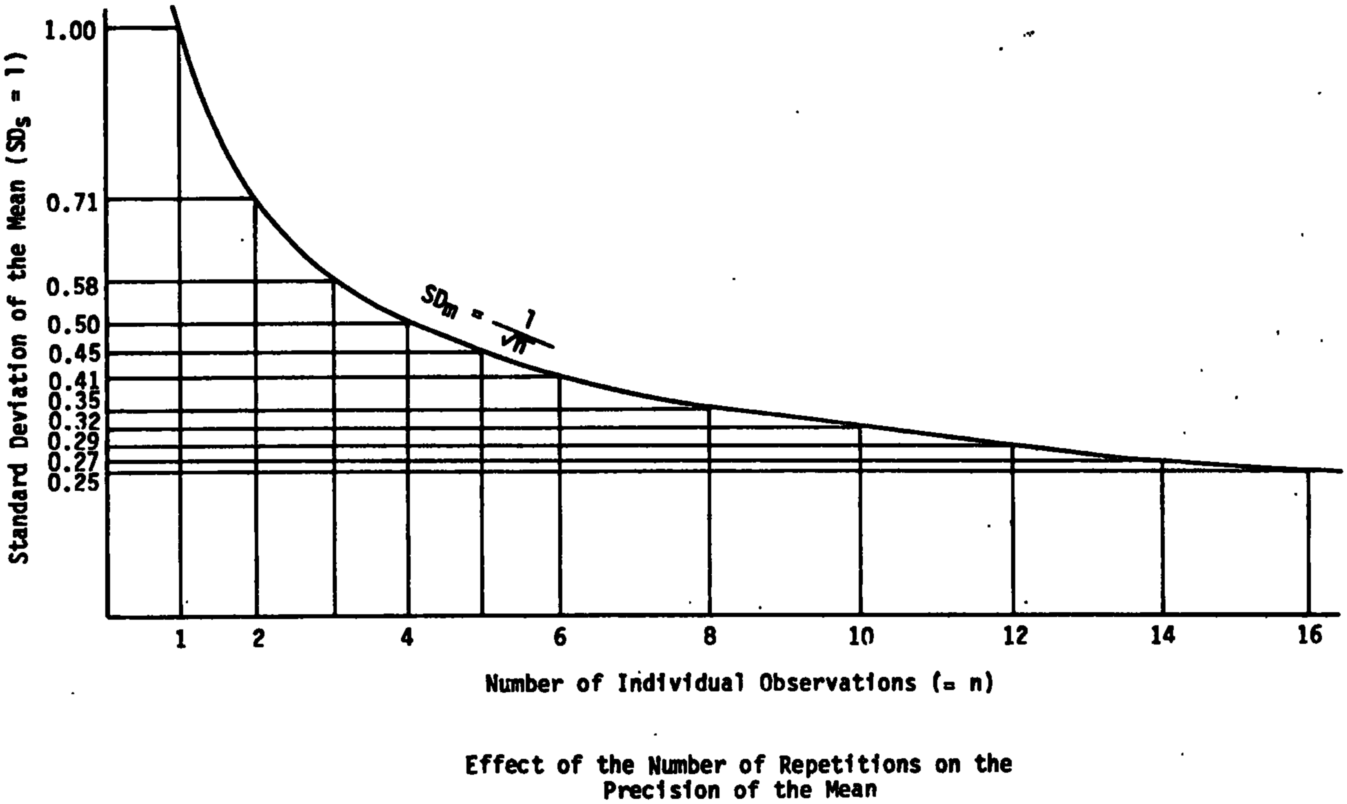


Figure 12.--Effect of the number of repetitions on the precision of the mean.

That is:

$$SD_r = \sqrt{SD_1^2 + SD_2^2 + SD_3^2 \ldots + SD_n^2}$$

(2) Example. It is desired to determine the SD_r of the bearing of the sixth course in a traverse. The standard deviations of the angles used to compute this bearing are tabulated here:

Angle	Standard deviation of measured angle
Course 1	5 seconds
Course 2	4 seconds
Course 3	8 seconds
Course 4	6 seconds
Course 5	4 seconds
Course 6	7 seconds

$$SD_r = \pm\sqrt{5^2 + 4^2 + 8^2 + 6^2 + 4^2 + 7^2}$$

$$r = \pm \sqrt{206} = \pm 14.4'', \text{ say } 14''$$

If it has been desired to determine the SD_r of the fourth course, the solution would be the following:

$$SD_r = \pm \sqrt{5^2 + 4^2 + 8^2 + 6^2}$$

$$r = \pm \sqrt{141} = \pm 11.9'', \text{ say 12 seconds}$$

(3) When Individual Standard Deviations Are the Same. In many survey operations, the standard deviations of the individual measurements are all equal, or nearly equal. For example, when a distance is measured by taping, it can be assumed that each tape length (an individual measurement) has the same standard deviation of the result, reduced to the following:

$$SD_r = \pm SD_s\sqrt{n}$$

where

SD_s = the standard deviation for each of the individual measurements; and

n = the number of measurements.

This equation illustrates an important principle of accidental errors:

When all measurements are made to the same precision, errors accumulate in proportion to the square root of the number of individual measurements (the number of times an error can occur).

b. Results Determined by Multiplication.

(1) Formula. When the result is determined by a multiplication process, the standard deviation of the result is computed as follows:

$$SD_z = \pm\sqrt{(Y^2)(SD_x{}^2) + (X)^2(SD_y{}^2)}$$

where

z = *X times Y (X and Y are measured quantities);*

SD_x = *standard deviation of X;*

Sd_y = *standard deviation of Y; and*

SD_z = *standard deviation of Z.*

(2) Example. Determine the SD_r (in acres) of the area of a rectangular parcel of land. The dimensions of the parcel with the corresponding standard deviations are as follows:

Long sides = *1,000.00'; $SD_x = 0.10'$*
Short sides = *500.00'; $SD_y = 0.05'$*

$$SD_r = \pm \sqrt{500^2 \times 0.10^2 + 1000^2 \times 0.05^2}$$

$$SD_r = \pm \sqrt{2500 + 2500} = \pm 70.7 \text{ ft}^2$$

To convert to acres:

$$SD_r = \pm \frac{70.7}{43,560} = \pm 0.0016 \text{ acres}$$

Measures of Precision

In the previous section, "Distribution of Errors," a fixed relationship is shown between the standard deviation and the probability of any selected error range. For this reason, the standard deviation is the basis for the commonly used term "measures of precision."

1. Standard Deviation. As stated previously, the probability of the occurrence of an error within the range of +SD to -SD is 68.3 percent. This means that about one measurement of three will have an error (either plus or minus) greater than the standard deviation.

Often the precision of an electronic distance measuring instrument is expressed in terms of the standard deviation.

2. 90-Percent Error. As the name implies, this measure of precision defines the size of error (plus or minus) that is greater than 90 percent of all random errors. Thus, the probability of the error for a single observation or measurement exceding (either plus or minus) this value is only 10 percent. The 90 percent error is obtained by the relation:

$$E_{90} = 1.6449 \text{ SD}$$

Some authorities believe that most surveys should be performed at a precision equal to the 90 percent error. This means that 10 percent of the survey values will not meet the desired (or required) accuracy. The theory is that it is cheaper to repeat a small portion of the measurements than to perform the entire survey at a greater precision.

3. Summary.

a. Comparison Table. Common measures of precision are summarized as follows:

Measure of precision	Relationship to	Probability of error within its range
SD	1.0 SD	68.3 percent
E_{90}	1.6449 SD	90 percent
2 SD	2.0 SD	95.4 percent
3 SD	3.0 SD	99.7 percent

b. Example. In the example given above under “Standard Deviation Computations - Single Observation,” the standard deviation was determined to be ±2.1 seconds. The various measures of precision for a single observation in this example are:

$$E_{90} = 1.6449(+ 2.1) = + 3.5 \text{ seconds}$$
$$2SD = 2(+ 2.1) = \pm 4.2 \text{ seconds}$$
$$3SD = 3(\pm 2.1) = \pm 6.3 \text{ seconds}$$

These results are graphically illustrated in figure 13.

c. Analysis. An inspection of the original field measurements reveals:

Range	Number of observations within range	Percent of total	Percent/law of probability

± 1.4″	6	50	50
± 2.1″	9	75	68.3
± 3.5″	11	92	90
± 4.2″	12	100	95.4
± 6.3″	12	100	99.7

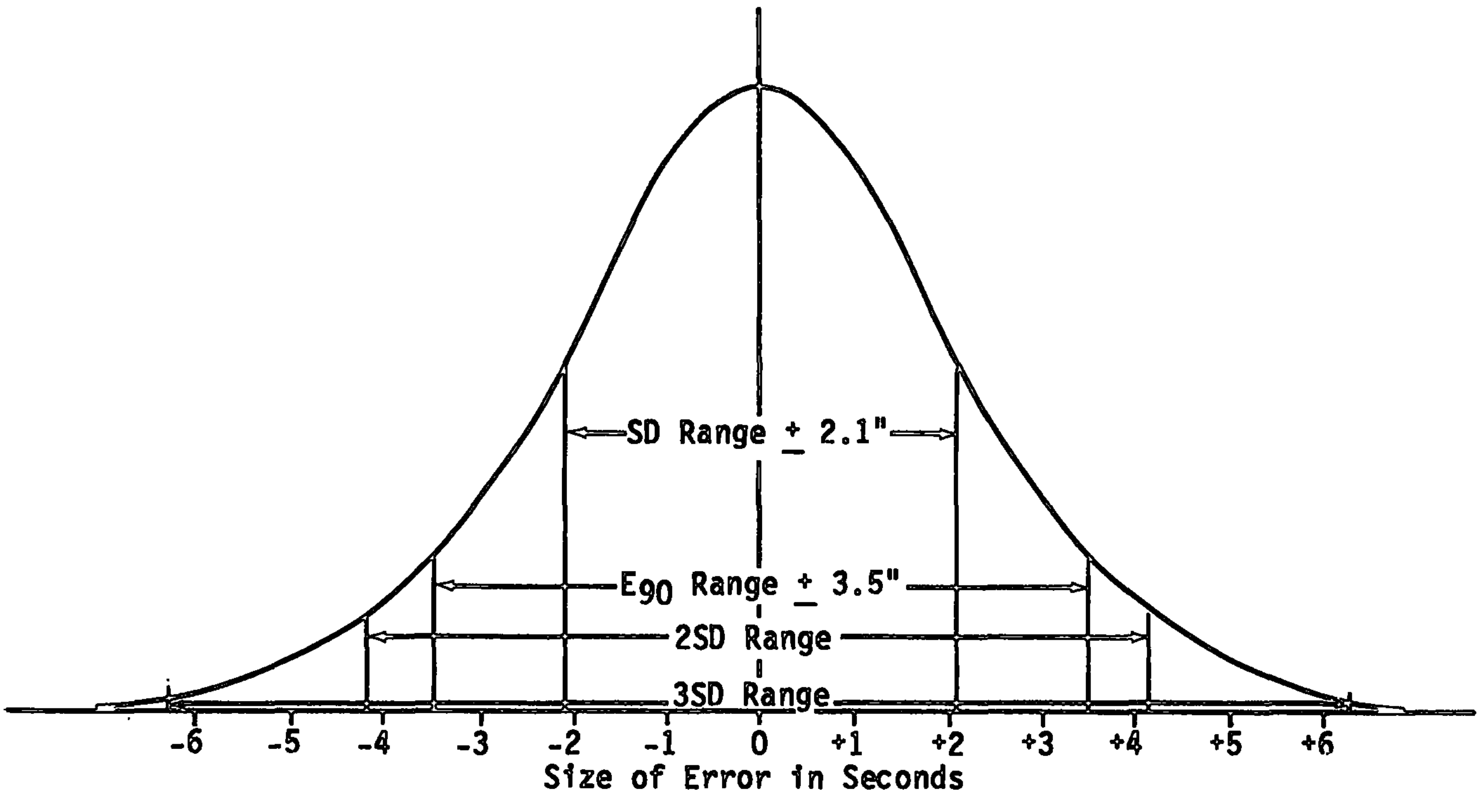


Figure 13.--Measures of precision for sample problem.

This tabulation shows that the field results closely follow the results expected according to the laws of probability. The more measurements in the series, the greater the chance that field results will conform to expected results.

Weighted Observations

Most surveys contain redundant measurements. These extra measurements are necessary for checking purposes and also to increase the precision of the final result. The following are some examples of redundant measurements:

1. Repetitious measurement of angles.

2. Level networks, where elevations of junction points can be computed using various routes.

3. Observing the three angles of a triangle.

Redundant measurements produce multiple values for the same quantity. Thus, the individual measured values must be combined, or adjusted, into a single result. When the individual measured values are of different precision, weights must be assigned to the individual values. The weight of a measured value is defined as the relative reliability (or certainty) of that value as compared to other values of the same quantity.

1. Assigning Weights. The assignment of weights is a process giving consideration to the laws of probability. The person who is most knowledgeable of the conditions at the time the observations were made should be the one who assigns the weights. Usually this is the observer.

a. Basic Rule. The weight of a measured value is inversely proportional to the square of the standard deviation of the measured value.

$$W \propto \frac{1}{SD^2}$$

In practice it may be difficult to determine the standard deviation of a survey value. However, the same procedures frequently are used throughout a survey. Thus, it can be assumed that the precision of the individual measurements is approximately equal. When the precision of all the individual measurements is equal, the basic rule for assigning weights reduces to the following:

b. Measured Values Are Result of Cumulative Measurements.

(1) Rule. If the measured values are determined by algebraically adding a number of individual measurements, the weight of each measured value is inversely proportional to the number of individual measurements used to determine the measured value. That is:

$$W \propto \frac{1}{n}$$

(2) Example. A new bench mark, BM-29, is established by running separate level lines from two control points called BM-101 and BM-203. The same procedures (precision) were used for each level line. If the level line from BM-101 required 18 turns and the level line from BM-203 required six turns, the relative weights of the elevations for the new bench mark as determined by the two separate lines would be as shown in the following table:

Elevation of BM-29 from -		Weight
BM-101	1/18	1
or		
BM-203	1/6	3

In this case, each turn can be considered an individual measurement.

c. Measured Values Are Means.

(1) If the measured values are mean values, the weight of each mean value is directly proportional to the number of individual observations made to determine the measured value. That is:

$$W \propto n$$

(2) Example. The three angles of a triangle were measured, using the same precision for each individual observation. If angle A was observed two times, angle B four times, and angle C eight times, the relative weights of the three angles would be the following:

Angle	Weight
A	1
B	2
C	4

2. Weighted Mean. When a series of measurements is made of a quantity and the individual measurements are of different reliability, the most probable value (best value) for the quantity is the weighted mean.

a. Computing. The weighted mean is obtained by multiplying each individual measurement by its assigned weight and dividing the sum of those products by the sum of the weights. That is:

$$\textit{Weighted mean} = \frac{W_1 M_1 + W_2 M_2 + \ldots W_n M_n}{W_1 + W_2 + \ldots W_n}$$

$$= \frac{\Sigma (WM)}{\Sigma W}$$

where

W_1, W_2, . . . W_n are the assigned weights; and

M_1, M_2, . . . M_n are the individual measurements.

b. Standard Deviation. The standard deviation of the weighted mean SD_m is obtained by the following formula:

$$SD_m = \pm \sqrt{\frac{\Sigma (Wv^2)}{W (n-1)}}$$

where

(Wv^2) = *sum of the products of the weights times the squares of* the errors.

That is:

(W_V2) = $W_1V_12 + W2_2 \; . \; . \; . + W_nV_n$

where

W = *sum of the weights; and*

n = number of measurements.

3. Adjustment of Sum of Values of Varying Weights. This discussion covers only one common adjustment procedure. Reference 47 provides additional information about this subject.

a. Basic Rule. Often in surveying, the sum of a series of observations of unequal precisions must equal a known value, either measured or exact. When this condition exists, the most probable values for the individual observations are obtained by applying corrections to them that are inversely proportional to their weights. That is:

$$corr. \propto \frac{1}{W}$$

The weighted mean is an example of an adjustment that follows this principle.

b. Example. An angle and the three segments that comprise the angle are measured using the same degree of precision for each individual observation.

(1) The field results were:

Angle	(Mean) Repetitions	Weight	Measured Value
AOB 2	1	200 10′ 12″	

BOC	4	2	590 21′ 06″
COD	4	2	20 38′ 58″
AOD	8	4	820 10′ 34″

(2) The observed values are adjusted as follows:

Observed	1		Adjusted	
Angle	Value	Weight	Correction	Value
AOB	20°10′12″	1/1	+8″	20°10'10"
BOC	59°21′06″	1/2	+4″	59°21′10″
COD	2°38′58″	1/2	+4″	2°39′02″
SUM	82°10′16″			82°10′32″
AOD	82°10′34″	1/4	-2″	82°10′32″
Error	+18″			
Eof	(1/Weight)′s	9/4		

(3) Sample correction calculation. Correction for angle AOB:

$$= Error \left(\frac{1/weight\ of\ AOB}{\Sigma(1/weight)'s} \right)$$

$$= 18'' \left(\frac{1}{9/4} = \right) 8''$$

The other corrections are computed similarly.

Principle of Least Squares

The principle of least squares is as follows:

When each of a number of measurements of any quantity is of the same precision as the others, the most probable (best) value of the quantity is the one for which the sum of the squares of the errors or corrections is a minimum (Z v^2 = minimum). If the measurements are of unequal weights, then the most probable value is the one for which the sum of the squares of the weighted errors is a minimum, [E(Wv^2) = minimum].

An explanation of the principle of least squares and its applications is too lengthy and complex for inclusion in this guide (see references 47, 7, and 66 in the Introduction).

THEORETICAL, or ESTIMATED, UNCERTAINTY

Some better means of assessing survey quality than relative precision is needed. It should be reliable, meaningful, consistent, fairly easy to compute, and understandable. Relative precision belongs in the museum with the link chain. It can be replaced with either the concept of theoretical uncertainty (T_u), or estimate of uncertainty of position (E_u).

Theoretical uncertainty (T_u) can be rigorously computed, but not as simply as the approximation E_u. E_u, computed with some simplifying assumptions, meets the above criteria. For any given survey, the mathematical error of closure (E_c) can be compared. This comparison will enable realistic estimates of precision and accuracy, detection of blunders or sloppy survey procedure, and conformance to survey specifications that use positional tolerance.

One-Dimensional Errors

In one dimension, the distribution of the errors of measurement from the mean or best value is specified by the standard deviation (SD). According to the laws of probability, 68.3 percent of normally distributed observations will have deviations less than this value; and 99.7 percent will be less than 30. Many authorities state that 3SD can be considered the maximum error since it occurs only once in about 370 times. Thus, for any system of measurement, if SD is known, the practical maximum error (3SD) of one observation also is known.

Manufacturers of modern EDM equipment publish the measurement accuracy of their equipment, usually showing the standard deviation value. Table 6 shows typical 3SD values for various classes of theodolites, according to the number of direct-reversed pairs observed, for typical daytime conditions.

Two-Dimensional Errors

Errors occurring in two dimensions, such as those from an angle and distance observation, form an error ellipse, with one axis along the line of sight and the other normal to it. If the two measurement systems are consistent, that is, each contributes the same amount of error to the observation, the ellipse can be considered a circle. In this case a circle of radius 3 for both angular and distance error contains about 99 percent of the observations.

Error Accumulation

Obviously, random errors do not accumulate in direct proportion to the number of observations. That is, if the error is one observation of 100 meters equals 1 centimeter, the accumulated error in the sum of 5 observations does not equal 5 centimeters.

Table 6.--Instrument class.

Least division of Micrometer, Scale, or Vernier						
# of D-R	1″	6″	10″	20″	30″	1′
1[a]	7″	7.4″	7.5″	10.5″	13″	15″

2	5.9	6.2	6.3	8.8	10.9	12.6
3	5.3	5.6	5.7	8.0	9.9	11.4
4	5.0	5.2	5.3	7.4	9.2	10.6
6	4.5	4.7	4.8	6.7	8.3	9.6
8	4.2	4.4	4.5	6.2	7.7	8.9

[a]Or angles doubled.

Typical 30 random angular error for various instruments in usual daytime conditions, pointing good targets.

For one-dimensional independent observations, the errors accumulate so that the total error (Et) is the following:

$$E_t = \sqrt{E_1{}^2 + E_2{}^2 + \ldots E_n{}^2}$$

This is a simple, correct expression easy to evaluate and use.

Example: What is the maximum angular misclosure allowable in a loop with 18 stations using a theodolite and procedure that yields 30 = 8.0?

$$E_t = \sqrt{(E_n)^2} = \sqrt{18(8)^2} = \sqrt{33.9''}$$

Angular misclosures in excess of this would be suspected of having either unresolved systematic errors or blunders.

Two-Dimensional Error Accumulation

Random, independent two-dimensional errors accumulate according to the same general model. Assuming that the error ellipse for each observation is a circle, the accumulated error circle for a series of independent two-dimensional observations is the following:

$$\text{Radius} = E_t = \sqrt{r_{e_1}^{2} + r_{e_2}^{2} + \ldots r_{e_n}^{2}}$$

Example: A connected series of 12 compass and tape measurements of roughly equal length and consistent angular and linear accuracy is made. What is the Et of the final point with respect to the beginning point if re = 0.2′?

$$Radius\ E_t = \sqrt{(r_n)^2} = \sqrt{12\ (.2)^2} = 0.7'$$

Dependent Observations

Notice that the two previous examples consisted or independent observations. In a normal traverse this is not independent because it is correlated to the computed position of all previous points. This fact introduces a complication in the mathematics involved in computing T_u. However, experience shows that the rigorous mathematical approach can be simplified to the form expressed in the second equation for practical estimates of acceptable closures in closed traverse. Thus, $E_u <= T_u$. This is so because many of the extra terms in the expression for T_u tend to be small and in a traverse that closes upon itself tend to cancel one another. Moreover, using consistent angular accuracy for the greatest length encountered makes the linear error the greatest contributor for all shorter distances. The simple expression for accumulating errors can be used under these assumptions:

1. The maximum errors (3SD) are circular, with the radius equal to the greatest of either the angular or linear error.

2. The errors accumulate as random independent observations.

3. Most of the error contributed is linear, not angular.

4. $E_u <= T_u$ and is a conservative estimate of maximum positional error.

The mathematical error of closure E_c should be less than E_u. If significantly larger, a blunder or unresolved systematic error is suspected.

Example: The five-leg closed traverse shown in table 7 is measured using an EDM with 5mm +5 ppm accuracy (SD) and a 20″ instrument, all angles observed with two D-R pairs. Analyze this survey to determine allowable E_c and angular misciosure.

Table 7.--Sample closed traverse.

Course	Dist.	E_a (Angle)	E_d (Distance)	E_r	E_r2
1	700	.030	.051	E_d	.0026
2	900	.038	.052	E_d	.0027
3	1900	.081	.058	E_a	.0066
4	500	.021	.051	E_d	.0026
5	1200	.051	.053	E_d	.0028
=	5200				.0173

E_a = Sine 8.8″(d)

$$E_d = 3\sqrt{K_2 + (d(PPM))^2}$$

where

d = horizontal distance of traverse course;

k = constant supplied by EDN manufacturer; and

PPK = parts per million (also supplied by EDM manufacturer).

$$\textbf{Estimated Uncertainty} = E_u = \sqrt{.0173} = 0.13'$$

$$\textbf{Total Angular Error} = A_e = \sqrt{5(8.8)^2} = 19.7''$$

$$\textbf{Relative Precision} = \frac{5,200}{0.13} \quad 1:40,000$$

The 3SD error for a 20″ instrument using two D-R pairs is 8.8″ (see the section entitled "One-Dimensional Errors"). The angular position error contributed is E_a = dSin 8.8′, and the position error due to distance is the following:

$$E_d = 3\sqrt{0.0164^2 + \frac{(5d)^2}{10^6}} \text{ in foot units}$$

See figure 14 and observe that with angular precision of 8.8′, the consistent precision for distance occurs at about 1,150 feet. Beyond that distance, the angular error is controlling over the linear error. Therefore, the radius of the error circle E_r for all courses except number 3 is controlled by E_d. E_u is computed as the square root of the sum of the squares of the largest error in each leg. Total angular error A_e is computed as Sqr(n) times angular 3. The mathematical misciosure should be less than E_u, and the total angular misclosure should be less than A_e. This yields a limiting relative precision of 1:40,000. It is interesting to note that a relative precision of half this amount would usually be considered acceptable, yet could in reality hide possible blunders or unresolved systematic error. Both A_e and E_u should be computed. An excessive A_e will also indicate systematic errors or blunders in the traverse angles.

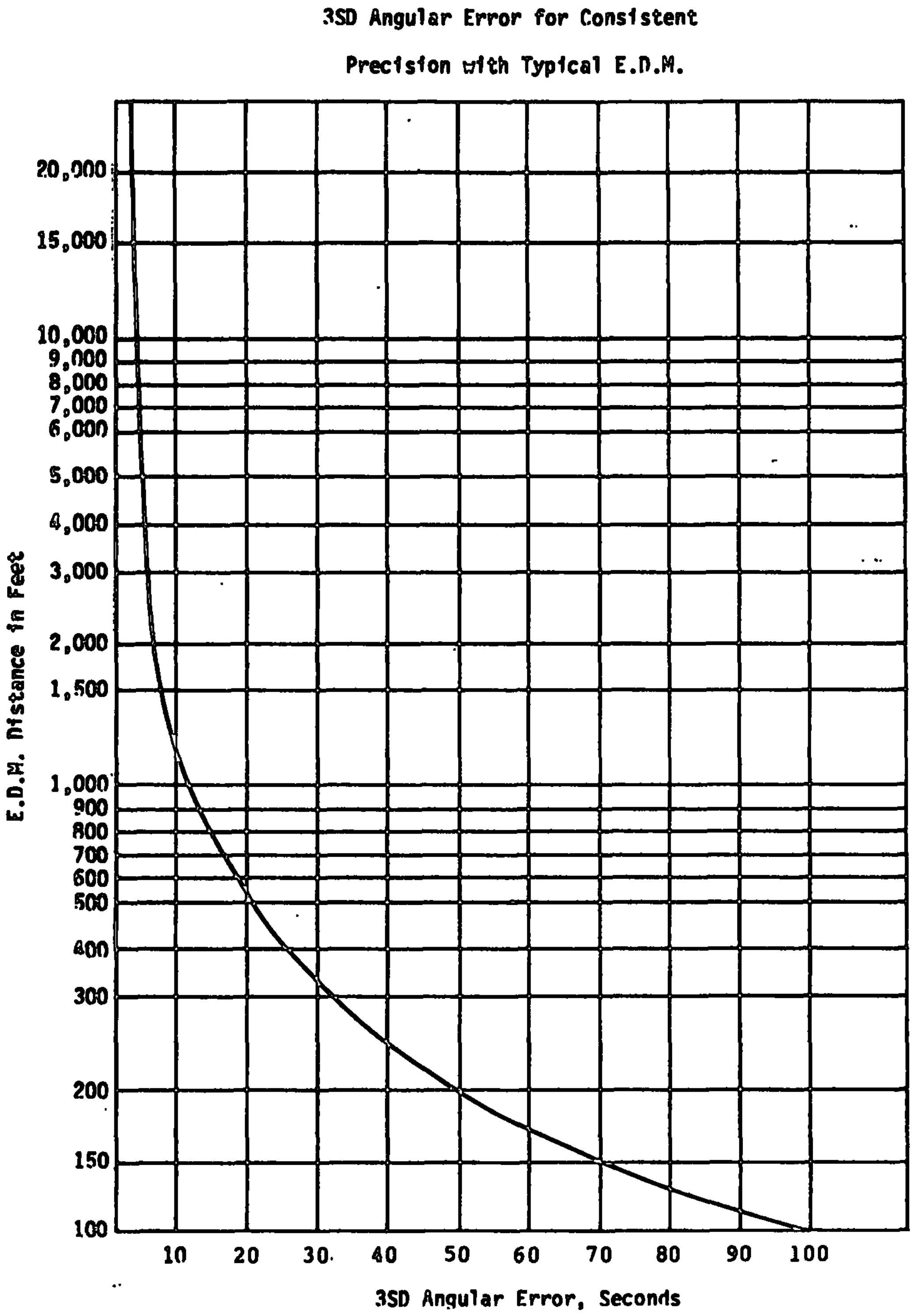


Figure 14.--Angular error for consistent precision with typical EDM.

POSITIONAL TOLERANCE

Positional tolerance is an expression of the total error that can be tolerated in a measurement or set of measurements. Strictly speaking, it is a two-dimensional figure best represented by an ellipse. As explained, it is usually simply assumed to be a circle with errors in distance and alignment set equal.

The allowable positional error of a point to be established can be arbitrarily set; such as ±2 feet and methods and equipment chosen to achieve results less than that positional error, Positional tolerance always is in relation to another point, such as a controlling corner. For ease in computation, the controlling point usually is considered the starting point. Positional tolerance is also stated to be at a certain confidence level; such as 3 sigma.

For traverses, the precision in measurements and hence the selection of instruments and number of repetitions will depend on the positional tolerance of the points to be established and their distances from the starting point. Table 6 will assist in the selection of angle-measuring instruments and provide a guide as to the number of repetitions of angle measurements necessary to obtain a given result. For EDM equipment, the manufacturer[9]s specifications will provide the precision that can be expected from a particular instrument.

For inertial survey systems a formula has been developed for estimating the accuracy of positions obtained under proper operating conditions:

Elevation: 10 centimeter + 8 centimeter/hour (0.33 + 0.26 feet/hour)

Horizontal: 13 centimeter + 12 centimeter/hour (0.43 + 0.39 feet/hour)

The error accumulation is a function of time, not distance; thus the expressions include the time between control check stations.

Satellite doppler positioning equipment in the translocation mode can provide high relative precisions (on the order of 1/50,000) but their relative accuracy degenerates at short distances. The manufacturers claim 30 centimeters (1 sigma) can be obtained under good conditions. It is doubtful if this equipment can attain a 3-sigma position of 2 feet between closely spaced (½ mile) property corners, However, at distances of 2 miles and beyond, the relative precision exceeds 1/10,000 and is more than adequate for many control applications.

The new global positioning system has obtained 3 millimeters (1 sigma) over short distances of 0.2 to 0.8 kilometer on a National

Oceanic and Atmospheric Administration Test Range. It appears that the system will be fully capable of being used to set even the most closely spaced property corners.

Photogrammetry will produce positional tolerances of almost any size if proper procedures are used. Analog instruments can produce root mean square errors of 1/10,000 of the flying height and fully analytic methods 1/50,000. To take advantage of these relatively high capabilities, careful, highly accurate control procedures must be employed. It is doubtful if cadastral surveyors should use anything less than Federal Geodetic Control Committee second order, class II procedures and equipment for control surveys for extensive photogrammetric surveys, Federal Geodetic Control Committee Specifications (see references 62 and 63 in the Introduction) provide the standards, Notice that reference 63 states that "the quantities listed are considered to be at the 2-sigma or 95-percent confidence level.”

CLASSIFICATION STANDARDS of ACCURACY

The Department of Commerce publishes two pamphlets that list and provide explanations for the Federal system of classifying control surveys. These publications are listed in the section on references and should be included in the library of every Forest Service Land Surveyor.

The Federal system consists of a classification scheme that includes three orders descending in accuracy from first to third for both vertical and horizontal surveys. Some of the orders are further subdivided into classes. Each order and class has a standard expressed as relative accuracy between adjacent stations or bench marks. For horizontal surveys, the standard is expressed as a fraction (1 part in 100,000), while for vertical surveys the standard is a constant multiplied by the square root of the distance between bench marks in kilometers (0.5mm sqr(k)). They also include specifications that consist of a set of instructions for angular measurements, linear measurements, station spacing, azimuth checks, and other procedures that, if followed, should meet the standards for each order and class. These classification standards are intended to be used to establish geodetic control stations for many scientific and engineering applications. They have application in cadastral surveys as well.

It is a settled principle of law that original monuments control, regardless of the accuracy of their placement, and that missing original monuments should be restored according to the rules of evidence recognized by the courts. Nevertheless, accuracy in measuring the relationship of original monuments to each other and placing new monuments provides credibility and acceptability by the public and courts to a surveyor’s work. Because of this fact, some standards for control surveys are useful. Some States have no survey standards and other States have standards that are not based on scientific principles. The Federal standards are scientifically sound and have been proved over many years of use.

Analysis will show that Federal third order, class II standards will meet Forest Service cadastral survey positional tolerance requirements for surveys up to about 2 miles in length. Beyond that, proportionally higher classifications must be used, depending on the distance between corners.

It also is important to note that the Forest Service positional tolerance standard is a results-oriented standard, while the Federal geodetic standards are procedural in nature. In other words, if the Federal procedures for a given classification are rigorously followed, the random errors will be within the limits specified. It also is noteworthy that adherence to the procedures in the Federal standards has the potential of saving money because precision is proportional to cost. For example, third order, class II accuracy in angulation can be obtained with a direct and reverse observation in two positions of the circle, but second order, class II specifications require 6 positions for the same 1-second theodolite. Three times the effort is required to attain the higher accuracy. Survey procedures and instrumentation should be carefully chosen to achieve the accuracy necessary because unwarranted accuracy will increase costs by an exponential ratio.

The Federal control survey standards are not included in this guide because they are periodically revised and updated by the Commerce Department. Some agencies have excerpted various tables from the standards without the accompanying text and explanations. That is a poor practice because the standards cannot stand alone without a thorough understanding of how they were developed and how they are to be applied.

FEDERAL GEODETIC CONTROL COMMITTEE

A Federal Geodetic Control Committee (FGCC) was formed in 1968 by interagency agreement between nine Federal agencies. The Department of Agriculture is represented on this committee by a member and alternate, both employed on the Director of staff of the Forest Service in Washington, D.C. The FGCC was organized to assist the Department of Commerce in meeting the requirements of the Office of Management and Budget COMB) circular A-16, dated May 6, 1967. Under the circular, the Department of Commerce is to exercise Goverment-wide leadership in ensuring coordinated planning and execution of its national geodetic control surveys and the related survey activities of Federal agencies, including activities financed in whole or in part by such agencies so that--

1. The geodetic control needs of Government agencies and the public at large are met in the most expeditious and economical manner possible with available resources.

2. All surveying activities financed in whole or in part by Federal funds contribute to the national networks of geodetic control when it is practicable and economical to do so.

The circular also requires that each Federal agency cooperate in the development of appropriate coordinating mechanisms; supply necessary information to the Department of Commerce concerning its requirements, programs, and products; and conduct its surveying and product distribution activities in a manner that provides effective Government-wide coordination and efficient service to the general public. A major restructuring of FGCC was accomplished in 1981, along with the development of the Department[9]s responsibilities.

The FGCC also develops and publishes standards, specifications, and input instructions for producers and Users of geodetic control and related surveys.

Tests of survey equipment are performed by a subcommittee of FGCC and made available to all member departments, thereby eliminating the need for each agency to conduct individual tests.

The plan provides the basis for the Department of Commerce’s report to 0MB relative to the responsibilities assigned through OMB circular A-16. Survey requirements and plans and. other information contained in this report will allow coordinated plan-fling by Federal, State, and local agencies, thereby reducing the potential for duplication of effort and enhancing the opportunity for the development of multipurpose surveying products.

The exchange of information on surveying plans and requirements potentially is one of the most beneficial aspects of the FGCC’s activities. Overall knowledge of surveying requirements and plans is essential to the success of the consultation and coordination functions assigned by the Office of Management and Budget COMB) circular A-16.

At present the Forest Service does not contemplate needing any control surveys more accurate than third order. Since third order surveys do not contribute to the national network but are only referenced to it, the Forest Service is not required to submit its work to FGCC. However, with the increasing use of advanced survey technology and application of a systems approach to the cadastral survey program, this situation will change. Highly accurate control will become necessary and, at the same time, will be economically feasible to acquire.

When the need arises for geodetic control surveys of first and second order accuracy within the National Forests, it will be essential that the Forest surveyors use the procedures established by the FGCC for requesting such surveys. Contact Regional surveyors or geometronics leaders for details.

CONTRACT SURVEY

PRECONTRACT RESEAPCH

Outyear preparation is essential for successful surveying contracts. Without adequate lead time to assemble all of the office and field information, contract preparation becomes burdensome in both time and money. A thorough search and evaluation of both office and field data must be accomplished prior to contracting.

Record Data

See the section entitled "Search and Evaluation.”

Field Data

An important element of the successful contract survey is job site reconnaissance. During this field review, such things as access, ground cover, and topography can be evaluated to formulate a more realistic estimate of the total job requirements. Additional field related data are as follows:

1. Project Controlling Corner Search. It is important that the controlling corners for the project are documented with accurate, complete, and current field information. It is recommended that the controlling corners be visited and verified within the 2 years prior to the contract award.

2. Remonumentation$_0$ This important phase usually can be done at the time of corner search and evaluation and normally is less costly when done by force account, Exceptions may be with proposed contracts containing large numbers of nonremonumented corners coupled with lack of Forest manpower to accomplish the remonumentation.

3. Landowner Contacts. At times a landowner is reluctant to have his boundaries delineated or controlling subdivisional monuments established adjacent to his property. The field reconnaissance phase is an excellent opportunity for the cadastral surveyor to explain the purpose of the survey and acquire written permission from adjoiners to establish, post, and mark the common Forest Service-private boundaries. The contractor also should be instructed to contact the landowners prior to entering private property.

4. Permission To Survey Forms. All completed forms for "Permission to Survey” by adjacent landowners will be furnished to the contractor, Occasionally, a landowner is unavailable prior to the contract awarding, so blank "Permission to Survey" forms will be made available for the contractor's use on the job when contacting these adjoiners CFSM 5461.12c).

CONTRACT PREPARATON

Preparation of an organized contract package will assist the Contracting Officer, Contract Officer's Representative, and contractor when questions concerning the contract specifications arise. The following documents are required for each contract package:

1. Request for Contract Action. (FSPR 4G-16.870-4, form FS 6300-4.) The Forest Service registered land surveyor requesting contract action identifies the type of contract action the contracting officer will use. Either an Invitation For Bid CIFB) or Request For Proposal CRFP) procedure is used depending on the complexity of the project.

Table 8 identifies procurement methods for different surveying services.

2. Schedule of Items. Indicates the work to be accomplished, such as number of corner monuments to be set, miles of line to be posted and marked, and preparation of final records.

3. Specifications for Survey Contract. National Standard specifications for land surveying contracts will be used. The Contracting Officer, Contract Officer’s Representative, inspectors, and contractors must become totally familiar with all the provisions contained in these specifications, exhibits, technical proposal forms, price proposal forms, and technical evaluation forms.

The Standard National Specifications are written to define all the services normally required in a cadastral survey. These include retracement, resurvey, subdivision, monumentation, marking, posting, clearing, blazing, record preparation, and filing. All the clauses of the Standard National Specifications shall be maintained in a word processor at the Forest level. When a contract is prepared, only the con- tract clauses needed to accomplish the desired work will be printed from the word processor to form a master copy of the contract. This procedure eliminates the need for supplemental specifications to delete unwanted services and the printing of a lot of unnecessary material. Supplemental Specifications will be required. The Standard National Specifications may need occasional revision and will be accomplished upon direction from the Washington Office.

4. Supplemental Specifications. All information unique to a particular contract shall be placed in the supplemental specifications. This includes project location and a discussion of any special or unusual conditions that may be encountered or required to accomplish the project. Their purpose is to add pertinent information to the standard specifications.

Table 8.--Procurement method guidelines.

Surveying Service	Procurement Method
Line maintenance	IFB (Invitation For Bid)
Corner monument rehabilitation	IFB
Line marking and posting	IFB
All types of land surveys	IFB except when the following conditions are suspected and then RFP (Request for Proposal) will be used: 1. Trespass or title claim 2. Conflicting surveys 3. Junior/Senior corners 4. Lost Corners 5. Complex or disputed ownership patterns 6. Fraudulent or erroneous surveys 7. Extensive obliteration 8. Technically complex surveys (i.e., fractional sections, HES, Completion Surveys, etc.) 9. High value or sensitive lands Note: The responsible surveyor will inform the Contracting Officer when any of these nine conditions is suspected at the time contract action is requested.
Corner search, evaluation, and remonumentation	RFP

Minor variations from the standard specifications will be identified in the supplemental specifications--for example, post spacing, paint color, and particular platting requirements of the local authority.

A supplemental specification that results in a major change of a Standard National Specification must be reviewed and approved by the Regional Office.

A set of the supplements must be prepared and attached to the standard specifications as an addendum. Care must be taken to emphasize the additions contained in the supplemental specifications so the Contracting Officer, Contract Officer’s Representative, and contractor fully understand the contract requirements.

5. Exhibits. Detailed exhibits showing corner search status, land-ownership, required survey lines, lines to be posted and marked, and other related data as needed will be prepared and attached to the specifications as contract exhibits.

6. General Provisions. The boilerplate is assembled by the Contracting Officer and attached to the specifications. These consist of the nontechnical provisions and requirements of the contract, Items such as hiring practices, safety, default clauses, and claims are covered in the general provisions.

7. Other Support Data. All plats, corner-record forms, and related survey information known to the cadastral surveyor will be made available to the contractor for use and evaluation.

8. Preproposal Conference. The contract package submitted to contracting may give the time and place for a preproposal conference. At the preproposal conference, information shall be given that is pertinent to the contract. A site review of the project area shall be the option of the Contracting Officer. During a preproposal conference, the Forest will make available all current records in their possession.

9. Contractor Evaluation and Selection. The contract package shall contain national criteria for contractor evaluation and selection. Contractors should be evaluated on the following basic items and additional special criteria:

a. Qualifications and experience of the registered land surveyor who shall be assigned to and be responsible for the survey project.

Experience must be related specifically to performing boundary surveys of the character of the survey to be performed.

b. Submittal of two or more sample copies of land or boundary survey plats prepared and certified by the licensed surveyor who will supervise the contract.

c. A detailed explanation of the technical approach to be used in performing the work.

d. A list of proposed manpower, equipment, and production rates to be utilized on the survey project.

10. Cost Estimate Worksheet. A cost estimate will be prepared with sufficient detail to enable a comparison of job activities between the Forest Service estimate and the contractor's estimate.

EVALUATION of TECHNICAL PROPOSALS

Once the request for proposals has been circulated and the responses of prospective offerors have been reviewed, the technical proposals shall be evaluated. The Board of Technical Evaluation shall be convened to determine the acceptability of the technical proposals. The Regional Forester shall ensure that a qualified land surveyor is a member of the Board. The acceptable proposal shall satisfy the criteria established for the particular project.

PRICE SOLICITATIONS

The Board of Technical Evaluation shall not have access to the price submitted while making the technical evaluation of proposals.

After the technical proposals have been evaluated, a narrative report is made of the Board's finding of acceptance or nonacceptance. This report is forwarded to the Contracting Officer.

The Contracting Officer may require offerors to furnish additional information to clarify proposals.

The Contracting Officer must determine a competitive range for the proposals that includes both technical and price considerations. The award is normally made to the proposal that is lowest in price within the competitive range.

PREWORK CONFERENCE

After the selection has been completed, the Contracting Officer and Contracting Officer's Representative shall review the contract package and prepare a list of important items to be reemphasized in the prework conference. During the conference any additional questions concerning the contract can be answered. Usually, this is an opportune time to give the contractor the Government-furnished supplies and record data as needed for the contract.

CONTRACT ADMINISTRATION

For contractural procedures, see FSH 6309.11, Contract Administration Handbook, and figure 15.

Government-Furnished Property & Information

The Government shall furnish all property items as listed in the supplemental specification of the contract. In addition, all plats, corner record forms, and related survey information known to the cadastral surveyor shall be made available to the contractor for use and evaluation.

Inspections

Checks shall be made of the contractor’s progress during the duration of the contract.

Field Inspections

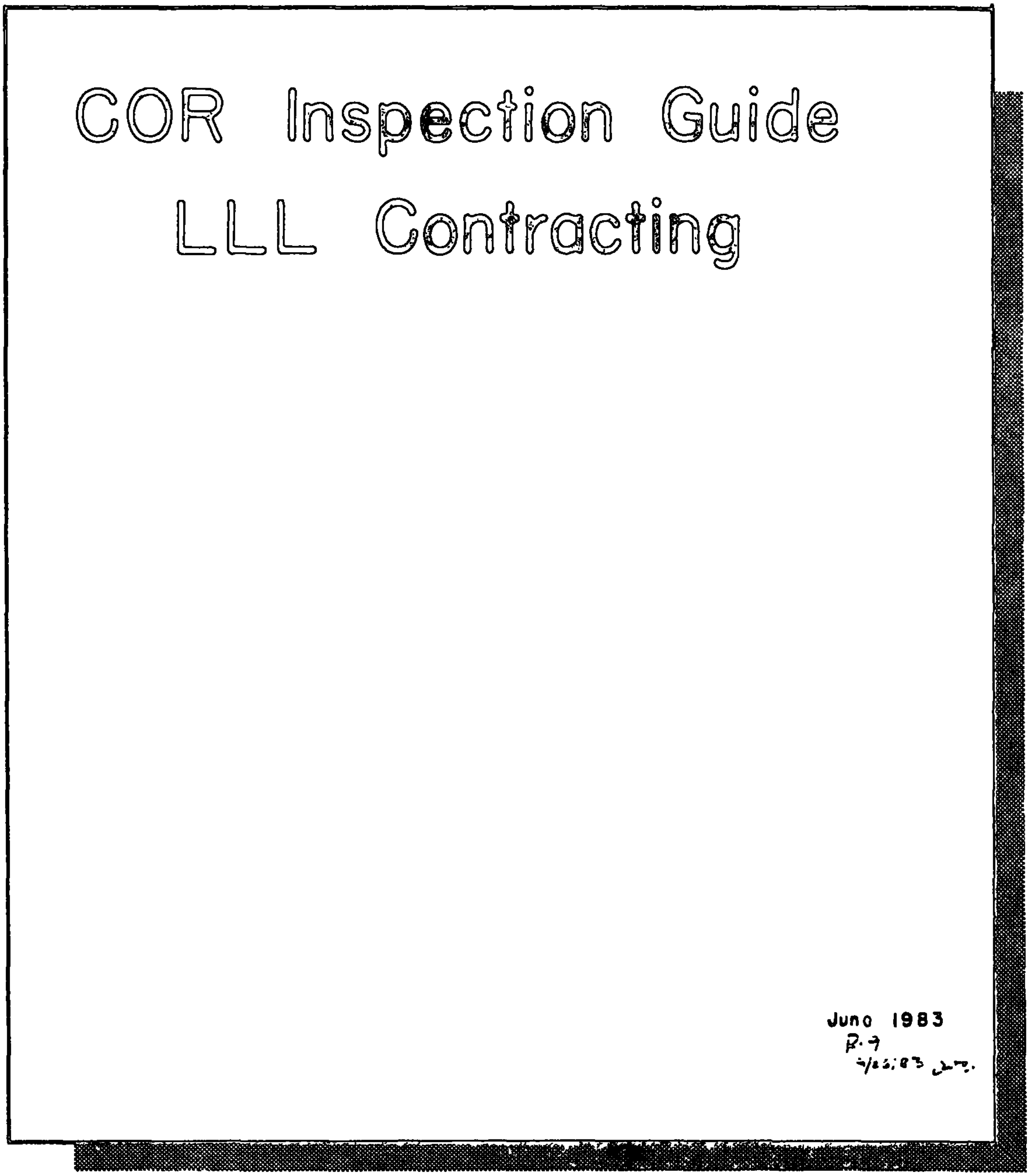
All inspections will be documented in the daily diary.

1. Reviews. Field reviews shall be carried out early in the contract to ensure that the contractor complies with the contract specifications. Many problems can be prevented by an early review of each phase of the contract items.

2. Audits. The Contracting Officer’s Representative or Inspector shall check a sufficient portion of the traverse survey to satisfy himself that the quality meets the minimum contract specifications. The Contracting Officer’s Representative or Inspector should inspect all monumented corners, accessories, and the required miles of posted and marked line for contract compliance. The Contracting Officer’s Representative or Inspector should review and inspect any evidence of original corner monuments, accessories, or supportive data used to reestablish obliterated corners.

Office Inspections

The contractor’s fieldbooks and computation sheets (or copies) shall be reviewed for format, completeness, and usability prior to final acceptance, Other contract records, such as plat, corner record forms, control diagrams, and photo identifications shall be reviewed for neatness and content. Computational checks will be made of platted data. All field and office contacts with the contractor or his representative will be documented on a daily diary form and a copy will be submitted to the Contracting Officer. Include important items discussed, suggested directions, and contractor’s responses.



COR Inspection Guide

LLL Contracting

Juno 1983

R. 7

[illegible]

Figure 15.--Contract administration procedures.

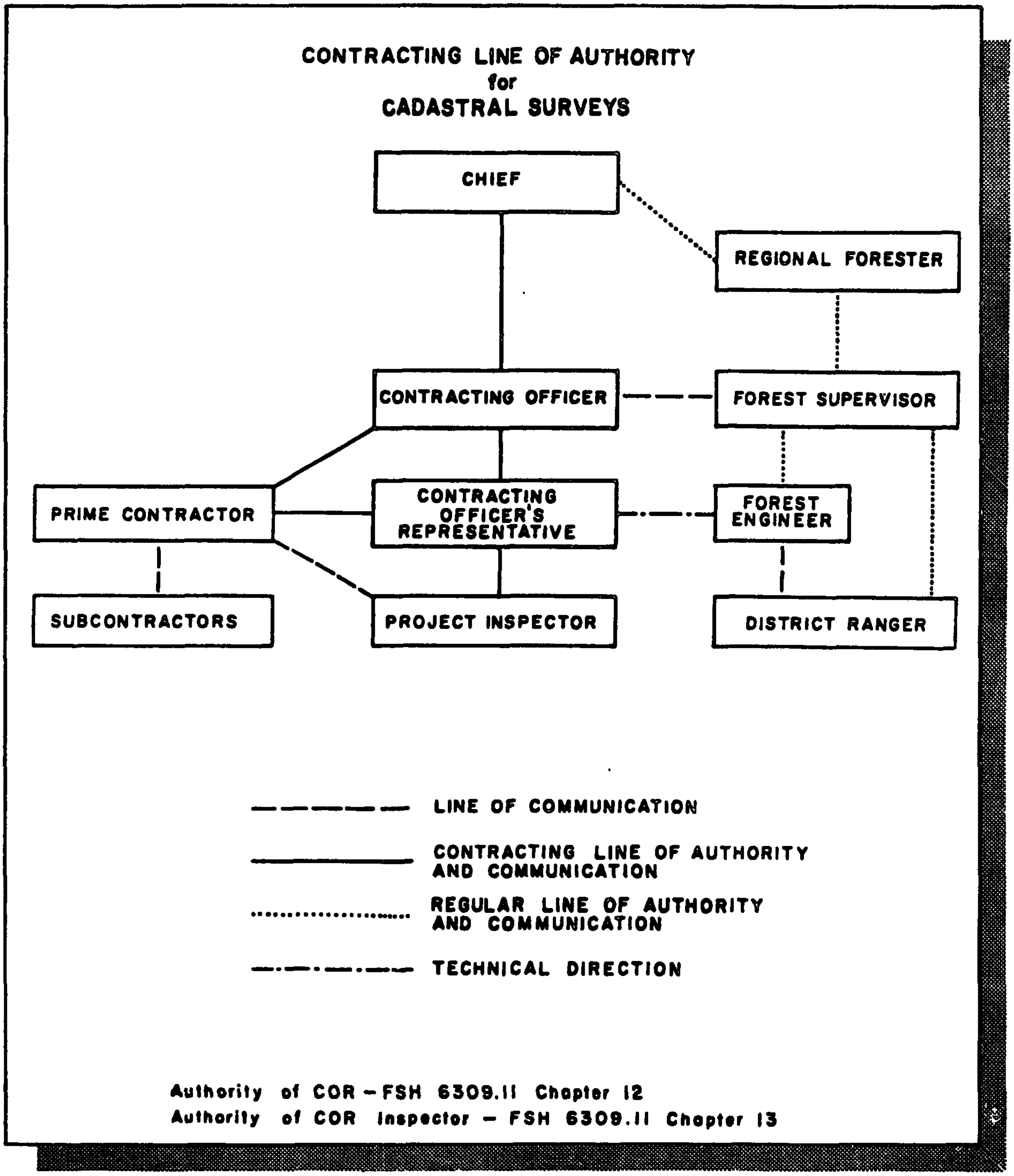


Figure 15. (cont.)--Contract administration procedures.

Line of Authority

Only the Contracting Officer and designated representatives are authorized to conduct official business with the Contractor in the administration of a contract.

INDEX | Page

Figure 15. (cont.)--Contract administration procedures.

Preproposal Meeting

A preproposal meeting may be conducted by the Contracting Officer and/or designated representatives at a place generally convenient for the interested offerors to assemble.

The purpose of these meetings is:

1. Acquaint offerors with contract requirements and specifications, including exhibits.

2. To describe project area(s) with maps and records.

3. Provide uniform response to questions from the offerors assembled.

4. Provides general discussion on technical rating and evaluation based on offerors response to contract solicitation. Pricing is separate consideration.

5. Give offerors indicator as to response to contract solicitation.

Prework Conference

A prework conference is conducted by the Contracting Officer or representatives.

Contract provisions are reviewed with the Contractor for the items listed on Form R9-6300-7. Form FS-6300-6 is used to designate the Contracting Officer's Representative (COR).

The prework conference or an on-site meeting with the Contractor should lay the groundwork for Contractor-COR relations as to meeting places, inspections, cooperative assistance, and review and discussion of problems during the course of the survey.

Project Orientation

The Contractor has the responsibility to visit the project area and learn the field conditions in responding to a contract solicitation.

Preliminary Inspection

The Contractor should be contacted on the project site within five days after start of the survey. Any apparent problem or procedural techniques should be examined to minimize potential for rework. Acceptance or rejection of questionable corner evidence should be resolved in early stages of survey to minimize or eliminate later survey stage disputes.

Figure 15. (cont.)--Contract administration procedures.

Interim Inspection

Project orientation and preliminary inspections should indicate the degree of inspection and check measurements needed before final inspection and acceptance. Procedural and technical problems should be resolved in early stages of the survey and as problems may occur or be brought to the attention of the COR.

Basic items for inspection include:

1. Evaluate Contractor recovered corner evidence as supported by the original and subsequent survey records. With a first time Contractor a 100 percent check is recommended.

2. Survey measurements between traverse points and monumented corner positions. Check measurements should be made over randomly selected sections of closed traverse and on open and spur lines. The degree of inspection should be not less than 10 percent and up to 25 percent for first time contractors. <u>The inspector must be certain any apparent error or marginal accuracy tolerance does not rest with the inspector's measurements.</u> The accuracy of the inspector's measurements should be not less than 1 part in 15,000 for tangents of 500 feet or less and in the order of 1 part in 30,000 for tangents of 1,000 feet or more. See appendix.

Final Inspection

The final inspection should be a confirmation of the interim inspections and, in addition, cover that part of the project work not reviewed during the interim inspections. The minimum final inspection should verify that corner monuments are in place and referenced, that boundary lines are marked to standard, and that encroachments are identified and located.

Final inspection items include:

1. Review field books and notes for traverse entries, corner searches and recovery, reference sketches, survey techniques, use of survey records, testimony, affidavits, and any data pertinent to the performance of the survey.

2. Review of plat survey, survey notes, certificates, and corner cards.

<u>**On Plat**</u>

a. Check for closure.
b. Check symbol for corners to assure they agree with legend.
c. Check for lines to standard, surveyed lines, unsurveyed lines, etc.
d. Check for heading, north arrow, and scale.
e. Check details for encroachments to assure they agree with results of review in field.
f. Check distances along line to be sure totals agree.
g. Check that each line shows a bearing.
h. Check enlargements for detail.
i. Check ownership status.
j. Check that procedure complies with applicable laws and rules.

Figure 15. (cont.)--Contract administration procedures.

Survey notes

a. Results of historical research of survey records are identified on plat.
b. Compares with exhibits furnished Contractor.
c. Check to assure accepted terminology is used to restore or establish corner positions.
d. Check to assure correct accessories are documented in notes.
e. Check to assure certification is documented in notes.
f. Check surveyor affidavit to assure it is correct, with signature and seal of contractor, personnel used in field work, and date of survey.

Certificates

a. Compare with plat of survey to insure concurrence.
b. Signature, seal and filing.

Corner Cards

a. Compare with plat of survey and certificates to assure concurrence.
b. Check to assure cards are filled out properly.

3. Review of Rework

a. To assure changes have been accomplished as noted in field inspection.
b. To assure changes have been made on plat of survey, certificates and corner cards.

Report and Recommendation to C.O.

COR to send letter to Contracting Officer stating project field work is completed and in conformance with contract specifications and recommends acceptance.

Acceptance

With acknowledgement and acceptance by Contracting Officer of COR recommendations and plat approval per FSM 7153.03, the COR tells the Contractor to file plats and certificates.

Letter from Contractor stating plat of survey and certificates have been filed and gives the document number and date of filing for each survey document filed.

Receipt of Contractor letter with required copies of plat and certificate closes contract after final payments have been made.

Non-Acceptance

COR is the liaison between the prime Contractor and the Contracting Officer. Any survey or contract problems that may arise during the course of the inspections, and cannot be resolved in the field, shall be brought to the attention of the Contracting Officer. The problem should be documented and include appropriate recommendations. Any needed consultation for resolution of a problem should be made through the Contracting Officer.

Figure 15. (cont.)--Contract administration procedures.

Diaries

Complete diary records by the COR for all phases of the contract are essential as a record and references of the orientation, inspection, problems, rework, and project acceptance. Emphasis is placed on dates and contacts. Diary entry items include:

1. Preproposal meetings
2. Prework conferences
3. Reference to written communications
4. Telephone conversations
5. Local contacts - testimony
6. Inspections - what, where, and with whom
7. Problems and disputes - resolution
8. Assistance to contractor
9. Communications with C.O.
10. Miscellaneous
11. Acceptance of survey

Inspector and COR

Background:

1. A specialist in land surveying and being well informed by:

   a. Education
   b. Continuing education
   c. Experience
   d. Professional memberships and participation

2. Able to make good judgments and sound decisions

   a. Using record research
   b. Using written evidence
   c. Using unwritten evidence
   d. Using local testimony
   e. Evaluating physical evidence
   f. Applying personal knowledge
   g. Using consultation
   h. Knowing project requirements

Checklist:

1. Be cooperative and responsive

   a. Assist contractor in starting project, if requested
   b. Discuss problems that may arise
   c. Be frank and honest
   d. Not be defensive
   e. Be a good communicator
   f. Provide limited training, if requested

2. Have powers of observation and conviction

   a. Be forthright
   b. Be willing to learn
   c. Be willing to listen
   d. Be fair and impartial

Figure 15. (cont.)--Contract administration procedures.

CLOSEOUT

Closeout of a Government contract is essentially a process of gathering together all essential documents reflecting the completion and satisfaction of a wide list of obligations that are required by the contract. The final step in contract closeout is normally the submission of the final invoice by the contractor and its acceptance and payment by the Government. The contractor also is required to sign a release of any claim against the Government.

Significant Items

Significant items that must be completed before closeout include the following:

1. Verifying that Government-supplied property has been returned in acceptable condition.

2. Ensuring that adequate documentation (diaries) exists to show receipt and formal acceptance of all contact items.

3. Determining that all administrative reviews, inspections, audits, and approvals have been accomplished and documented.

4. Determining that all required data have been delivered or filed with the appropriate local offices as required by the contract--for example, record of survey, survey report, recordation forms or FS 7100-52 corner cards, copies of fieldbooks, and computations.

5. Contract release with the final billing from the contractor.

6. Reporting and documentation of encroachments and trespasses.

Acceptance

After inspections are complete and all survey returns have been submitted and accepted, the Contracting Officer’s Representative shall recommend final payment. The Contracting Officer’s Representative may write a Final Contract Report if he or she feels that pertinent information needs to be documented concerning items or events in the contract.

DESCRIPTIONS

Land descriptions and the interpretation of land descriptions are used at every administrative level of the Forest Service. All resource management activities are governed by the limits of boundaries described in executive orders, proclamations, laws, deeds, easements, allotments, sale contracts, leases, and so forth.

This section contains information on preparing an acceptable description. An excellent text on the subject is "Writing Legal Descriptions” by Wattles.

TYPES of DESCRIPTIONS

"Legal description” is a generic term, referring to a description recognizable by law that definitely locates property by reference to the Public Land Survey System, coordinate systems, or recorded maps; such a description is sufficient to locate the property without oral testimony. The following are types of legal descriptions.

Public Land Survey System

The description of a parcel of land referenced to an official plat of the public land survey. Example: Section 22, Township 5 North, Range 15 West, 4^{th} Principal Meridian; HES 386; MS 1642.

Bounds

Land described by calling for the adjoining landowner. Example: Bounded on the north by the land of Leo Smith.

Metes & Bounds

Description of a parcel of land by references to courses and distances around the tract, natural features, record monuments, recitations of monuments set, legal reference to adjoining deeds of record, and so forth.

Plat

Description of a parcel of land by reference to a map that has been filed with the proper authority and is recognized as a part of the public record.

SPECIFICATIONS

1. Descriptions are to conform with “Specifications for Description of Tracts of Land” (1942 edition) by the Bureau of Land Management, Department of Interior.

2. Forest Service Manual specifications for land descriptions are found in FSM 5400, 5540, and 2860.

ESSENTIAL FEATURES

In writing descriptions, it is essential that technically accurate and sufficient information be given to allow definite location on the ground. The writing should be clear, concise, and complete. The description shall show intent, be physically locatable, have accurate dimensions, and be susceptible of only one interpretation.

RECITALS

The outline of a written description and the essential information contained in each section are discussed in the following sections.

Caption

1. General location by city, county, and State and gross bounds of the tract.

2. General title recital, such as “Smith’s land.”

3. Intent, such as undivided half interest.

Body

1. Metes and Bounds.

a. Description of the point of beginning.

b. Intent of the course or bound, such as along the right-of-way line.

c. Bearing and distance.

d. Corner or monument call with description and bound.

e. Monument reference information.

f. Closing call.

g. Area.

h. Exception description.

i. Basis of bearing.

2. Public Land Survey System. Normally, a PLSS description does not have a separate body and caption; they are combined. This is also true of lots and blocks.

a. Identification of location by section, township, range, and meridian or survey.

b. Aliquot part or parts.

c. Area.

d. Exceptions.

Special Cases

1. Azimuth. An azimuth is the angular direction of a line measured clockwise from a specified reference line, For civilian geodetic surveys, the reference line generally is considered to be south, However, most modern computer programs are referenced to north.

2. Curves. Curves in descriptions are usually plane circular curves, or a combination of curves, In order to mathematically determine and describe a curve, two elements or dimensions are needed. The most frequently used are degree of curve (or radius), length of curve, tangent distance, and Delta (or central angle). The preferred elements are the radius and arc length.

3. Coordinates. It is possible to describe a parcel of land by giving the coordinates of corner positions.

WORDS & PHRASES

The use of proper words and phrases is essential.

1. “Adjoining,” “contiguous,” and “coincident” all refer to a common boundary.

2. “Adjacent” means in the vicinity and may not necessarily be adjoining.

3. “Along,” referring to a line, means on and in the direction of the line.

4. “Course” refers to the dimensions of the line and includes the bearing and distance.

5. "Except” withdraws a part of the whole.

6. "Reserving” creates an outstanding right or privilege.

7. “More or less” denotes uncertainty as to accuracy of dimension in a small degree.

8. “Approximate” indicates ignorance of the exact dimension but a knowledge with reasonable limits.

9. “About” is general information and used only for broad identification.

10. “Northerly,” “easterly,” “southerly,” and “westerly” all imply a general sense of direction.

Administrative Descriptions

The writer of an administrative description is urged to consult with a person who is knowledgeable about placing the description on the ground.

Past practice of defining administrative boundaries by aliquot parts has required some costly surveys. Example: A wilderness boundary follows a subdivision of section line. The subdivision line controls and must be established if the Forest Service is called upon to define and defend the boundary.

The main point is to make absolutely sure the intent of the description is clear and easily definable.

Sample Descriptions

Several textbooks cited in the reference section in chapter 3 contain sample legal descriptions. Reference 65 is the definitive authority for descriptions for Government land orders and proclamations.

Contents for Chapter 3
Legal Responsibilities

Page

Chapter 3
Legal Responsibilities

The land surveyor is responsible for locating boundary lines in compliance with applicable rules and laws. The listing and briefs of boundary case digests provide a general guide for the legal aspects of the location of boundary lines. A working knowledge of case law is necessary for surveying; however, the opinion and advice of legal counsel is advisable if there is potential for litigation or related problems.

Surveyors perform in a quasi-judicial capacity, but their role is as an expert witness and not as a judge. “What is the boundary?” is a question of law; "where is the is a question of fact. Surveyors are responsible for the recovery of evidence of survey systems.

The legal significance of any survey is determined by judicial review and acceptance. The legal sufficiency of any cadastral survey involves its ability to satisfy the tests of evidentiary admission and to withstand the review of a competent judicial tribunal. Cadastral surveys performed by competent land surveyors in accordance with the requirements of applicable rules, laws, and regulations will meet the evidentiary admission tests and normally withstand attack or question when judicially reviewed. Although the issue of survey legality lies ultimately with the courts, a survey description prepared according to law and regulation by a competent land surveyor definitely facilitates the court’s function and promotes the survey’s legal status.

Various State and Federal statutes govern the land surveyor’s activities. It is necessary for the Forest Service land surveyor to be aware of those statutes. Because of the diversity of State and local laws, the Forest Service land surveyor should make a compilation of the laws pertinent to his area.

LEGAL AUTHORITY & ACCURACY of SURVEYS

AUTHORITY

The legal authority for the execution of land surveys has been identified in FSM 7153.01. Except for those land surveys performed by the Forest Service under the current memorandum of understanding with the Bureau of Land Management, all land surveys affecting the rights of adjoiners will be performed under the direction of a land surveyor licensed in the State where the project is located.

New corners and corners reestablished by the Forest Service shall be set by one with proper authority who follows the rules of law and who employs methods in common use for lands of similar character and value in the locale.

ACCURACY

Land surveys conducted for the Forest Service shall attain the most restrictive of the following standards:

1. Requirements of the statutes of the State where the survey is located.

2. Requirements of the “Standard Practices Manual” published by the State surveying society of the State where the survey is located.

3. Forest Service minimum standards (FSM 7152.6).

LITIGATION

CAUSES

Litigation occurs when one party challenges the position taken by another and the challenge is irreconcilable. The land surveyor’s responsibility is to provide the facts requested by the attorney and to assist him in the support or challenge of a survey as the case may be.

Litigation involving the Forest Service most frequently is the result of a functional trespass or a title claim.

Title Claims

Title claims usually are the result of a land survey performed either by the adjoiner or by the Forest Service. The result of the land survey has placed the validity of previously accepted boundaries or ownership of the land in question.

Functional Trespass

Functional trespass requires the identification of the area where the trespass or violation occurred. A land survey will determine the exact location and provide data to determine the extent of the trespass.

SURVEYOR-ATTORNEY RELATIONSHIP

The surveyor must remember that the attorney is the expert on matters of law, but he may be ignorant of boundary law. The surveyor is to collect facts regarding the survey, assemble them for presentation, and advise the attorney. The surveyor should get a clear statement from the attorney of the basis of the litigation, what the attorney seeks to prove, what the time constraints are, what information the attorney currently has on hand, and what information the opposition intends to present.

After the surveyor has received a thorough briefing from the attorney, assembly of the case file should begin.

During the assembly of the case file, it is necessary to maintain contact with the attorney in order to keep current on the status of the case. The attorney should be kept informed of significant discoveries made during the research, whether the information is beneficial to the Government's case or not.

CASE PREPARATION

The land surveyor, having been informed of the intentions of the attorney, shall prepare a case packet. The first prerequisite is that a complete and thorough search of all land title records and survey records be made.

A chronological list of the history of all the land transactions and related land surveys is prepared. Copies of the land transactions as recorded, not as abstracted, are obtained. All of the transactions are examined for evidence of surveys that may have been performed but not recorded and that were used to provide the language of the transaction.

Records Research

Research needs to be thorough enough to determine the important evidence of corner positions. The surveyor must recognize when assistance is needed in doing research. If survey aides or technicians are going to do the research, they should be trained to evaluate material as evidence.

Research should not be done in a hurry. Future research can be reduced by taking the time to catalog information obtained from old field books or other documents.

In addition to the field notes of the original surveys, resurveys, mining claims, private claims, reservations, and land grants, which are available in the Bureau of Land Management State office, there are many other sources of information concerning the location of an original corner. Where applicable, these sources should always be checked thoroughly for possible evidence before proceeding to restore a corner by proportionate methods.

Field Research

The land surveyor should be familiar with the conditions on the ground. The land surveyor who performs the survey may be called upon to testify about the survey. The land surveyor must be able to give certain testimony as to what he observed. Therefore, physical conditions are to be noted if pertinent to the case.

Conditions to be observed in the field range from the manner of scribing used to the terrain and vegetative cover.

DUTIES of SURVEYOR in COURT

The surveyor in court will respond to the questions of the attorneys in a positive manner.

The American Congress on Surveying and Mapping has published “The Surveyor in Court,” which covers the conduct of the surveyor in court as an expert witness.

LEGAL REFERENCES

The large number of legal references on boundaries do not permit more than an abstract of references, Specific cases that apply to the case at hand need to be studied.

Selected References

The following references to statute and case law cover many of the commonly recurring questions involving land survey laws.

1. <u>United States Code Annotated - Title 43 - Public Lands</u>. This comprises all laws of general and permanent nature, arranged as official code of the laws of the United States, with annotations from Federal and State courts.

2. <u>Historical</u>. The Act of May 18, 1796, is the basis of the present system of surveys (88 U.S. 660).

3. <u>Authority to Survey</u>. The power to make and correct surveys of public lands belongs to the Federal Government, and the decisions of the General Land Office are unassailable by the courts, except by direct proceedings (128 U.S. 691).

4. <u>Effect of Survey</u>. A survey of public lands does not ascertain boundaries, it creates them (260 U.S. 427).

Until public land is officially surveyed, it cannot be described or conveyed by reference thereto as sections or subdivisions of sections (154 F. 425).

5. Elements of Survey. The running of lines in the field and the laying out and platting of townships, sections, and legal subdivisions are not sufficient to constitute a survey, Until all conditions for filing in the proper land office and all requirements for approval have been complied with, the lands are to be regarded as unsurveyed and not subject to disposal as surveyed lands (260 U.S. 427).

6. Division of Lands. Public lands are to be surveyed into townships 6 miles square, and each in turn subdivided into 36 sections of a mile square, except where a line of an Indian reservation or of a tract of land theretofore surveyed or patented or the course of a navigable river may make this impracticable and in that case the rule must be departed from no further than such particular circumstance requires (239 U.S. 538).

7. Fractional Subdivisions. Government surveyors have authority to make fractional sections where a navigable body of water or obstruction prevents the making of a regular section (the term “fractional section” meaning a fractional part of a regular section).

Where a section of land is not whole or regular in its contents and does not contain approximately 640 acres, it may be called a fractional section (263 U.S. 684).

8. Meander Lines. On lots patented under the public land laws, according to a plat showing the lots bordering on a lake, extend the lot to the water as a boundary and embracing pieces of land found between it and the meander line of the survey, where the failure to include such pieces within the meander was not due to fraud or mistake but was consistent with a reasonably accurate survey, considering the areas included and excluded, the difficulty of surveying them when the survey was made, and their value at that time (260 U.S. 662).

A patent from the United States of a surveyed fractional Government subdivision, bounded on a meandered lake, conveys the land to the lake, although the meander line of the survey is found not to be coincident with the shoreline. The purchaser is not estopped to assert that his title extends to the lake, and beyond the meander line (46 N.W. 405).

9. Erroneous Survey. Whether a Government survey as originally made is correct or incorrect is for land department alone to determine, and the courts have no jurisdiction, except by original proceedings in equity (20 S. 2d 136).

10. Correction of Survey. Where through fraud or error land is excluded from a survey of public land by a meander line, the land

department on discovering the mistake may cause the excluded area to be surveyed and dispose of it (245 U.S. 24).

11. After Disposal of Lands. Original surveys of public lands by the Federal Government, on the faith of which property rights have been acquired, control over subsequent Government surveys affecting such rights (227 P. 46).

Where the surveyor did not follow statutory rules in making survey of Federal land or in reestablishing the lines, they are to be run as the surveyor ran them when making the survey and not as he should have run them (8 S. 2d 655).

12. Conclusive Effect of Survey. The location of corners and lines as established by the Government survey when identified are conclusive (247 SW 801).

The fact that the location of a corner in accordance with an inaccurate official Federal Government survey will set awry shapes of sections and subdivisions does not affect the conclusiveness of the survey (247 SW 801).

Where a township corner has been located definitely by Government surveyors and the field notes show the location of a quarter corner in a straight line at the proper distance, a change in the location of the township corner by State, county, or other surveyors that is accepted by the owners of contiguous lands will not affect the location of such quarter corner in the absence of evidence that the quarter corner actually was established at some other point by the Government surveyor (183 N.W. 665).

13. Judicial Notice. The courts will take judicial notice of the Government surveys and the legal subdivisions of the public lands (38 P 81).

14. Plat and Survey as Part of Patent. When lands are granted according to an official plat of a survey, the plat, with all its notes, lines, descriptions, and landmarks, becomes a part of the grant or deed by which they are conveyed, and controls so far as limits are concerned as if such descriptive features were written out on the deed or grant.

15. Inconsistent Notes. Where a Government corner is lost or obliterated so that resort must be had to the Government field notes for the purpose of determining its location, but the field notes are inconsistent and cannot be reconciled, there is no universal rule that certain ones shall be preferred to the others. However, as in a case where living witnesses contradict each other, those should be accepted as correct that are most entitled to credit under all circumstances, and most likely to be in accordance with the actual

facts, and a witness or bearing tree is not an established corner, but merely a designated object from which, in connection with the field notes, the location of the corner may be ascertained (79 N.W. 537).

16. Lost Corners. An obliterated quarter section corner under an official Federal Government survey should be fixed as originally located (155 P 2d 612).

The rule as to use of the proportional method in reestablishing Government corners, as laid down by the Surveyor General of the United States, is for the guidance of the United States deputy surveyors in running lines in which the Government is interested and cannot control a State court in its choice of means for establishing such a fact as the point where the Government surveyor originally placed the section or quarter section corner, when the question properly arises within its jurisdiction (43 Cal. App. 194).

17. Evidence. The field notes are presumed correct, are prima facie evidence of the facts stated, and must be taken as true until they are disproved by a clear preponderance of evidence (133 N.W. 412).

Field notes and Government plats made by a Government surveyor at the time of the original survey are prima facie evidence of the true location of the line. Where Government corners cannot be identified, the burden is then shifted to the party who wishes to establish the corner at a different place from that called for by the field notes and Government plat of the original survey (181 N.W. 158).

Corners and boundary lines established by the Government survey of the public lands are where they were actually marked on the grounds by the Government surveyors, and if the point where a section or quarter section post was placed is satisfactorily established, it is conclusive as to the location of the corners it marks even if the location does not accord with the courses and distances shown on the plat and field notes (180 N.W. 37).

18. Quantity. When the United States grants the lands by legal subdivisions, the grantee takes all the land in the subdivision and is not limited by the number of acres specified in the patent (31 N.W. 209).

A grant by the United States of a fractional subdivision shown by field notes and by an official map of U.S. Government survey, bounded on three sides by Government subdivision lines and on the fourth side by navigable river, carries title to the low-water mark where boundary is not otherwise designated (271 N.W. 775).

19. Navigable Waters. United States patents, including land under navigable lake, did not affect State's rights in material of its bed (217 N.W. 570).

When land bordering on navigable water is granted by a patent of the U.S. Government, the adjacent land under the navigable water does not pass by virtue of the patent alone (209 P 194).

Any tract of land omitted from the survey of a fractional quarter section described in patent as bounded by lake is not included in patent (110 So. 743).

20. Nonnavigable Waters. Where the patents are to lands bordering a nonnavigable lake, the patents purport on their face to transfer the acreage of the lake bottom (127 F 2d 988).

21. True Corners. A Government section corner is where the Government surveyors correctly or mistakenly placed it, and if its location can be found, it is not a lost corner, and it controls (193 N.W. 730).

Government corners fixed by the Government surveyor at the time of the original survey will control the field notes of the survey made at the time and will control the field notes of courses and distances of any subsequent survey (109 Neb 282).

Where land is described in a deed by sectional numbers according to the Government's survey, the land thereby conveyed is only that which is situated within the designated sections as surveyed and platted by the Government; the original corners and lines thereof established by the Government are their true and only boundaries (84 So. 134).

22. Finding Corner. To find the common corner of quarter sections or the legal center of a section of land, straight lines must be run from the quarter section corners on the boundary of the section to the opposite corresponding corners. The point of intersection constitutes the legal center, and the boundary line between two quarters cannot be legally established by measuring along one side of the section 160 rods (185 N.W. 917).

Where there is no other evidence on the subject, and the location of a quarter corner may be fixed with reasonable certainty using the field notes of the Government surveyor, such location will be adopted (106 Neb. 377).

Where the location of a quarter corner may be fixed with reasonable certainty by using the field notes of the Government surveyor, there is no authority for fixing the quarter corner at a point midway between known section corners if such point does not conform to the field notes (106 Neb, 377).

Where the proper location of quarter corners of a section of land is disputed, and the defendant produces evidence tending to show the establishment of such corners by the Government surveyor at points conforming to the field notes, and the plaintiff produces no evidence of their location elsewhere, a verdict for the defendant is sustained by the evidence, and the corners will not be disturbed (107 Neb, 377).

23. Monuments. Monuments are controlling (126 MaineT62).

Government monuments of corners, as placed upon public lands surveyed, control the calls of the maps, plate, and field notes (153 P. 283).

Where public lands conveyed by patent are described by legal subdivisions and lot numbers according to the official plat of the survey of said lands returned to the General Land Office by the Surveyor General, and there is a discrepancy in such plat between the lines subdividing the section and the Government corners as they exist upon the ground and are shown in the plat and described in the accompanying field notes, the monumented corners will prevail as against a hypothetical dividing line protracted by the draftsman upon the plat in the Surveyor General's office (221 P. 556).

24. Lost Corners. A Government corner fixed by a Government surveyor at the time of the original survey, if identified, is the best evidence of where the line should be, In the absence of such satisfactory proof, the field notes of the survey will govern and determine the true line (181. N.W. 158).

An obliterated quarter section corner under an official Federal Government survey should be fixed as originally located (155 P 2d 612).

Lost quarter section corners in regular interior sections under official Federal Government surveys generally should be relocated on a straight line between section corners and equidistant therefrom (155.P 2d 612).

25. Plate and Field Notes. A plat embodied in a patent by reference is itself taken as a monument (264 U.S. 206).

There is no official survey of Government lands until the plat of the survey has been approved by the Surveyor General (205 P.78).

26. Boundary Lines. Corners marked in the surveys in the manner prescribed must be regarded as the proper corners of sections, and boundary lines actually run and marked on the surveys returned are made the proper boundary lines of the sections or subdivisions for

which they are intended. Lines intended as boundaries not actually run and marked must be ascertained by running straight lines from the established corners to the opposite corresponding corners are fixed, the boundary lines must be ascertained by running from the established corners due north and south or east and west (74 U.S. 272).

In the absence of finding and locating the marks established by the original Government survey, the location of long established and recognized physical evidence of such boundary lines, as indicated by the maintenance of boundary fences, becomes a value and important and cannot be disregarded or set aside either by a surveyor or by a court in determining the true Government line (177 N.W. 878).

The general rule is that in matters of boundary, calls for natural objects and fixed monuments control those for distances, and calls for courses prevail over those for distances (264 U.S. 206).

In ascertaining lines of land or in reestablishing lines of an official Federal Government survey, footsteps of the original surveyor, so far as discoverable on the ground, should be followed, and it is immaterial if lines actually run by original surveyor are incorrect (155 P2d 612).

In an action between owners of adjoining Government subdivisions to quiet title to a disputed strip, if evidence is insufficient to enable the court to locate the true line between the respective tracts, the plaintiff has the burden of fixing the line according to the Government survey (190 N.W. 938).

Since boundaries of land originally were fixed by Government survey, it is presumed that persons bought according to such survey (162 N.W. 63).

The location of corners and lines as established by the Government survey when identified are conclusive (247 S.W. 801).

Location calls, identified on the ground, must be followed, if possible (7 S.W, 630).

When the description in a conveyance is erroneous, that which is intended to be conveyed, rather than that which is described, is conveyed (42 F. Supp. 459).

In determining boundaries, the court should ascertain intention of the parties deduced from the composite of all evidence (42F Supp. 459).

27. Boundaries Bordering on Waters. Meander lines are run in surveying fractional portions of the public lands bordering on

navigable rivers, not as boundaries of the tract, but for the purpose of defining the sinuosity's of the banks of the stream and as the means of ascertaining the quantity of the land in the fraction subject to sale that is to be paid for by the purchaser (74 U.S. 272).

In a Government survey of the public lands bordering on a body of water or watercourse, a meander line is properly run for the purpose of computing acreage of fractional lots; however, the lake or watercourse, not the meander, is the true boundary, and the survey is not invalidated by the failure to include within the meander lines small irregular areas of land (260 U.S. 662).

Where ledges or spits or tongues of land project or are beyond the meander line of a bay, they are included as part of the fractions or sections shown on the Government survey and conveyed by the Government patent (57 F 883).

Where an area of high land between meander line and the waterline is great compared with subdivision surveyed, it is not included in the patent (273 U.S. 757).

Government lots bordering on a nonnavigable stream are bounded by the thread of the stream and not by the meander line on the bank (76 U.S. 272).

Under the common law, the boundary of an island is the line of ordinary high water (316 U.S. 354).

Patents for fractional sections of land facing on a marsh, that recite the number of acres granted, and refer to the official plat of survey, by which plat the marsh is shown as the boundary, while the computed areas conform to the area included within the surveyed lines, without including any part of the marsh, must be limited by the surveyed boundaries, without including any land that is part of the marsh (245 U.S. 24).

When the United States has disposed of the lands bordering on a meandered lake by patent, without reservation or restriction, it has nothing left to convey and any patent thereafter issued for land forming the bed, or former bed, of the lake, is void and inoperative (53 N.W. 1139).

28. Original Survey Controls. Generally, the original corners as established by Government surveyors, if they can be found, or the places where they were originally established, if they can be definitely determined, are conclusive on all persons owning or claiming to hold with reference to such survey and the monuments placed by the original surveyor without regard to whether they were correctly located or not (100 P2d 455).

Original surveys of public lands by the U.S. Government, on the faith of which property rights have been acquired, control over surveys subsequently made by the Government that affect such rights (183 N.W. 980).

The Government has the right to resurvey public land, as corrective and as a retracing, but such survey will be constructed to follow the lines of the original Government survey where it would affect bona fide private rights held under such original survey (88 P2d 277).

A corrected survey or resurvey of public lands by the Government can be used instead of original survey until such time as rights have been acquired to specific tract of land under original survey (145 So. 2d 737).

When the Government resurveys public lands, the question is not where an entirely accurate survey would locate lines, but where the original survey located lines. In all cases, whenever possible, the original survey must be retraced since it cannot be disregarded or needlessly altered after property rights have been acquired in reliance on it (145 So. 2d 737).

29. Descriptions and Relative Importance of Calls. "American Jurisprudence" 2d ed. Volume 12, reads: "All parts of the description in a conveyance should be allowed to stand, if possible, and none of the calls should be rejected if they can be applied in any reasonable manner; it is only in the case of an obvious mistake where there is such contradiction or inconsistency as to render the conveyance unintelligible that some of the calls are to be rejected."

The general rule that in the construction of boundaries, the intention of the parties is the controlling consideration applied in determining the relative importance of conflicting elements of description. The various rules adopted by the court for construing and interpreting conflicts between calls of description all have as their primary purpose the ascertainment of the intention of the parties. Another basic consideration is that those particulars of the description that are uncertain and more liable to error and mistake must be governed by those that are more certain; the description should be retained and given efficacy that is the most certain and the least susceptible to mistake.

Where the calls for the location of boundaries to land are inconsistent, other things being equal, resort first to natural objects or landmarks, next to artificial monuments, then to adjacent boundaries (which are considered a sort of monument), and thereafter to courses and distances$_0$ However, where it is apparent that a mistake exists with respect to the calls, an inferior means of location may control a higher one, In the last analysis, the call adopted as the controlling one should be that most consistent with the apparent intent of the grantor. Generally, among the inferior calls, course will control distance, if they are inconsistent, and course and distance will control quantity.

Typical locative call cases read:

As a general rule in the location of lands described in a deed, natural objects called for therein, such as mountains, lakes, rivers, creeks, rocks, and the like, control artificial objects, such as marked lines, marked trees, stakes, and so forth, and the latter control courses and distances, and course controls distance, and course and distance control quantity (28 L ED 109).

The rule that, in matters of boundaries, natural monuments or objects will control courses and distances is not absolute and inexorable, but is founded upon the presumed intention of the parties to be gathered from the language contained in the grant, and upon the assumption that the description by monuments approaches accuracy within some reasonable distance and places the monuments somewhere near where it really exists (48 L ED 662).

If marked trees and corners conform to the calls of a patent, or if watercourses, mountains, or other natural objects are called for, distance must be lengthened or shortened, and courses varied, so as to conform to those objects (3 L ED 964).

The different calls in a deed ought to be taken together in determining, the boundaries of the property conveyed thereby and a call for a natural boundary may be controlled by the other calls if it appears that such a call was inserted through inadvertence or mistake (6 L ED 477).

Where, in a deed, there is a specific description, by metes and bounds of the lands conveyed, other words therein intended to describe generally the same land, do not vary or enlarge the specific description (38 L ED 97).

Metes and bounds in the description of premises control distances and quantities when there is any inconsistency between them (24 L ED 456).

Quality in description must yield to definite description by metes and bounds or by name and number; quantity may aid but cannot control such description (40 L ED 562).

Courses and distance control quantity, but if the description is vague, the quantity may govern (40 L ED 673).

The beginning corner of a survey does not control more than any other corner actually ascertained, and it is not necessary to follow the calls of the grant in the order they stand in the field notes, but they may be reversed and the lines traced the other way whenever by so doing the land embraced will more nearly harmonize all the calls and objects of the grant, but where to reverse the calls would not have that effect, courses and distance of the survey should be followed (34 L ED 803).

30. Other Federal Court References

a. U.S. United States Supreme Court Reports annotated with: ALR - American Law Reports L ED -Lawyer's Edition and to American Jurisprudence.

b. Federal Reporter. Cases argued and determined in the Circuit Court of Appeals and District Courts of the United States the Court of Appeals of the District of Columbia.

c. Federal Supplement. Cases argued and determined in the District Courts of the United States and the Court of Claims.

d. Am Jur. American Jurisprudence - A modern comprehensive text statement of American Law--State and Federal.

e. C. J. S. Corpus Juris Secundum being a complete reference of entire American Law as developed by all reported cases.

31. State Court References

A	Atlantic Reporter
A2d	Atlantic Reporter, Second Series
Cal. Rptr.	California Reporter
N. Y. S.	New York Supplement
N. Y. S. 2d	New York Supplement, Second Series
NE	North Eastern Reporter
NE 2d	North Eastern Reporter, Second Series
NW	North Western Reporter
NW 2d	North Western Reporter, Second Series
P	Pacific Reporter
P2d	Pacific Reporter, Second Series
SE	South Eastern Reporter
SE 2d	South Eastern Reporter, Second Series
So.	Southern Reporter
So. 2d	Southern Reporter, Second Series
SW	South Western Reporter
SW 2d	South Western Reporter, Second Series

32. United States Code Annotated - Title 43 -Public Lands

Contents for Chapter 4
Coordination & Cooperation

Page

Chapter 4
Coordination & Cooperation

The Forest Service surveying activity does not exist as a separate program. It is an activity that directly affects other programs and other activities. Because of this fact, it is imperative that coordination takes place between those engaged in this activity and other programs and activities both within and outside the Forest Service.

Survey activity affects those individuals, companies, and other Government agencies that own or manage land adjoining National Forests. Cost savings and improved public relations can result from cooperation.

The Forest Service is not alone in the task of locating boundaries. Other agencies do cadastral survey work for the Forest Service. Coordination of this effort is necessary to avoid duplication and to ensure that priorities and schedules are adhered to.

COORDINATION WITH OTHER FOREST ACTIVITIES

LANDS

Land Adjustment Program

The land adjustment program is involved in acquiring and disposing of lands to facilitate the management of the National Forests. Both actions often involve cadastral surveys to identify the lands to be transferred.

Generally, when lands can be adequately described by reference to a previous official survey, it is not necessary to resurvey them for subsequent transfers. This is especially true when description is by an aliquot part of a surveyed section.

1. Surveys will be required when lands are acquired under the following conditions:

a. The parcels do not conform to an aliquot part of a surveyed section.

b. The parcel is a part of a Government lot

c. The parcel is described by metes and bounds and no official survey exists.

2. Surveys will be required when lands are disposed of that do not have an official United States public land survey plat on file that

can be used for writing a patent. These surveys may only be performed by the Bureau of Land Management or a Forest Service surveyor operating under the Bureau of Land Management-Forest Service Memorandum of Understanding.

3. Land surveys should not be made on parcels of land identified as "Exchange Base" lands (land suitable for disposal) in the Forest Land Adjustment Plan.

The stated instructions apply for fee simple transfers of land and some partial interest acquisitions, such as scenic easements. Transportation easements are covered elsewhere in this guide.

Trespass & Title Claims

Normally a suspected trespass is treated as a title claim initially. That is, the status of the land in question is checked to ascertain who has title. If it appears that the Government has a clear title to the land, the case is usually pursued as trespass. Surveying is almost always involved at this point. It may be to establish the property line, but it may also include a survey to establish the amount or quantity involved. When trespass appears to have occurred, it is important that all surveys be done under proper State and Federal authority because the chance of litigation is increased (FSM 7153.01). When title is not clearly vested in the United States, a title opinion may be sought from the Office of General Counsel. Investigation may involve questions that can only be resolved by survey. Examples for which surveys may be required are:

1. Omitted lands are lands that were in existence at the time of the original surveys in the area but were not included on the plat as either a lot or an aliquot part of a section. Islands and swampy land were often shown as water. These lands are often occupied without written title.

2. Acquired lands where there may be conflict between the title received by the United States and the occupation that appears to exist on the ground.

3. Acquired lands where there is conflict between the title received by the United States and the call for the titles of the adjoiners.

Status

The cadastral surveyor uses the status records in his/her work. At the same time, the surveyor is responsible for ascertaining that the survey work is incorporated into these records. One should arrange to have a copy of all plats prepared by staff surveyors and contractors routed to the status section to update the records.

TIMBER

Much of the surveying activity on the National Forests is generated by the timber sale program. It is a manual requirement that timber sales adjoining private land boundaries support the cost of establishing those boundaries to legally acceptable standards (FSM 7153.03). This and other requirements dictate that the cadastral survey activity, right-of-way surveys, and engineering surveys for transportation facilities be closely coordinated with planned timber sales.

Programming Surveys for Timber Sales

The cadastral surveyor must ensure that survey activity is adequately provided in any critical path scheduling of the timber sale. Factors that must be evaluated are:

1. How much survey is needed?

a. Is boundary involved?

b. Is a right-of-way involved?

c. What class survey will be used for the roads?

2. Who will do the survey?

a. Is Federal cadastral authority needed?

b. Is a licensed land surveyor available?

3. When must the surveys be completed?

Long-term timber sale plans often involve sales adjoining private land. It is necessary that these plans become firm soon enough to program the funds necessary to accomplish the survey prior to sale layout. During the current program year the cadastral surveyor should be involved by providing cost figures to the programming team. When sales programs are modified, the cadastral surveyor must respond with changed program cost estimates. Coordination between the timber and survey staffs must occur to ensure that support activities are programmed and funded so that sale objectives are met.

Details of the timber sale preparation process are found in FSM 2431.19.

Timber Sale Contract Provisions for Protection of Land Survey Monuments

Division B of the standard timber sale contract contains language designed to alert the timber purchaser of the responsibility for protecting land survey corners and accessories.

The cadastral surveyor shall coordinate with sales layout personnel to ensure that these provisions are enforced.

RANGE

Range programs involve fencing of National Forest lands to control livestock. When fencing is to occur on or near property boundaries, Forest Service policy is to place the fence on the true property line (FSM 7153.03).

The cadastral surveyor must coordinate with range specialists to ensure that fencing plans include the necessary support funds for surveys. Cost estimates must be provided to ensure realistic programming and schedules must be arranged to provide surveys prior to fence construction.

WILDERNESS

Wilderness is managed in a different manner than surrounding multiple use lands. This fact necessitates a boundary between the two. This boundary must be reduced to a written legal description and should be capable of being defined on the ground by a competent surveyor.

The cadastral surveyor should become involved in the description of any new wilderness created on the Forest. The surveyor will be asked later to define the boundary on the ground. If the legal description is not capable of being defined on the ground by a surveyor, it will be a source of continuing conflict. Thus the land surveyor, in conjunction with lands specialists, will coordinate the written legal description.

COORDINATION WITH REGIONAL OFFICE

Some survey functions that require coordination and processing with technical and administrative services support groups are not delegated to the National Forests but are reserved to the Regional Office. Coordination between the cadastral surveyor and various specialists in the Regional Office must occur.

BUREAU of LAND MANAGEMENT SURVEY ACTIVITY

To avoid confusion and to provide a point for contact with the Bureau of Land Management survey organization, it is the policy of the Forest Service that one person is responsible for liaison within the Regional Office. That person is usually the Regional cadastral surveyor.

All requests for Bureau of Land Management survey assistance should be coordinated with the Regional Surveyor. Requests for technical opinions on survey matters also should be coordinated through the Regional Office.

SURVEY REVIEW

Forest Service policy requires a peer to review and approve all cadastral surveys. Procedures should be developed to perform the review for both force account and contract cadastral surveys by qualified colleague review at the Forest level. These procedures should include provisions for timely review, allow for corrective action, and prompt return for final publication and distribution of plate.

OFFICE of the GENERAL COUNSEL

Trespass resolution frequently requires that surveys be presented and defended in court. Procedures exist for prosecution of trespass that involve surveys, lands, and fiscal specialists. Cadastral surveyors should ensure that survey matters are communicated to the other specialists and Office of General Counsel attorneys in a manner that will be understandable and useful. The land surveyor may be called to court to testify regarding surveys. It is important that there be a good working relationship with OGC attorneys. Together they should review what the surveyor will testify to in court, what questions may be expected from the opposing attorneys, and how the witnesses will be questioned.

COOPERATIVE EFFORTS

BUREAU of LAND MANAGEMENT

Considerable Forest Service cadastral survey work is accomplished in cooperation with or through services obtained from the Bureau of Land Management (BLM).

Generally, this work involves National Forest System lands reserved from the public domain in the rectangular system. Most of this activity is in the western Regions, but much remains to be done in the eastern Regions on Weeks Act lands.

This cooperative work falls into five main categories discussed below. The characteristics and differences of each of these categories of work should be clearly understood.

Corner Remonumentation

In this program, the Bureau of Land Management assigns a cadastral surveyor to this work, pays his salary and travel, and furnishes corner monuments. The Bureau also prepares the official survey notes of remonumentation accomplished. These notes become a permanent official Bureau of Land Management survey record; Forest Service personnel guide Bureau of Land Management surveyors to corners previously searched by the Forest Service. The Bureau of Land Management surveyors are taken only to those corners found to need remonumentation and believed to have sufficient remaining evidence. Final evaluation of the evidence is the responsibility of the Bureau of Land Management surveyor. The Forest Service assists Bureau of Land Management with the remonumentation of these corners in the western Regions.

Funds Appropriated to Forest Service & Transferred to Bureau of Land Management

This special program (Bureau of Land Management assigned activity number 9800) was first initiated in fiscal year 1966. Its purpose is to provide additional Bureau of Land Management surveying services required to reestablish corners that the Forest Service has determined to be lost and urgently needed. These funds are appropriated only for this purpose on public domain lands administered by the Forest Service.

Funds Appropriated to Bureau of Land Management

With its directly appropriated funds, Bureau of Land Management conducts a program of cadastral surveying for the Forest Service and for other Government agencies (Bureau of Land Management assigned activity number 4530). These services are furnished to the extent BLM-appropriated funds and personnel ceilings permit.

Surveys by Bureau of Land Management on Cost-Reimbursement Basis

The Bureau of Land Management also does cadastral surveys for the Forest Service and for other Federal agencies under reimbursement (Bureau of Land Management assigned activity number 1900). Services available under this arrangement are limited because of Bureau of Land Management personnel ceilings. Such work as surveys for land exchanges, trespass surveys, and emergency type surveys that arise after regular programs are established is sometimes handled under this activity.

Surveys by Bureau of Land Management Through Cost Reimbursement From Non-Federal Sources

The Bureau of Land Management will make cadastral surveys of public domain lands when the cost is defrayed by special deposits under authority of 43 USC 1364 (Bureau of Land Management assigned activity number 7200). The Forest Service may be involved where a land-exchange proponent wishes to pay the cost of survey of the selected lands. These special deposit provisions may also be used by adjoining landowners to assist in obtaining needed surveys of benefit to themselves and the United States.

All these services will be requested through the Regional Forester for coordination with the appropriate Bureau of Land Management office.

Surveys by Bureau of Land Management Using Memorandum of Understanding

These surveys permit use of Forest Service facilities by the Bureau of Land Management and designate the period of time, in years, for financial support of planned program of work.

ADJOINING PRIVATE LANDOWNERS

Every Forest property line is shared with an adjoining owner. The owner may be an individual, a company, a corporation, or another Government agency (local, State, or Federal). These adjoiners have a vital interest in the location of a common property line. Forest Service policy emphasizes and promotes sharing the responsibility with the adjoining landowners for the location, marking, and maintenance of the common property line. This will provide mutual cost and management benefits. Also, lines established in a spirit of cooperation are less likely to be contested.

Authority

Authority to enter into collection agreements supporting cost sharing activities for the surveying, identifying, and maintaining of common property lines is contained in the Granger Thye Act, as amended (16 U.S.C. 572). This authority, its limitations, and a sample agreement are covered in FSM 1580 and FSH 1509.11.

Scope

Areas of cooperation and cost sharing may consist of contributing labor, materials, and/or dollars for all or any part of a land surveying project. The project may be accomplished by contract or by force account crews. The exchange of labor, materials, and/or funds may be from the private party to the Forest Service or vice versa. The Forest Service requires that the proposed work be accomplished in a manner that satisfies Forest Service specifications for survey accuracy and platting format, as well as marking and posting standards. In addition, the Forest Service reserves the right to ensure that such surveys have complied with all applicable Federal and State legal requirements, with regard to survey procedures, platting, and ancillary documentation, prior to the entering of such surveys into the public record. The participating adjoiner also shall have the right to review.

Examples of possible cost-sharing approaches to performing land surveys, marking, and maintaining of mutual property lines are found in this chapter in the section entitled "Documentation.”

Planning

Every Region has the objective to accomplish not less than 15 percent of the annual assigned land line location program target by cost sharing.

One method to accomplish this objective would be to establish a working capital fund of 15 percent of the Forest annual land line location program funding for cost-sharing with adjoining private landowners.

The priorities of planning resource management activities will generally control where the Forest Service could participate in a cost-share mutual interest common boundary line survey. However, with the development of a pool of funds, the Forest would have the flexibility to manage short- and long-term land-surveying needs with a variety of planned projects, and also take advantage of the opportunity to work on an unscheduled project proposed by an adjoining landowner, With a large industrial adjoining owner, it may be possible to set up an annual program where both the adjoiner and the Forest Service agree to accomplish a specified amount (in dollars or miles) of common boundary line annually while serving independent priorities. The Forest Service and the adjoining landowner would both agree to an annual program of work on common property lines. The Forest Service would work on lines where Forest Service activities are anticipated and the adjoiner would work on lines where Forest Service activities are not anticipated. In this way, the Forest Service could cooperate without having to have common priority lines. This would require a simple reporting and accounting system whereby each informs the other of what surveying activities were accomplished and the amount of funds spent each year.

Negotiation

To invite or promote participation in common boundary surveys will require judicious public relations. Laying the groundwork and developing the interest to participate in these surveys and line marking activities should be by personal contact. Correspondence may be the only means of initial contact with an absentee owner, but the letter should emphasize the desire for personal contact. Personal discussions will bring out the mutual advantages of a common boundary survey and show that the opportunity does exist for cooperation.

Follow-up discussions may not be appropriate unless the adjoiner expresses an interest in a cost-sharing venture.

Forest Service administrative and overhead costs, survey standards, and line marking or visibility requirements are sensitive issues. A careful explanation of Forest Service activities is needed to emphasize why and how such standards have been developed. Overhead cost should be de-emphasized as a separate item and discussed as a part of the total cost. The Forest Service should not expect a Forest Service adjoiner to contribute toward activities that may be considered excessive to their individual needs. A contribution or assistance of any kind is appreciated.

Procedures

Contacts

Emphasis is placed on personal contact. The contact should cover the following topics:

1. Access and permission to enter a Forest Service adjoiner’s land to accomplish the survey project.

2. Written permission to place monuments on private land; to mark bearing trees; to reference objects on private land; and to blaze, hack, and paint trees on private land along the property line.

3. Sharing the cost of surveying and marking a mutual property line.

Documentation

Documentation in some form is desirable to ensure that everyone understands what is going to be accomplished by the working relationship. (See the sample collection agreement in figure 1.)

1. Whenever the adjoining landowner provides incidental labor or services, no formal agreement is necessary. A letter of agreement or understanding is desirable, but this has no binding effect on the adjoining landowner if there is a default of labor or materials. A more desirable approach would be to have the adjoiner sign on as a volunteer using Form FS 1800-7, "Volunteer Agreement." This would provide mutual protection to everyone in case of accidental injury and the like.

SAMPLE

COLLECTION AGREEMENT

between

(ENTER NAME OF DEPOSITOR)

and

(ENTER NAME OF YOUR FOREST) National Forest, USDA Forest Service

THIS COLLECTION AGREEMENT, made and entered into by and between (ENTER NAME OF DEPOSITOR), hereinafter referred to as the Depositor, and the Forest Service, U.S. Department of Agriculture, hereinafter referred to as Forest Service, under the provisions of the Act of April 24, 1950 (16 U.S.C. 572).

WITHESSETH:

WHEREAS, the Forest Service has the responsibility of management of the lands in the National Forest System; and

WHEREAS, the Forest Service recognizes the need for the identification of the property lines between National Forest Land and private land; and

WHEREAS, the Depositor recognizes the need for the identification of the property lines of the private land owned by them; and

WHEREAS, the Depositor has expressed a desire to have the Forest Service survey the common boundary between the mutually-owned lands.

NOW, THEREFORE, in consideration of the above permises, the parties hereto agree to follows:

A. The Depositor Shall:

1. Upon presentation of a Bill for Collection, deposit with the Forest Service on or before (ENTER DATE), an estimated amount of (ENTER AMOUNT) as their share of the total cost for the survey of the portions of the land boundary common to the Forest Service and the Depositor located in (ENTER TOWNSHIP, RANGE, AND SECTION).

B. The Forest Service Shall:

1. Deposit funds so collected in the cooperative work fund of the Forest Service.

2. Upon receipt of payment from the Depositor, cause to be surveyed and posted all property lines, common to both parties, to Forest Service standards in accordance with surveying laws and rules of the United States and the State of (ENTER STATE). The method in which lines shall be posted is attached as Exhibit _____ and made a part of this agreement.

Figure 1.--Sample collection agreement.

3. Refund to the Depositor any funds collected that are in excess of the cost of doing the specified work.

C. <u>It Is Mutually Agreed and Understood By and Between the Said Parties That</u>:

1. No Member or nor Delegate to Congress, nor Resident Commissioner, shall be admitted to any share or part of this agreement, nor to any benefit that may arise therefrom; but this provision shall not be construed to extend to this agreement if made with a corporation for its general benefit.

2. Nothing herein shall be construed as binding on the Forest Service for payment of money in excess of appropriations authorized by law.

3. The United States shall not be liable for any damage incident to the performance of work under this agreement to any Depositors or landowners who are parties to this agreement, and any such Depositors or landowners hereby expressly waive any and all claims against the United States for cooperation for any loss, damage, personal injury or death occurring in consequence of the performance of this agreement.

4. Either party may terminate the agreement by providing a 30-day written notice. Unless terminated by written notice, this agreement shall remain in force until (ENTER DATE) .

5. In case of termination of this agreement, any funds on deposit shall be available for expenses incident to closing out the work beyond the period of written notice.

IN WITHNESS WHEREOF, the parties hereto have executed this agreement as the last date written below.

______________ Date	______________ Depositor
______________ Date	______________ Forest Supervisor
	______________ National Forest

Figure 1. (cont.)--Sample collection agreement.

2.   Where the Forest Service is providing materials (corner monuments, signs, posts, paint, documents, and so forth) to a registered survey that is surveying a common property line for the adjoining owner, a simple letter of explanation is all that is required. The letter should state what materials will be provided, how they are to be used, where and when they may be acquired, where to deliver excess materials, and the nature of the Forest Service review and approval process to ensure that acceptable evidence and procedures are used.

3.   Where the Forest Service is paying funds to an adjoining landowner or an agent for several adjoiners, the Forest Service follows sole-source procurement procedures for professional services, Sole-source procurement regulations are found in FPR 1--3.101b and 3.210(A) (1)

The adjoining landowner becomes the prime contractor, who will subcontract for land survey services. A Forest Service Contracting Officer will make a Determination of Findings based on a report prepared by the Forest Staff surveyor. The report should address the following information:

a.   The number of miles of common property lines in the area to be surveyed.

b.   The adjoiner’s willingness to share the costs of survey and act as the prime contractor to acquire the services of a registered land surveyor.

c.   A cost estimate of the project to show the savings to the Government by sharing the cost of surveying activities.

The Forest Service must reserve the right to approve the subcontracting land surveyor, provide the contract specifications, and review and approve the survey plat prior to filing in the public record.

4.   Where the adjoining landowner is providing funds to the Forest Service to accomplish a project, a collection agreement is used to describe the terms and conditions. A collection agreement sample and information are found in chapter 70 in FSH 1509.11.

SURVEY FIRMS

Options for cooperation with survey firms operating in or adjacent to the National Forests can exist. They may include:

1.   Provision of standard monuments for use by firms when surveying Forest boundaries.

2. Provision of signs and posts for surveys along Forest boundaries.

3. Sharing of survey records and information on corners and lines. Opportunities for cooperation with other agencies of government often arise. The following are some of these opportunities:

OTHER GOVERNMENT AGENCIES

1. Control station listings are available from the National Geodetic Survey for use in establishing geodetic control. They will publish Forest Service control work that is performed in accordance with their specifications.

2. Local government units may want to extend control from the basic network for integration of all survey records into one coordinate system. The Forest may want to participate in this endeavor. Various methods of shared costs and manpower utilization can be negotiated with State, county, municipal, and other agencies.

3. Part of the U.S. Geological Survey’s quadrangle mapping program is devoted to locating and mapping property corners, bench marks, and horizontal control stations. An exchange of information can benefit both agencies.

Contents for Chapter 5
Training & Safety

Page

Chapter 5
Training & Safety

TRAINING

The Forest Service training program is to be an on-going effort throughout the employee's career. Training may be on-the-job, self-study, formal group training, or academic study for college credit. Training may be specific to surveying, but it also may be to enhance employee awareness and enrichment, or to improve management ability.

Employee training is a cooperative effort between the employee and management, reflected in the annual training plan. Each employee has the opportunity to identify training needs and to develop an annual training plan during the annual employee performance evaluation.

The Chief's Cadastral Survey Action Plan of March 24, 1978, required initiation of a Service-wide cadastral training program. Short-term formal training is to be provided for selected onboard paraprofessionals so that they will be able to become full professional surveyors. Long-term formal professional cadastral training is to be provided for new professional trainees and others who qualify for professional development leading to registration.

The Forest Service/Bureau of Land Management Memorandum of Agreement of March 19, 1980, also specifies certain training programs. These programs cover the specific techniques of the public land survey system, including instructions, preparations, abstractions, field investigations, performance and documentation of field. surveys, and preparation of notes and plats in accordance with Bureau of Land Management methods and procedures.

The Memorandum of Understanding on the interagency career development plan between the Bureau of Land Management, Soil Conservation Service, and Forest Service also is concerned with training. One element of this plan is the establishment of joint technical and managerial training programs, courses, and sites. Joint training will produce a technically balanced employee who has a diversified approach to multiple resource management. The program will reduce duplication and inefficient training programs that may currently exist, with this direction; several different methods and types of training have been developed.

FOREST SERVICE/BUREAU of LAND MANAGEMENT COOPERATIVE TRAINING PROGRAMS

Forest Service/Bureau of Land Management Slide Tape Courses

A system of dual slide projectors connected to a taped video system with a programmed workbook has been developed for self-study. The individual lessons developed by the Bureau of Land Management cadastral training unit are available from Regional and Supervisor's Offices, Every trainee will complete and retain the lesson workbook. Courses include:

1. Avulsion, accretion, and reliction surveys.

2. Introduction to cadastral surveys and record- keeping.

3. Cadastral plat preparation.

4. Corner point identification.

5. Conventional surveying around obstacles.

6. Obstacle problems in public land surveying.

7 Cadastral survey monumentation.

8. Restoration of lost corners by proportionate methods$_0$

9. Introduction to water boundary surveys.

10. Overlaps, hiatuses, and junior/senior corners.

11. Subdivision of sections.

12. Survey records investigation.

13. Cadastral survey safety training.

14. Applications of coordinate systems.

15. Geodesy for large scale cadastral surveys.

16. Omitted and swamplands and islands.

17. Solar and stellar observations.

Forest Service/Bureau of Land Management National Interagency Training Center Courses

Landspan Seminar

1. This training is designed to orient key cadastral field survey personnel to a developing generation of highly sophisticated land surveying systems, instruments, and techniques. At the completion of the training, the participants will be able to--

a. Demonstrate through analysis the most cost-effective equipment to perform a stated cadastral survey project.

b. List all system components needed to accomplish a given field surveying task when using new instrumentation.

c. Correlate accuracy requirements of the survey project with the capabilities of new systems and techniques.

d. Describe the best survey techniques for given types and systems of equipment.

e. Identify logistical and maintenance requirements of new systems and instruments.

2. The training is conducted in two major segments by Bureau of Land Management/Forest Service and other agency personnel who are experienced in the new technologies:

a. Classroom instruction in the new methods, and the quality and cost results of using new instruments and systems.

b. Field demonstration, hands on operation, and field training in using new instruments and techniques.

Advanced Cadastral Surveying

This course is sometimes called “Professional Cadastral Surveying Level III (P-3).” This training is designed for GS-9 through GS-13 cadastral surveyors. The subject matter is the most complex of courses presented on cadastral surveying.

Upon completion of this course, the trainee should be able to--

1. Recognize the problem and state the procedures for handling the following:

a. Erroneous or fictitious surveys.

b. “Fakes” or “tampered-with” monuments.

2. State the survey procedures involving the following:

a. State boundaries.

b. Completion surveys.

c. Protraction surveys.

d. National park boundaries following terrain features.

3. Recognize and identify reliction, accretion, and avulsion when presented with survey data or a field situation.

4. State the method of resolution of survey problems presented from unusual data involving reliction, accretion, and avulsion.

5. State the ownership and boundary location involving navigable and nonnavigable streams and lakes when presented with usual surveying data.

6. State the conditions and select the procedure under which a corner may be replaced by single and multiple point control.

7. Recognize the problem and state the conditions for restoration of off-line closing corners.

8. Recognize the problem and state the procedure for resolution of junior-senior corners and survey problems involving junior-senior corners.

9. Determine the proper conditions under which corners may be restored from private surveys or from railroad or highway survey information, considering the weight of evidence available.

10. State the procedures under which townsite surveys are retraced and monuments restored (proportionment versus record).

11. Recognize, from examination of plats, whether a corner has been established by proportionment or not.

12. State legal aspects involved in a single and double proportionment.

13. State the legal effect of broken boundaries.

14. Recognize the effect and correctly compute the results of a line tree upon corner proportionment.

15. State procedure for resolving problems involving (or calculate solutions to) overlaps, omitted lands along rivers and lakes, hiatus, and fictitious surveys.

16. State procedure and perform calculations for subdivision of sections where--.

a. Some corners were not established in the original survey.

b. Prior survey protracted and section has a broken centerline.

c. Distances must be computed from areas of lottings.

17. Describe procedures and legal background for performing mineral segregation surveys.

18. Describe and compare survey procedure when dealing with reacquired lands.

19. Describe and recognize need for procedures involving patented legal subdivision in unsurveyed township.

20. Prepare special instructions, using usual actual records, to a cadastral survey office according to instructor-furnished standards.

21. State in his or her own words the meaning of basic legal procedures that commonly occur in court proceedings involving real property.

22. State the conditions under which testimony is given by the following:

a. Eyewitness.

b. Expert witnesses.

c. Depositions.

d. Affidavits.

23. Prepare diagrams according to instructor- furnished standards that are suitable for expert testimony before a jury, emphasizing clarity of visual material and use of exaggerations.

Forest Service/Bureau of Land Management Formal University Courses

Land Survey Descriptions

This training is designed for GS-7 through GS-11 Land Surveyors and Technicians.

A university will present the course. The training will include lectures on the basic elements of property descriptions, including easements and right-of-ways and exercises in writing typical Bureau of Land Management and Forest Service property descriptions. The student may be required to do prestudy and will be required to take a final examination for a grade.

The student will be required to list the basic elements of a land description, to write an acceptable property description for land described by the rectangular system or metes and bounds, and to describe how to survey a given description.

Advanced Survey Computations

This training is designed for GS-7 through GS-12 Land Surveyors and Technicians.

A university will present the course. The training will include both lecture, and group and individual exercises. The instruction will include computing geographic positions, geographic inverses, properties of the spheroid, datums, errors associated with surveying measurement, and advanced astronomic computations. Calculus required for understanding computations will be taught during session; however, the student must have completed analytic geometry and ELM courses 9600-ST-13, AV Presentation: Geodesy for Large Scale Cadastral Surveys, and 9600-ST-12, AV Presentation: Application of Coordinate Systems.

The student may be required to do prestudy and will be required to take a final examination for grade.

Performance objectives of the course are that, given survey data for typical Bureau of Land Management or Forest Service cadastral, photogrammetric, and control surveys, the student will be required to use practical and theoretical knowledge of the mathematics of geodesy, astronomy, and error analysis to compute geographic positions, distances, and azimuths. In addition, given the final accuracies required for a survey, the student will develop technical specifications.

Photogrammetry as Applied to Surveying

This training is designed for GS-5 through GS-9 Land Surveyors and Technicians.

The course will include lectures as well as group and individual exercises. Trainees will be required to take a mathematics aptitude test to show their ability to handle basic trigonometry. Any mathematics above basic trigonometry used in the course will be taught during the course. The student may be required to do prestudy and will be required to take a final examination for a grade.

Performance objectives of the course are that, given a survey project, the student will be required to prepare a flight plan; specify film, filter, and camera; specify photo scale; specify target configuration, material, and placement; specify positional tolerances; and plan field control. Given simple photography, a student will be required to inspect it for compliance with specifications; and from sample photographs, determine nominal scale, object height, corners and search area; and identify image points in the field.

Land Survey Systems

This training is designed for GS-5 through GS-9 Land Surveyors and Technicians.

This course will be primarily lectures. It will cover both the structure and history of the public land survey system and metes and bounds system, including townsites, Eastern States rectangular systems, and mineral surveys. The student may be required to do prestudy and will be required to take a final examination for a grade.

Upon completion of the training, the student should be able to list the advantages, disadvantages, and survey problems of the public land survey and metes and bounds survey systems; and define and describe the major components of each system.

Survey Instrumentation and Mathematics

This training is designed for GS-5 through GS-9 Land Surveyors and Technicians.

The course will consist of both lecture and field exercises and will stress the actual procedures and not theory. The student must have a working knowledge of plane trigonometry. All candidates will have to take a mathematics proficiency test. The student may be required to do prestudy and will be required to take a final examination for a grade.

Performance objectives of the course are the following:

1. From given field survey data the student will be required to--

a. Select proper method of adjustment, distribute the error, and compute coordinates and area.

b. Compute simple curves.

c. Compute astronomic azimuth and latitude.

d. Compute inverses.

e. Compute tangents and secants.

f. Compute convergency.

2. For commonly used instrumentation, list the operational, maintenance, and safety procedures.

Land Survey Law

This training is designed for GS-5 through GS-11 Land Surveyors.

The course will present the basic foundations, concepts, and legal principles of boundary law, title rights, and riparian law. The student will participate in group exercises based upon actual cases; the exercises will include legal literature search and preparation of exhibits. The student may be required to do prestudy before attending and will be required to take a final examination for a grade.

The student will be required to list the basic foundations, concepts and legal principles of boundary law, title rights, and riparian law; to list and to describe the contents of legal references pertinent to land surveying; to list the requirements for presentation of evidence in Federal court; and to prepare, given the survey information, court exhibits.

Cadastral Survey Technical Training for Contracting

The objective of this training is to provide instruction of the technical needs of cadastral surveying contracts. Training will be provided to ensure consistent technical proposals, technical specifications, and credential review of survey contractors. The material also will cover field and office investigation needs and survey contract inspection and supervision.

Public Lands Survey Systems Training

The Forest Service/Bureau of Land Management Memorandum of Agreement of March 19, 1980, authorizes Forest Service employees to perform cadastral surveys governed by the Bureau of Land Management’s authority and instructions. Individual training programs will be developed in the three subject areas discussed in the following sections to provide qualified surveyors for this work.

Note and Plat Training

This training is designed for key Forest Service cadastral surveyors who will be preparing complete notes and plats to be accepted and approved into the Department of the Interior’s public land survey system of recordation. The training will be structured to ensure quality and effective performance and will be tailored specifically to Forest Service needs.

Performing and Documenting Field Survey Training

This training is designed for Forest Service personnel who will be involved in performing the field surveys to be accomplished within the Department of the Interior’s public lands survey system.

Abstract, Field Investigation, and Survey Application Training

This training is designed for Forest Service cadastral surveyors who will be abstracting records, performing field investigations, and preparing survey applications. It will be tailored specifically to Forest Service needs in accordance with the Department of the Interior’s authorities and instructions.

Self-Study

Training is performed by self-study of selected reference material or by using prepared material like a slide tape or programmed text.

Forest Service Self-Study Courses

1. Basic Mathematics EM-7110-1, January 1979.

2. Measurements EM-7110-1a, January 1977.

Correspondence Courses

A few correspondence courses are available. The following are some sources:

1. International Correspondence School.

2. Department of the Army.

3. Forest Service surveying courses.

Formal Training

Formal training is classroom instruction or participation in seminars and workshops. Every Region develops an annual regional training plan that lists the dates, place, course content, and trainee prerequisites.

In-Service Workshops

Workshops are held in each Region as a training need is identified. Instructors are Forest Service individuals who are knowledgeable.

Professional-Society Meetings

All employees are encouraged to belong to and participate in local professional societies and society meetings. The Forest Service Manual identifies who may attend national society meetings.

Other Agency Workshops

Other agency seminars and workshops are often available. These are scheduled and are part of the Annual Regional Training Plan.

Academic Study

The Forest Service is attempting to raise the knowledge and qualifications of paraprofessionals by sending them to college for credit. These courses show up in the Annual Regional Training Plan.

On-the-Job Training

On-the-job training is conducted as a part of the work assignment, usually on a one-to-one or small group basis. Training is job specific.

Certification

A certification program for survey technicians is planned. The program is being developed to identify training needs for various surveying tasks from crew members to professional surveyors.

When the certification has been developed and approved, it will be incorporated into this portion of the guide.

The following are certification categories:

1. Crew or party chief.

2. Search and evaluation specialist.

3. Property line posting specialist.

4. Chiefs of party or project surveyors.

5. Records-search specialist.

SAFETY

FSH 6709.11 HEATLH & SAFETY CODE

The Health and Safety Code is a guide to safe conditions and practices for all Forest Service activities. It should be used--

1. As a starting point for the development of special safety plans for specific, individual projects.

2. As instruction and stimulus for the individual worker in the development of safe working procedures and habits. The Health and Safety Code is used as an initial reference in the application of Forest Service safety.

Contents for Chapter 6
Records & Reports

Page

Chapter 6
Records & Reports

DEFINITIONS

1. Property Corner. A property corner is a geographic point on the Earth's surface usually denoting the intersection of two or more property boundary lines.

2. Property Controlling Corner. This is a public land survey corner that is not on a National Forest property line but that influences or fixes the location of one or more National Forest property corners.

RECORDS

Boundaries of land are defined by records and descriptions. Good land management requires ready access to survey records. Standard records are essential to ensure familiarity by the user. Records shall be maintained and filed at the Ranger District Office and other locations as required.

Administrative Records

1. Card form 7100-52 (5 inches by 7 inches) - Rectangular survey system.

2. Card form 7100-54 (5 inches by 7 inches) - Metes and bounds surveys.

3. Atlas maps with rectangular survey network, showing cumulative corner search, corner monumentation, and boundary lines marked to standard.

4. Atlas maps on primary base for metes and bounds surveys showing cumulative corner search, corner monumentation, and boundary lines marked to standard.

Atlas Map Legend

The circle is the standard symbol representing corner search, recovery, and monumentation.

An open circle denotes that no evidence was recovered at the corner location. This may not mean the corner is lost, but that additional search or surveys may be warranted.

A circle with inscribed cross denotes recovery of evidence that may lead to acceptance of the corner position.

A solid circle denotes a monumented corner that has been documented in the public records.

A solid heavy line connecting two controlling corners denotes a boundary marked to standard. The year of marking is to be added for the purpose of scheduling future maintenance.

STATUS RECORDS

Forest Service status records show ownership and encumbrances of administered lands. Those records should be available to the cadastral surveyor.

PLAT RECORDS

The cadastral surveyor should have available, preferably on microfiche, all original survey plats and their accompanying field notes, In addition to the PLSS data, the surveyor should also acquire the plats and field notes for all nonconforming surveys (Homestead Entry Survey, Small Holding Claim, Donation Land Claim, Mineral Survey).

REPORTS

Two reports are required for the land line location program at this time.

CADASTRAL ENGINEERING REPORT

Regions may design forms for recording their Forest’s annual and cumulative accomplishments similar to figure 1. The report shall be completed each year by October 30. The report shall be maintained at the Forest level and be made available to the Regional Office and Washington Office upon request.

BUREAU of LAND MANAGEMENT CADASTRAL SURVEY PROGRAM REPORT

Form FS 7100-54, “Request for Cadastral Surveys,” listing the Bureau of Land Management cadastral surveys needed by the Forest within the next 2 years, shall be sent to the Regional Office by November. The Regional Office will submit this 2-year program of work for remonumentation and cadastral survey to the Bureau of Land Management annually in December.

USDA-FOREST SERVICE CADASTRAL ENGINEERING REPORT (Ref. FSM 7150)	REGION	FISCAL YEAR COVERED	DATE REPORT PREPARED

TOTAL MILES OF PROPERTY LINES IN REGION	
TOTAL NUMBER OF PROPERTY CORNERS IN REGION	
ESTIMATED NUMBER OF ADDITIONAL CORNERS, NOT ON FS PROPERTY LINES, BUT NEEDED TO CONTROL FS PROPERTY LINES	

WORK ITEMS (1)	ACCOMPLISHMENTS	
	THIS FISCAL YEAR (2)	TOTAL TO DATE (3)
I. CORNER SEARCH:		
A. NUMBER SEARCHED		
B. NUMBER WITH ACCEPTABLE EVIDENCE		
1. NEED REMONUMENTATION		
2. DO NOT NEED REMONUMENTATION		
II. CORNER REMONUMENTATION:		
A. BY FOREST SERVICE		
B. BY FS/BUREAU OF LAND MANAGEMENT COOPERATION		
III. CORNERS ESTABLISHED OR REESTABLISHED BY SURVEY:		
A. FOREST SERVICE:		
1. NUMBER OF CORNERS		
2. MILES OF LINE		
B. BY BUREAU OF LAND MANAGEMENT:		
1. NUMBER OF CORNERS		
2. MILES OF LINE		
IV. LOCATE, MARK AND POST PROPERTY LINES:		
A. MILES TO FSM STANDARDS		
B. MILES TO INTERIM STANDARDS		
V. MAINTENANCE:		
A. MILES OF LINE		
B. NUMBER OF CORNERS		
NUMBER OF MILES OF LINE REPORTED IN COLUMN (2), LINE IIIA-2, WHICH WERE ACCOMPLISHED BY PHOTOGRAMMETRIC METHODS		

INSTRUCTIONS: Entries in the first three line items must agree with the last Washington Office approved periodic inventory figures. They are defined as follows:

Total Miles of Property Lines in Region: These are the property lines between U.S. Government land administered by the Forest Service and adjoining land owned or administered by others. This includes patented mineral claim property lines, etc. It does not include administrative lines which have National Forest land on both sides of the line, such as some boundaries of wilderness areas, experimental forests, etc.

Total Number of Property Corners in Region: These are land survey corners such as section corners, ¼ section corners, homestead entry corners, mineral survey corners, U.S. survey corners, acquisition survey corners, etc. that are on the property lines between land administered by the FS and adjoining land owned or administered by others. It also includes subdivision-of-section corner points on FS property lines, whether or not the actual corner monuments and accessories have yet been established on these points. It does not include corners which are needed to control FS property lines but which are not actually on FS property lines.

Estimated Number of Additional Corners Not on FS Property Lines but Needed to Control FS Property Lines: These are land survey corners that are needed to control FS property lines but which are not actually on the FS property line itself. It includes those corners needed to accomplish adequate search for property corners, to reestablish lost property corners, and to establish new property corners such as in subdivision-of-section surveys.

Numerical and alphabetical designations of the following items correspond to the item in the report to which the instruction applies:

ACCOMPLISHMENTS: Column (2): Enter accomplishments, by work items, for the fiscal year covered. Column (3): Enter total accomplishment from the beginning of this program in 1958 through end of this reporting period.

(Instructions continued on reverse)

APPROVED *(Name and signature)*	TITLE	DATE

7100-50 (4/68)

Figure 1.--Form 7100-50, Cadastral Engineering Report (front).

I. CORNER SEARCH

A. Number Searched: Include land survey corners required for property line location use (property corners and controlling corners) for which ground search has been made and the results property documented and filed according to FSM requirements. Most corner search information will be obtained during planned project corner search work. However, corner search information obtained as a result of activity of other functions, when properly documented, and believed to be reliable and authentic, will be included.

B. Number Acceptable: Enter here the number of corners searched which the Forest Service believes enough authentic evidence remains at the corner location from which the corner can be remonumented without need for official cadastral surveying. Of this total show under B-1 the number of corners that need remonumentation, and under B-2, the number of corners that are in satisfactory condition as found and do not need official action to ensure perpetuation of the corner.

1. Need Remonumentation: Enter the number of corners (included in 1B) that are in need of remonumentation.

2. Do not Need Remonumentation: Enter the number of corners (included in 1B) found in satisfactory condition and not needing remonumentation. (Item 1 plus item 2 will of course equal item 1B)

II. CORNER REMONUMENTATION

Include under this heading those land survey corners which have been remonumented to meet FSM standards and for which official remonumentation records have been prepared and filed.

For corners remonumented under FS/BLM cooperative activity, the BLM monuments will be considered to be standard. For this report, the BLM remonumentation records will be considered as completed for these remonumented corners when the field work is finished even though some time may elapse before the BLM notes are prepared in final form. Form 7100-52, properly filled out on the spot as the work is done and filed according to filing instructions on forms 7100-55 and 7100-56, provides information which is usually sufficient pending availability of the BLM remonumentation record in final form.

For corners remonumented by FS force account, or under negotiated contract for professional surveying services, it is a Forest Service responsibility to prepare and to file the remonumentation records as a public document, or in case facilities for so filing are not yet available, to provide for the safekeeping of the official record until such filing can be arranged. No corner is to be considered as remonumented unless it has an official record to back it up.

III. CORNERS ESTABLISHED OR REESTABLISHED BY SURVEY

Report under this heading the official cadastral surveying work done to establish needed new corners and to reestablish lost corners.

Obtain information on BLM work (III B) from the BLM. It will include work done for the FS by BLM service centers and State offices. The service centers tabulate accomplishments on FS work by fiscal years. The State BLM office may also follow this system.

Contacts with the BLM cadastral engineers should be through Regional Office Engineering and not by Forest or other units. (i.e., zones, ranger districts, etc.)

IV. LOCATE, MARK AND POST PROPERTY LINES

This is self-explanatory except for a definition of "Interim Standards", (IV B). For "Interim Standards" the following definition applies:

A property line located on the ground to full standards of accuracy, and sufficiently marked so that all that is required to bring it to full FSM standard is additional posting, painting, blazing, and clearing with no additional surveying required. For FSM standard see FSM 7153.62.

V. MAINTENANCE

See FSM 7153.72. Maintenance will generally be accomplished in two ways: (1) on a planned project basis, and (2) as work accomplished by FS employees who have need of the lines and corners in connection with multiple use work. Both are to be reported here.

GPO 841-710

Figure 1. (cont.)--Form 7100-50, Cadastral Engineering Report (back).

Engineering Technical Information System

The Series:

THE ENGINEERING MANAGEMENT PUBLICATION SERIES accommodates Engineering information that does not meet the criteria for Engineering Technical Reports, Engineering Field Notes, or Equipment Development series. Cite the full EM code and number, title, and date of publication in correspondence relating to material in this series.

Distribution:

Each Engineering Management Publication is designed to serve a specific purpose; therefore, each is distributed to a listing that is developed at the time the material is prepared for printing (FSM 1630 and 7113).

Submittals:

Held Personnel should submit material for EM publication or questions to their Regional Information Coordinator. Material submitted to the Washington Office for publication should be reviewed by the Regional Office to assure inclusion of information that is accurate, timely, and of interest to Engineers Service-wide. Except by FS Manual reference, do not include mandatory instructions or policy in this material. Type the manuscript double-spaced; include original drawings and black-and-white photographs (or, if only color photographs are available, send transparencies or negatives), and two machine copies of the manuscript.

Inquiries:

Regional Information Coordinators should send articles for publication and direct questions concerning format, editing, publishing schedules, etc., to:

FOREST SERVICE - USDA
Engineering Staff - Washington Office
Att: D.J. Carroll, Editor
M.J. Baggett, Editorial Assistant
Telephone: Area Code 703/FTS-235-8198

Regional
Coordinators:

R-1 JIM HOGAN
R-2 MIKE CLINTON
R-3 JOHN FEHR
R-4 TED WOOD
R-5 PHIL RUSSELL
R-6 KJELL BAKKE
R-8 JIM GILPIN
R-9 FRED HINTSALA
R-10 RON HAYDEN
WO   AL COLLEY

EM-7150-3
August 1985

Land Surveying Guide

United States Department of Agriculture

Forest Service

Engineering Staff

Washington, D.C.

EM 7150-4

November1986

Corner Search, Perpetuation, & Recordation

A Training Guide

Engineering Management Publications

Administrative Distribution

- Professional Development
- Management
- Data Retrieval

This publication is an administrative document that was developed for the guidance of employees of the Forest Service—U.S. Department of Agriculture, its contractors, and its cooperating Federal and State Government Agencies. This information has not been approved for distribution to the public, and must not be construed as recommended or approved policy, procedures, or mandatory instructions, except by Forest Service Manual references.

The Forest Service—U.S. Department of Agriculture assumes no responsibility for the interpretation or application of this information by other than its own employees. The use of trade names and identification of firms or corporations is for the convenience of the reader; such use does not constitute an official endorsement or approval by the United States Government of any product or service to the exclusion of others that may be suitable.

Inquiries:

Please direct any comments or recommendations about this publication to the following address:

FOREST SERVICE—USDA
Engineering Staff—Washington Office
Attn: D.J. Carroll, Editor
M.J. Baggett, Editorial Assistant

P.O. Box 2417—Washington, D.C. 20013

Telephone: Area Code 703—235-8198

Regional Coordinators:

R-1 Jim Hogan
R-2 Ray Ollila
R-3 Art Marty
R-4 Ted Wood
R-5 Larry Gruver
R-6 Bill Perry
R-8 Jim Gilpin
R-9 Fred Hintsala
R-10 Ron Hayden
WO Al Colley

Corner Search, Perpetuation, & Recordation—A Training Guide

Dennis Valdovinos
Cadastral Surveyor
Grand Mesa, Uncompahgre, &
Gunnison National Forests

Table of Contents

FOREST SERVICE INDEX MAP

Contents

Foreword

This “Corner Search” User’s Guide is intended as a training document for future Forest Service Land Surveyors and for personnel involved in corner search. It also may serve as a reference for experienced land surveyors. When the Land Line Location program began in 1958, we thought that any casual Forest employee should be able to recognize and preserve land corner evidence with a minimum of training. This was a costly error, resulting in the destruction of fragile original evidence and the mislocation of some property lines, requiring resurveys and legal action to correct honest mistakes. Corner search activities always should be conducted under the direct supervision of a registered Forest Land Surveyor for proper perpetuation and documentation.

This guide was developed in the Rocky Mountain Region. The user is cautioned that field conditions and situations in your particular location may not exactly be as described in the guide. Survey evidence in your location depends on the instructions in effect for contract surveys at the time the original surveys were made, the individual practices of the contractor surveyor, the many varied situations encountered by the original surveyor, and the many natural forces that have acted on the evidence since it was established. The corner searcher of today must methodically and meticulously search the written record and observe field conditions. By comparing the two, the searcher will find the “footsteps” of the original surveyor.

--Glenn Bergey
Chief Land Surveyor
USDA Forest Service

Introduction

This training guide has been prepared for several reasons:

(1) Various Forest Service personnel have raised questions about the meanings of corner markings, the status of a corner or boundary, original evidence, and what actions may be taken by field employees to preserve or rehabilitate a corner monument.

(2) Formal training sessions have been limited by distance and funding restrictions. A training guide presented in a direct readable format is needed to fill this void.

(3) No ready-reference-type training guide outlining corner search procedures, corner markings and their meanings, and other much needed information is available.

This training guide details the basics of the U.S. Public Lands rectangular system, procedures and techniques of corner search, and principles of perpetuation and recordation. The guide is directed toward a spectrum of field personnel, from inexperienced temporary employees to experienced surveyors. Portions of the guide may not be pertinent to every employee: therefore, the various topics are presented as independent units for rapid reference. A number of units also may be of interest to non-Forest Service personnel.

Few training guides are totally effective without supplementary field experience and exposure. However, once the fundamentals, as outlined in the guide, are understood, the individual will rapidly gain competence through “real world” field experience. The guide can be referred to in the future as required.

With the high costs involved in reestablishing corners, it is most important for all field personnel to become an integral part of the corner search-land line program. A few minutes of your time may result in a tremendous savings of time and funding. Without adequate training of some form, more and more land corners will become obliterated or destroyed.

The primary focus of this guide is the Western United States. However, certain portions may apply to surveys in other parts of the country.

Unit 1
U.S. Public Land Rectangular Survey System

U.S. PUBLIC LAND SURVEYS

The rectangular system of survey of U.S. public lands was initiated by the passage of the Land Ordinance on May 20, 1785, by the Continental Congress:

> Be it ordained by the United States in Congress assembled, that the territory ceded by individual states to the United States, which had been purchased of the Indian inhabitants, shall be disposed of in the following manner:
>
> A surveyor from each state shall be appointed by Congress or a committee of the states, who shall take an oath for the faithful discharge of his duty, before the geographer of the United States, who is hereby empowered and directed to administer the same; and the like oath shall be administered to each chain carrier, by the surveyor under whom he acts.

The Act of April 25, 1812, created the General Land Office. On March 3, 1849, Congress established the Department of the Interior. At that time, the public lands had ceased to be a major source of revenue. Expansion to the West and gold discovered in California in 1848 were of more importance than revenue from land sales.. The General Land Office was then placed under the treasury. The Act of July 16, 1946, known as the Organic Act, abolished the General Land Office and created the Bureau of Land Management.

Rectangular surveys commenced in Oregon in 1850 and California in 1851 and are still in progress in many States. Most of the original rectangular surveys in Colorado were completed in the 1870’s and 1880’s (see figure 1-1). A tremendous amount of mineral survey activities were attendant to the legendary mining areas that are so numerous throughout many of the Western States. Homestead Entry Surveys also were being completed under the Act of June 11, 1906.

It was provided by the public land laws that all the public domain be surveyed into townships and sections prior to settlement and that the corners, as established by the public land surveys, remain forever as the corners they were intended to be:

> The first line, running due north and south as aforesaid, shall begin on the river Ohio, at a point that shall be found to be due north from the western termination of a line, which has been run as the southern boundary of the state of Pennsylvania; and the first line, running east and west, shall begin at the same point, and shall extend throughout the whole territory; provided, that nothing herein shall be construed, as fixing the western boundary of the state of Pennsylvania. The geographer shall designate the townships, or fractional parts of townships, by numbers progressively from south to north; always beginning each range with No. 1; and the ranges shall be distinguished by their progressive numbers to the westward. The first range, extending from the Ohio to the lake Erie, being marked No. 1. The geographer shall personally attend to the running of the first east and west line; and shall take the latitude of the extremes of the first north and south line, and of the mouths of the principal rivers.

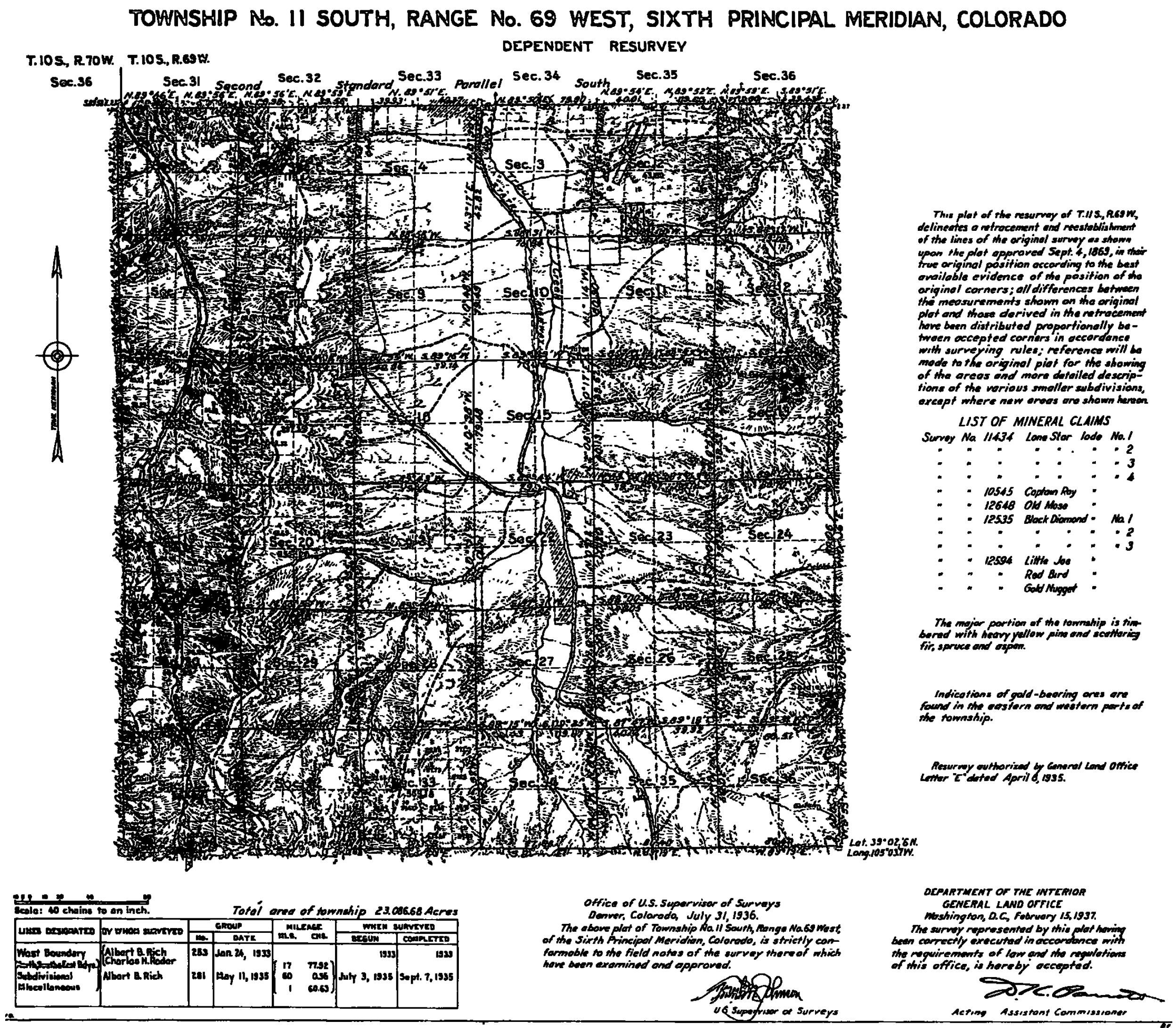


Figure 1-1.--Dependent resurvey of Township No. 11 South, Range No. 69 West, Sixth Principal Meridian, Colorado.

While the methods have, in general, been the same on all surveys, there have been important variations in detail. The local engineer or surveyor, before retracing old land lines, should become familiar with the exact methods in use at the time the original survey was made.

All land ownership in the United States, with the exception of the original 13 States, Texas, and Spanish grants, is based on the rectangular system of surveys--township, range, and sections. There are some minor variations and mineral patent surveys, but even these were intended to be tied in to the sectionalized system.

Homestead, timber, grazing, cash entry, and other patents were issued by the Government based on these surveys, in units of sections and their aliquot parts.

General Procedures

The following are the basics of the rectangular system:

Initial Point. The beginning place of the survey of any given region is called the initial point. Through this point is run a meridian, called the principal meridian, and a parallel of latitude, called the base line. The initial point is selected with a view to its control of extensive agricultural areas within reasonable geographical limitations. Upon the establishment of an initial point, the position of the point in latitude and longitude is determined by accurate field astronomical methods.

Since surveys in widely separated sections of the country have been in progress simultaneously, a large number of initial points have been established. The positions of these points and the areas governed by them are given in figure 1-2.

Meridian	Governing Surveys (Wholly or in Part) in the States of—	Longitude of Principal Meridian West from Greenwich	Latitude of Base Line North from Equator
		° ′ ″	° ′ ″
Black Hills	South Dakota	104 03 16	43 59 44
Boise	Idaho	116 23 35	43 22 21
Chickasaw	Mississippi	89 14 17	35 01 58
Choctaw	Mississippi	90 14 11	31 52 32
Cimarron	Oklahoma	103 00 07	36 30 05
Copper River	Alaska	145 18 13	61 19 21
Fairbanks	Alaska	147 38 26	64 51 50
Fifth Principal	Arkansas, Iowa, Minnesota, Missouri, North Dakota, and South Dakota	91 03 07	34 38 45
First Principal	Ohio and Indiana	84 48 11	40 59 22
Fourth Principal	Illinois	90 27 11	40 00 50
Fourth Principal	Minnesota and Wisconsin	90 25 37	42 30 27
Gila and Salt River	Arizona	112 18 19	33 22 38
Humboldt	California	124 07 10	40 25 02
Huntsville	Alabama and Mississippi	86 34 16	34 59 27
Indian	Oklahoma	97 14 49	34 29 32
Louisiana	Louisiana	92 24 55	31 00 31
Michigan	Michigan and Ohio	84 21 53	42 25 28
Mount Diablo	California and Nevada	121 54 47	37 52 54
Navajo	Arizona	108 31 59	35 44 56
New Mexico Principal	Colorado and New Mexico	106 53 12	34 15 35
Principal	Montana	111 39 33	45 47 13
Salt Lake	Utah	111 53 27	40 46 11
San Bernardino	California	116 55 17	34 07 20
Second Principal	Illinois and Indiana	86 27 21	38 28 14
Seward	Alaska	149 21 24	60 07 36
Sixth Principal	Colorado, Kansas, Nebraska, South Dakota, and Wyoming	97 22 08	40 00 07
St. Helena	Lousiana	91 09 36	30 59 56
St. Stephens	Alabama and Mississippi	88 01 20	30 59 51
Tallahassee	Florida and Alabama	84 16 38	30 26 03
Third Principal	Illinois	89 08 54	38 28 27
Uintah	Utah	109 56 06	40 25 59
Ute	Colorado	108 31 59	39 06 23
Washington	Mississippi	91 09 36	30 59 56
Willamette	Oregon and Washington	122 44 34	45 31 11
Wind River	Wyoming	108 48 49	43 00 41

Figure 1-2.--Meridians and base Lines of the rectangular surveys.

Principal Meridian. The principal meridian is a true meridian that is astronomically determined and is extended from the initial point, either north or south, or in both directions, as the conditions may require, to the limits of the area being subdivided (see figure 1-3). Monuments are placed on this line at intervals of 40 chains (1/2 mile) and at its intersection with navigable bodies of water (streams 3 chains or more wide and lakes of an area of 25 acres or more).

Because the only equipment available for most of the early surveys was a compass and a chain, discrepancies far in excess of these limits will be found in rerunning many old lines. In other cases the agreement will be surprisingly close when one considers that much of the country was often heavily wooded at the time the surveys were made.

Base Line. From the initial point the base line is extended east and west on a true parallel of latitude to the limits of the area being surveyed. Monuments are placed on this line at intervals of 40 chains and at its intersection with all meanderable bodies of water. The manner of making the measurement of the base line and the accuracy of both the alignment and the measurement must be the sane as that required in the survey of the principal meridian.

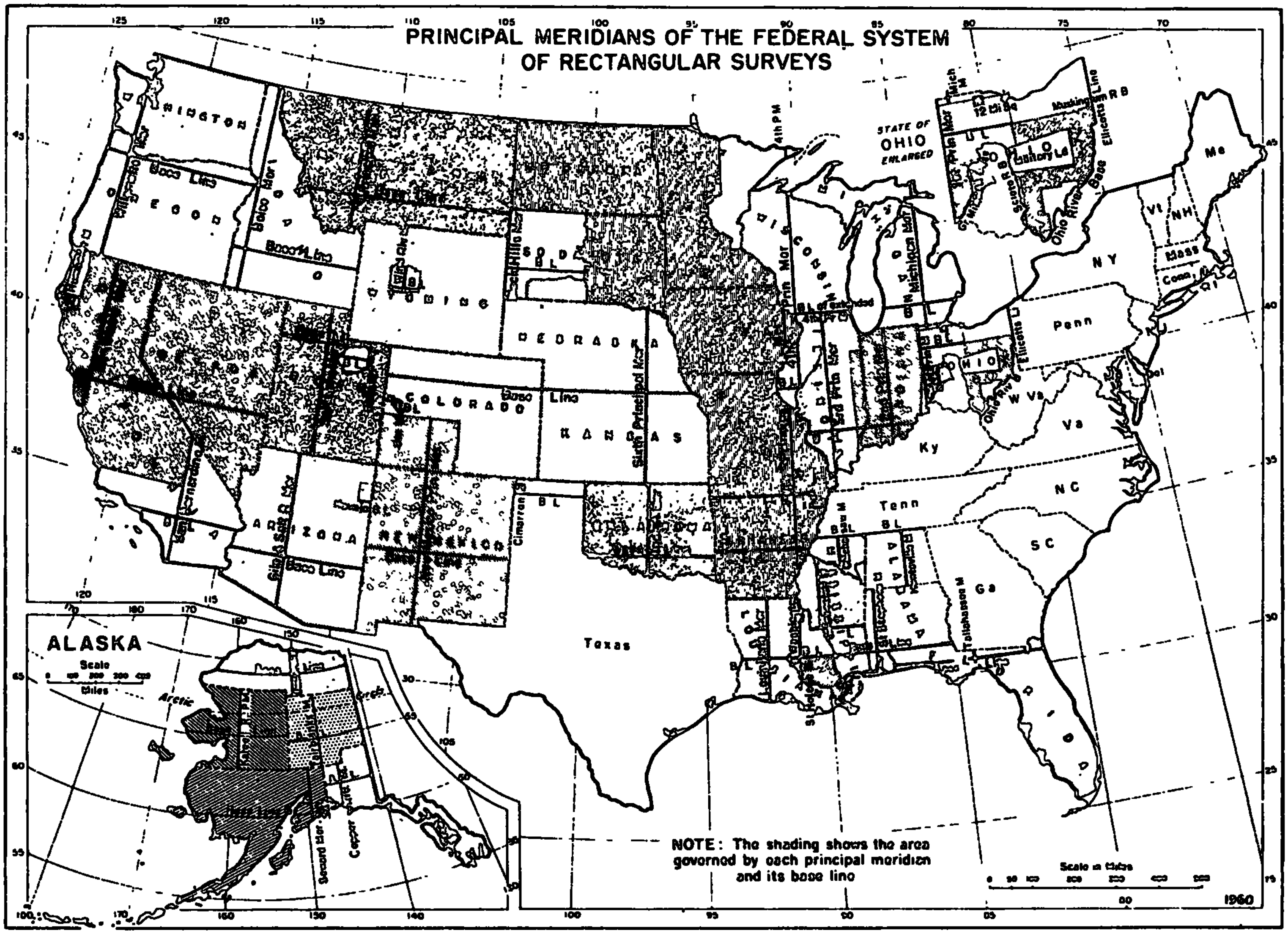


Figure 1-3.--Principal meridians of the Federal system of rectangular surveys.

The area is them divided into tracts approximately 24 miles square by means of meridians and parallels of latitude.. These 24-mile tracts are then divided into 16 townships, which are approximately 6 miles on a side (see figure 1-4). The last step, so far as the Federal Government is concerned, is to divide the township into 36 sections, each approximately 1 mile square (see figures 1-5 and l-6) The subdivision of the sections into smaller units may be accomplished by the local land surveyor.

Figure 1-7 indicates the order of subdivision survey of most original townships. The township exteriors normally were completed prior to this subdivision. The diagram shows, for example, that the surveyor began at the southwest corner of section 36. The west line of this section is surveyed and the west quarter and northwest section corner is set. A random line is run east, setting a temporary stake for the north quarter corner. The “falling or distance north or south of the northeast section corner was noted and the true quarter corner position computed. The monument was then set.

The reader can follow the procedure as is indicated by the numbers. As a result of this procedure, all excess or deficiency is placed in the west and north tiers of the township. Additional care must be exercised in searching for corners in these areas, as fractional distances (25 chains) may be involved.

As discussed earlier, excess and deficiency are placed in the north and west tiers of the township. Figure 1-8 illustrates how section 6 is doubly affected by this process. Fractional distances are found on both the north and west sides.

Double corners can occur along township lines as indicated in figure 1-9. Triple corners may also be found in some areas.. Care must be exercised in reporting the exact markings on the cap. A rubbing may be useful to avoid confusion.

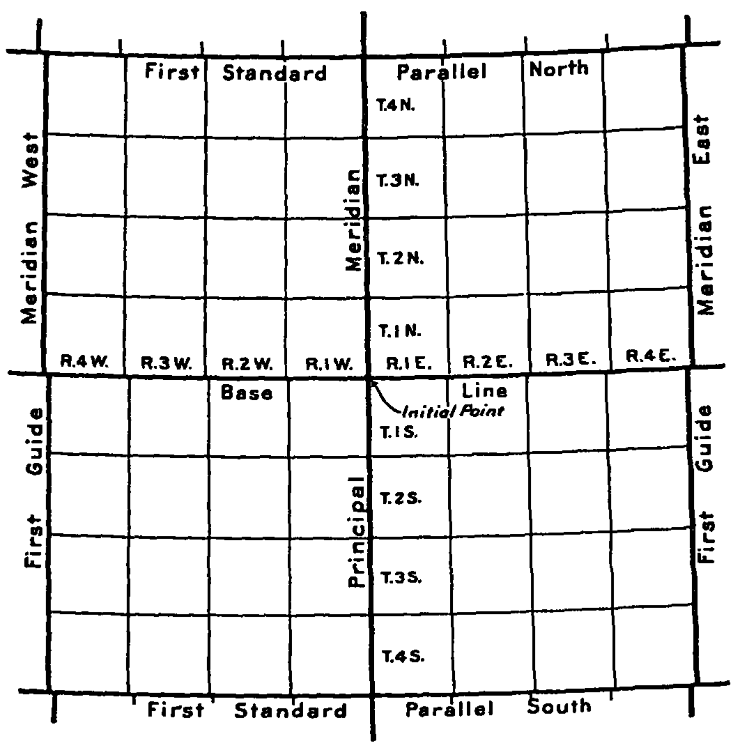


Figure 1-4.--Basic Parameters of the U.S. public lands system.

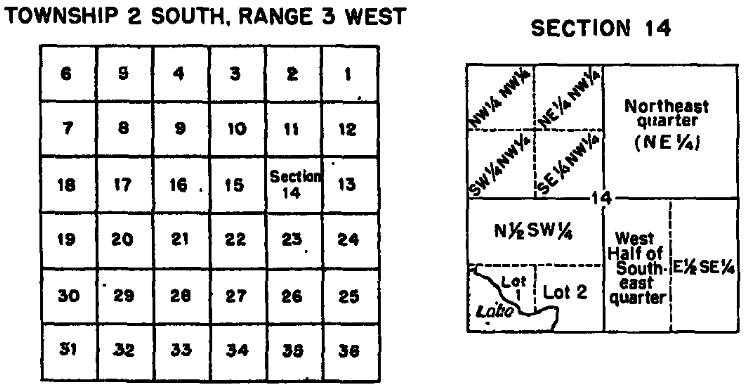


Figure 1-5.--Townships further divided into sections of I square mile (640 acres). Sections are then numbered from 1 to 36. Few sections are exactly 640 acres; in fact, they may vary considerably.

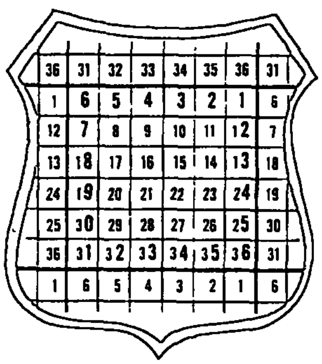


Figure 1-6.--Township diagram illustrating a system for remembering sectional numbering.

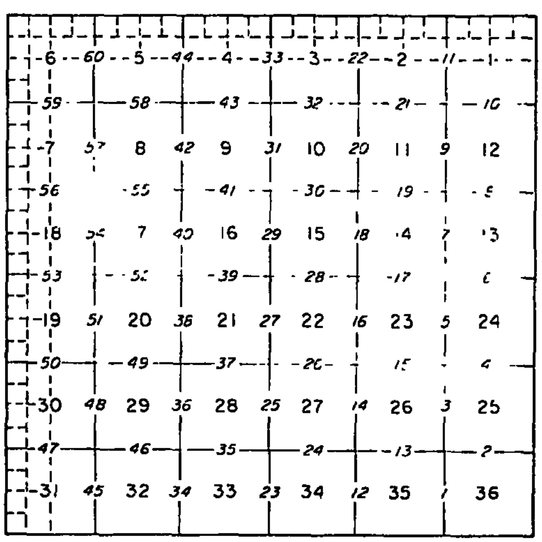


Figure 1-7.--Sequence of numbers of section lines showing normal order of subdivision

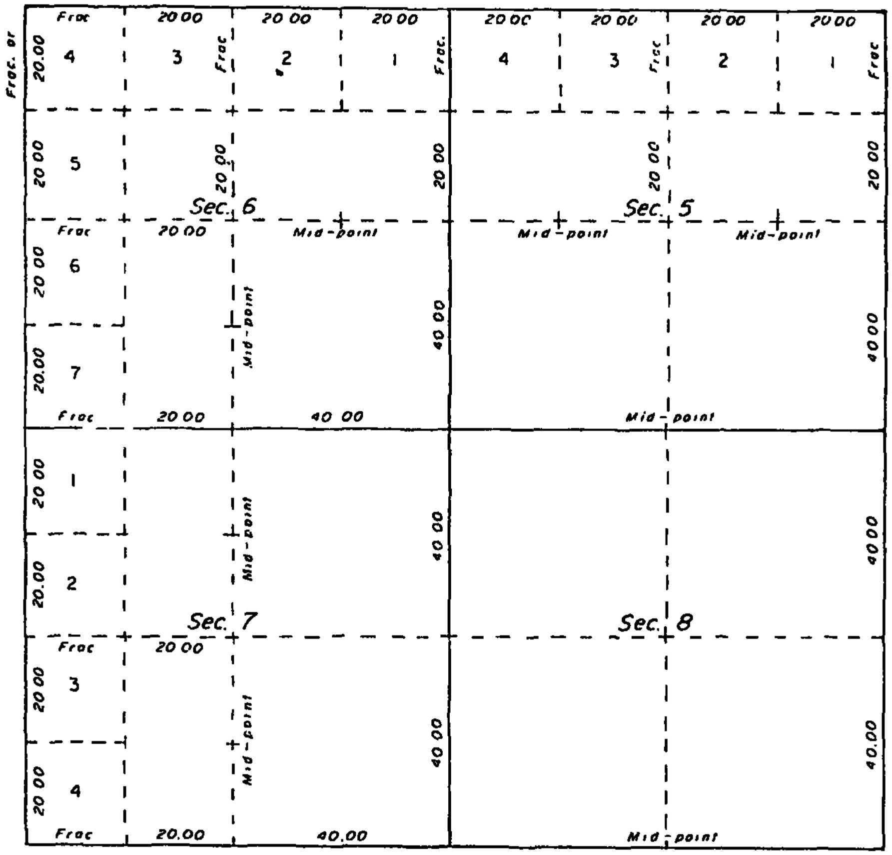


Figure 1-8.--Normal subdivision of sections.

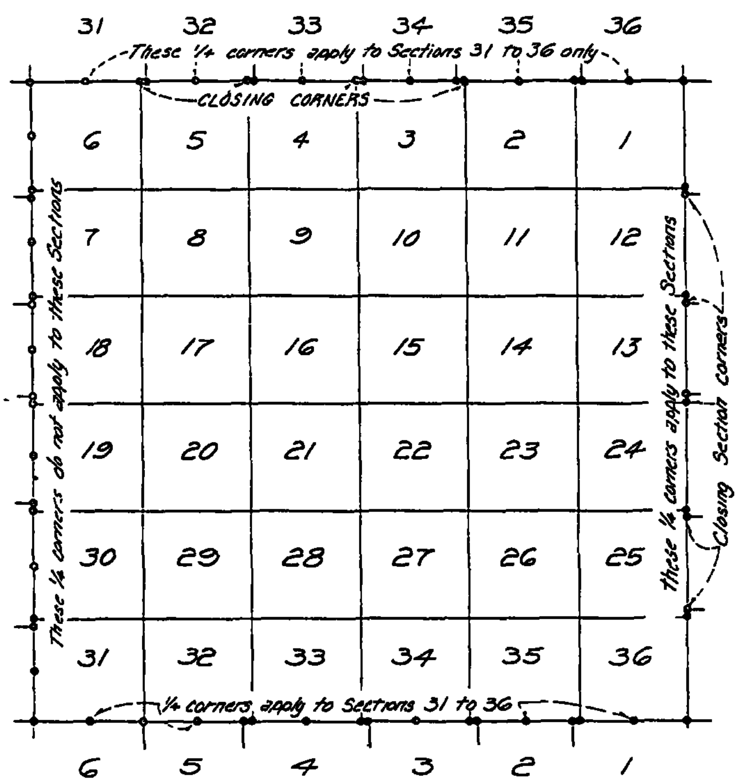


Figure 1-9.--Double corners along township lines. Normally these *will* occur *on only one* or *two of the township lines*

Unit 2
Corners & Corner Monuments

CORNERS

The following excerpt is taken from the booklet Restoration of Lost or Obliterated Corners and Subdivision of Sections," which is available through the U.S. Government Printing Office. Although the booklet primarily details methods for restoring lost corners, it defines the various states of corners: an existent corner, an obliterated corner, and a lost corner. As the booklet states, proportionate methods should be used only as the last resort to restore a "lost" corner. The method does provide for the approximate search area for the lost corner monument. There are frequently other means to restore a presumed-to-be-lost corner. Before considering a corner lost, we must first be aware of specific definitions of the various corners.

> The restoration of lost corners should not be undertaken until after all control has been developed: such control includes both original and acceptable collateral evidence. However, the methods of proportionate measurement will be of material aid in the recovery of evidence.
>
> **1. <u>An existent corner</u> is one 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.
>
> **2. <u>An obliterated corner</u> is one at whose point there are no remaining traces of the monument, or its accessories, but whose location has been perpetuated, or the point for which may be recovered beyond reasonable doubt, by the acts and testimony of the interested landowners, competent surveyors, or other qualified local authorities, or witnesses, or by some acceptable record evidence.**
>
> A position based upon collateral evidence should be duly supported, generally through proper relation to known corners, and agreement with the field notes regarding distances to natural objects, stream crossings, line trees, and offline tree blazes, unquestionable testimony, or other evidence.
>
> **3. <u>A lost corner</u> is a point of a survey whose position cannot be determined, beyond reasonable doubt, either from traces of the original marks or from acceptable evidence or testimony that bears upon the original position, and whose location can be restored only by reference to one or more interdependent corners.**
>
> If there is some acceptable evidence of the original location of the corner, that position will be employed.
>
> Decision that a corner is lost should not be made until <u>every</u> means has been exercised that might aid in identifying its true original position. The retracements, which are usually begun at known corners, and run according to the record of the original survey, will indicate the probable position for the corner and show what discrepancies may be expected. Any supplemental

survey record or testimony should then be regarded as doubtful if the retracement affords recovery of acceptable evidence.

In cases where the probable position for a corner cannot be made to harmonize with some of the calls of the field notes, due to errors in description or to discrepancies in measurement developed in the retracement, it must be ascertained which of the calls for distances along the line are entitled to the greater weight. Aside from the technique of recovering traces of the original marks, the main problem is one that treats with the discrepancies in alinement and measurement.

4. Existing original corners cannot be disturbed: consequently, discrepancies between the new and the record measurements will not in any manner affect the measurements beyond the identified corners, but the differences will be distributed proportionately within the several intervals along the line between the corners.

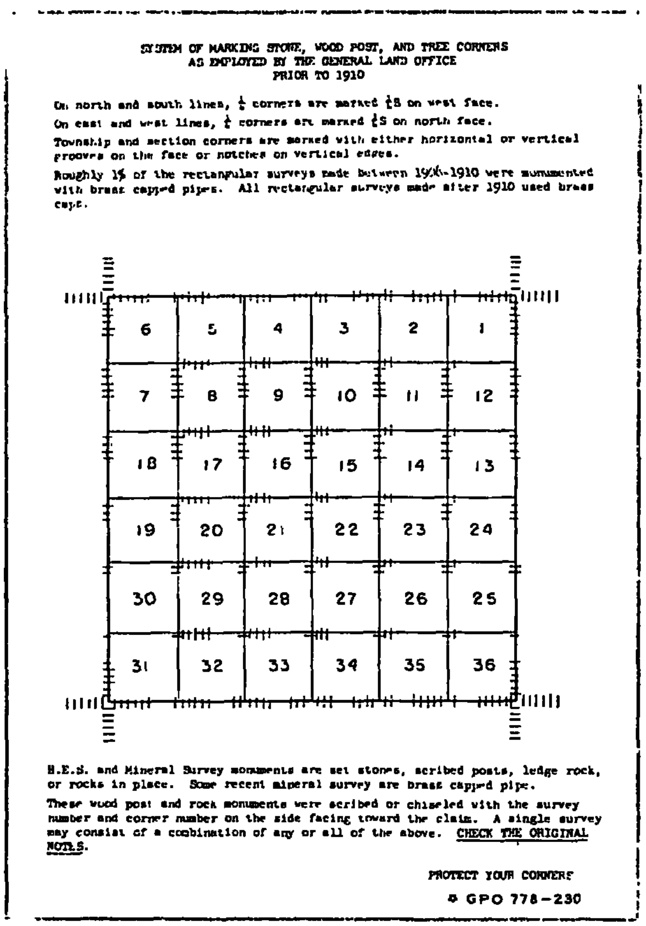
CORNER MONUMENTS

A recovered monument in its original location, as established by the original surveyor, is the best evidence of a corner. The monument material used by surveyors during the late 1800’s and early 1900’s was usually local native material or what was readily available. Monuments of public land surveys have included marked wooden stakes or posts, marked stones, a marked tree, a rock or boulder in place, a marked metal cap set in solid bedrock or in concrete, drill steel, axles, iron and aluminum posts, and other permanent materials (see figure 2-1).

Corner monuments that nay be encountered in the field are the Bureau of Land Management (BLM) or General Land Office (GLO) brass or aluminum caps. These are disk-like caps fastened to the top of iron or aluminum pipes (see figure 2-2). The iron post monument was first authorized by Congress for use on public land surveys in 1908. Aluminum posts are now in common use by Federal surveyors. They are 2.5 inches by 30 inches and have the bottoms flanged to prevent removal. Rock collars or mounds of stone were placed alongside when stones were available. The cap is pre-cast with the agency name and die-stamped with the rectangular corner data. All have the year of survey stamped on the cap.

These caps are referred to as “GLO caps” or BLM caps” to distinguish them from Forest Service survey caps and private registered land surveyor caps, which may consist of rebar or pipe with plastic or aluminum caps. Such metal monuments with brass caps were first introduced about 1909; however, because of transportation problems, stone monuments were in use into the 1930’s and occasionally later.

A word of caution: There are similar monuments that are <u>not</u> property corners, including bench marks, triangulation stations, reference marks, and right-of-way markers. It is never a waste of time to report such monuments. Although they do not define land ownership, care must be exercised to record the exact marking on each cap.



SYSTEM OF MARKING STONE, WOOD POST, AND TREE CORNERS
AS EMPLOYED BY THE GENERAL LAND OFFICE
PRIOR TO 1910

On north and south lines, ¼ corners are marked ¼S on west face.

On east and west lines, ¼ corners are marked ¼S on north face.

Township and section corners are marked with either horizontal or vertical grooves on the face or notches on vertical edges.

Roughly 1% of the rectangular surveys made between 19[illegible]-1910 were monumented with brass capped pipes. All rectangular surveys made after 1910 used brass caps.

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

H.E.S. and Mineral Survey monuments are set stones, scribed posts, ledge rock, or rocks in place. Some recent mineral survey are brass capped pipe.

These wood post and rock monuments were scribed or chiseled with the survey number and corner number on the side facing toward the claim. A single survey may consist of a combination of any or all of the above. CHECK THE ORIGINAL NOTES.

PROTECT YOUR CORNERS

☆ GPO 778-230

Figure 2-1.--Forest Service sticker showing system of marking stone, wood post, and tree corners as employed by the General Land Office before 1910.

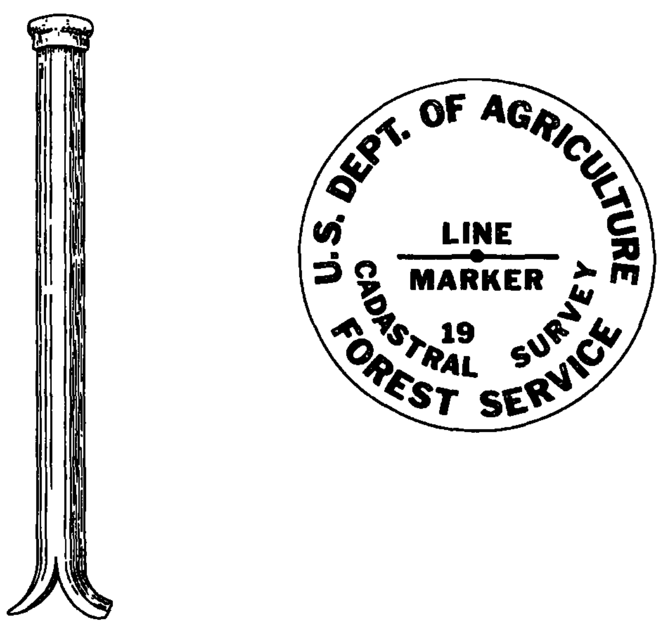


Figure 2-2.--Post and cap monument. Caps can *be purchased with desired pre-stamped logos.*

Prior to the use of metal monuments, rock monuments were predominantly used in Colorado and many Western States (see figure 2-3). Special instructions called for durable stone with a volume of 1,000 cubic inches. What was placed by the surveyor may approach this size but may be much smaller. Recovery of some corners will give an indication of reliability. If the field notes call for notches, and the stone found at the corner position is rounded and water-worn, grooves or scratches are more likely to be found. When the surveyor does not specify setting the stone to a depth, the stone may be lying on the surface. Charred stakes, charcoal, broken glass, or crockery (memorials) often were placed in the hole prior to placement of the monument.

Wood posts 3 to 6 inches square by 4 feet long commonly were used to mark corners. The surveyor frequently states in the field notes the species of wood used. If the notes state that a redwood post was placed at the corner, the remnants of a sawn post may be found, if only in the form of soil discoloration. If native material is used, it may have been cut on the spot and squared up to some extent. A pitchy material usually survives if a pine post was used.

The following excerpt is from the BLM publication History of the Rectangular Survey System, by Al White. This is a portion of the 1902 Manual of Surveying Instructions for the Survey of the Public Lands of the United States and Private Land Claims.

ESTABLISHING CORNERS.

> 52. To procure the faithful execution of this part of a surveyor’s duty is a matter of the utmost importance. After true coursing and most exact measurements, the establishment of corners is the consummation of the field work. Therefore, if the corners be not perpetuated in a permanent and workman-like manner, the principal object of surveying operations will not have been attained.
>
> 53. All marking of letters and figures should be done neatly, distinctly, and durably, using the tools best adapted to the purpose, and keeping them in good order. These tools are the chisel and hammer for marking stones, and the scribing tool or gouge for surfaces of wood. Since the greatest permanency requires stone corner monuments, and the perishable nature of wood prohibits its use where stones can be found or brought, the deputy should be provided with good chisels, to enable him to mark neatly and expeditiously, using arabic figures for all numbers.

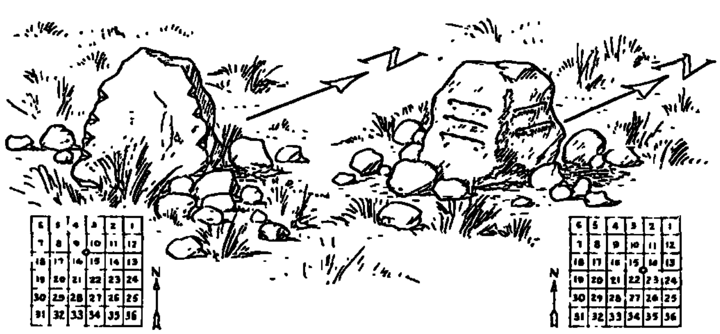


Figure 2-3.--Marks on old stone section corners. The grooves indicate the number of miles from the south and east boundaries of the township, respectively.

SURVEYING MONUMENTS.

54. These consist of what is called the corner, and its accessories. The corner itself should be durable and firmly imbedded. It may consist of an iron monument, rod, or pipe, a cross cut on a ledge, or a marked stone; or in case these cannot be obtained, then a post of durable timber. Where a stone corner has to be set upon a ledge of surface rock, it should be of large size and supported in a well-built stone mound, with its marks well shown; in addition to which, the usual witness mound will be separately built.

55. The accessories are needed to witness and identify the corner as a monument of public survey, and may consist of the following, mentioned in the order of their value and desirability:

Bearing objects, such as notable cliffs, rocks, boulders, etc., marked with a cross, the letters B. O., and a section number.

Memorials, buried 12 to 24 inches under the surface at the corner, such as glass or stone ware, potsherds, marked stones, cast iron, charcoal, or charred stake.

Pits of proper size and arrangement.

Mound of stones, at proper position and distance from the corner.

Bearing trees, blazed and marked as required.

Stake in pit, with letters and figures necessary.

Mound of earth, which in many regions is the least durable and useful of all accessories.

Older surveys were monumented principally with set and marked stones, although in heavily wooded areas many corner positions fell at a live tree, in which case the tree itself was marked as the true corner--usually by notching or blazing, and township, range, and section scribed in the appropriate face and almost invariably were witnessed by a marked bearing tree in each section. Where the true point for a corner fell in the position occupied by a sound living tree, the tree was made the monument (see figures 2-4 and 2-5). The tree was removed if it was too small to serve as the monument. When the trees were of the thin, smooth bark type, the marks were made by scribing lightly into the bark without blazing (bark scribed). The marks would remain as long as the tree was sound--even after it died. On the rough-barked trees, the marks would be scribed into a smooth, narrow, vertical blaze, prepared by removing just enough of the outer growth to expose a flat surface of the live wood tissue immediately beneath the bark.

Occasionally corners were marked with a set, scribed wooden post, sometimes in a mound of stone but many were mounded with earth. Such wooden post monuments were usually less permanent than the stone corners, which may exceed 100 years in age with the scribing still legible. Many posts have decayed at ground level with the underground remains still in evidence. <u>Do not disturb the underground remnants</u>--they are invaluable to the person who does the remonumenting and if they are disturbed the corner probably will not be well enough evidenced to be acceptable.

The photos in figure 2-6 are two views of an original wood post corner set by Deputy U.S. Surveyor Jacob H. Marts in 1869 for the corner of Sections 25-30-31 and 36, T23S, R68 and 69W, 6 P.M. It was made from a charred stump that is still standing nearby. The old marks are needle-sharp. The only decay is in the lower 10 or 12 inches that were underground.

Much evidence is fragile and can be easily destroyed by inexperienced personnel. When conducting the search, exercise care so as not to destroy useful evidence. <u>What is found should be recorded, not transported or destroyed</u>. For example, when a piece of wood with scribing is transported, the original position is then lost.

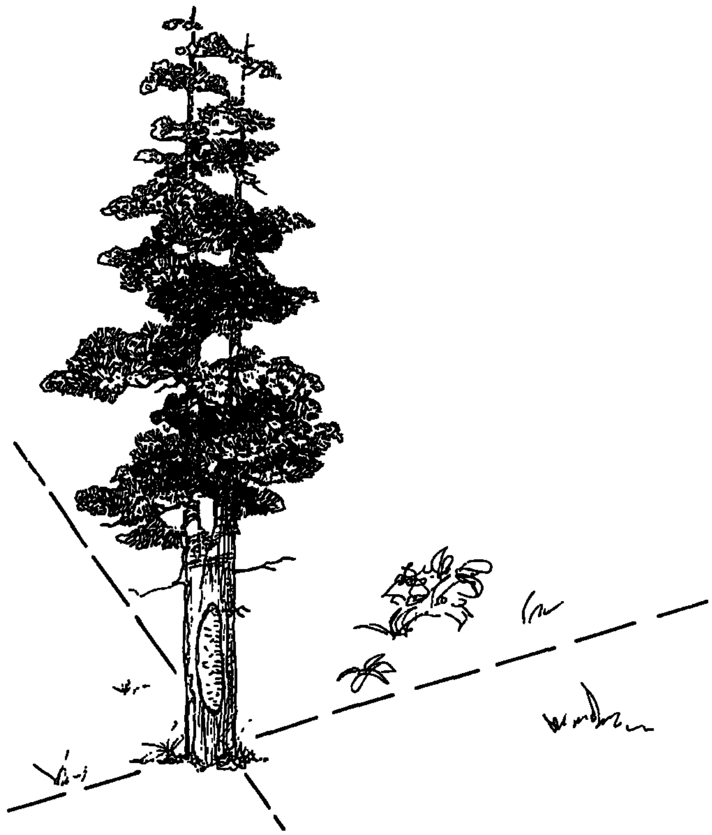


Figure 2-4.--General view of a tree *monument.*

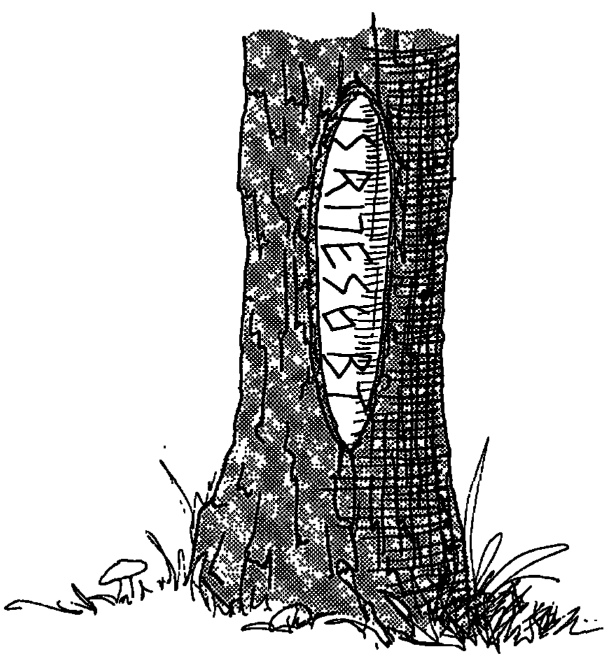


Figure 2-5.--Detail of a tree monument. Field notes should be reviewed to recover reference monuments or other accessories.

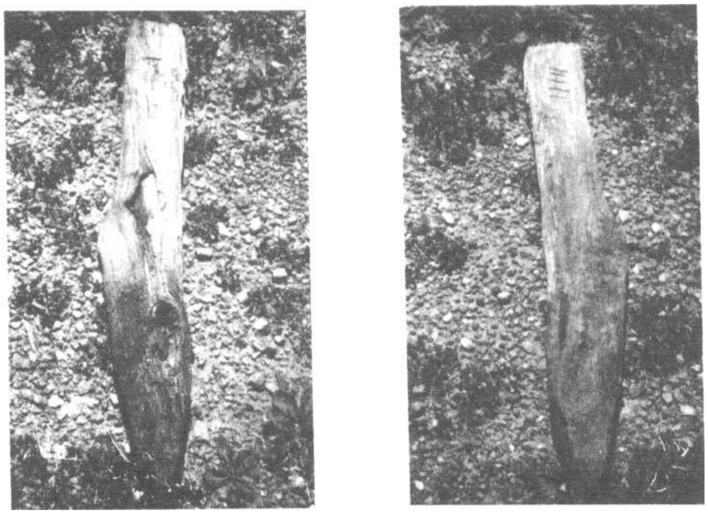


Figure 2-6.--Original post monument.

Unit 3
Corner Markings

The following is an excerpt from the BLM publication History of the Rectangular Survey System, by Al White.

> The Act of 11th February, 1805, entitled "An Act concerning the mode of surveying the public lands of the United States," (Land Laws, new edition, page 515), prescribes general regulations for dividing townships in Sections, and subdividing such sections into half sections and quarter sections. The following is a summary of those regulations pertaining to the marking of township corners and bearing trees:
>
> AS TO MARKING.
>
> The greatest possible caution is to be observed in marking the corners of townships, etc., in a plain, distinct, and permanent manner.
>
> Where a tree is not found immediately at the corner, a corner is to be established by planting a post, on which is to be marked the number of the township, over which is to be marked the number of the Range, and underneath the number of the Section.
>
> The post used in forming the corners of townships must always be larger (for the sake of distinction] than those which denote the sectional and quarter sectional corners, and should be neatly squared off at the top, to correspond with the cardinal points.
>
> [The marks on the posts and bearing trees should be deeply burnt into the wood with marking irons.]
>
> The posts must always be made of the most durable wood that can be had, and should be set in the earth to the depth of two feet, and very securely rammed in with earth and stone. [It is highly important, in reference to their durability, that the portion of each post below the surface should be charred, and the whole of it rubbed over with tar, except the portion which bears the Surveyor's marks.] The sectional posts are to indicate, by a number of notches on each of the four corners directed to the cardinal points, the number of miles that it stands from the outlines of the townships; the side of the post will be numbered to correspond with the number of the Section it faces. Each half-mile post on a section line, and quarter-section post on a township line, should be marked, to indicate that it is a quarter sectional ["1 4 S"] post, and the nearest adjoining tree on each side of such a post must be similarly marked; the Surveyor to note in his field book the kind of tree, its diameter, bearing and distance from the true corner.
>
> Posts denoting the same kind of character of boundary should be of uniform construction, and there should always be a striking difference between posts denoting different kinds of boundary.
>
> [To create additional and increased facility in the discovery of boundary lines by the purchasers of public lands, and to prevent errors of entry, you are to require your Deputies to fasten to the sectional and quarter sectional posts, near the ground, but so as to be plainly seen, a finger board, on which is to be distinctly marked with black oil paint, the appropriate number of the tract. This board to point diagonally across the tract, and to be marked similarly to this: N.W. 1/4 S.1 T. 1 N. R. 1 E.]
>
> In prairie countries, where bearing trees cannot be had, mounds, to be covered with sod, are, agreeably to contract, to be erected. Such mounds should be of uniform size, and conform precisely to instructions to be given by you. As mounds are subject to be worn away, by the action of the weather and other causes, I would recommend that a stone be planted in the centre of the mound, and that a few handfuls of charcoal be enclosed therein. I would further recommend, that at each corner of a square, which will enclose the

> mound and conform to the cardinal points, there be planted a chestnut, hickorynut, walnut, or acorn.
>
> A stake to be set up in the centre of the mound, to which is to be fastened a finger-board, on which is to be designated in black oil paint the appropriate numbers.
>
> All the particulars relative to the construction of a mound are to be minutely indicated in the field book.
>
> The perpetuation of the corners of the public surveys is a subject of primary importance. Every possible care and precaution to secure correct and durable corners must be observed by your agents, whose fidelity you should test by every means in your power.

As the above excerpt illustrates, the various instructions under which surveys were executed frequently contained unique and specific instructions, such as "The marks on the posts and bearing trees should be deeply burnt into the wood with marking irons." All this stresses the importance of reviewing the original instructions to the surveyors as well as the manuals of instructions under which the survey was conducted. Figures 3-1 through 3-5 illustrate examples cited in the excerpt.

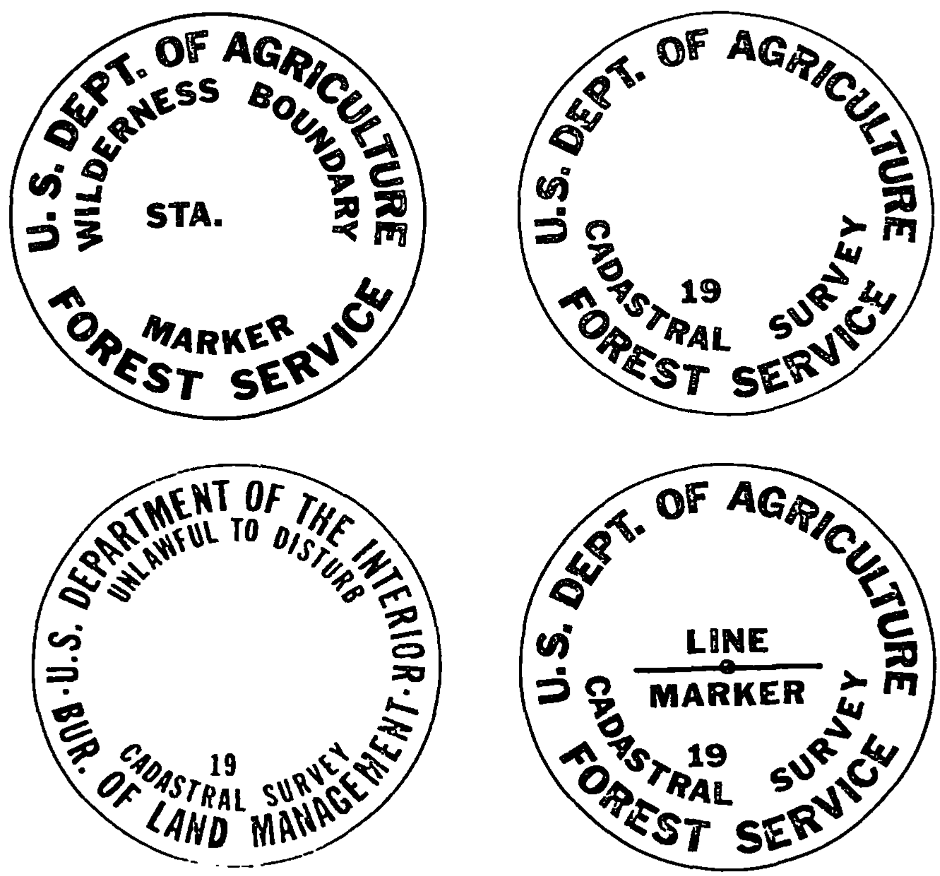


Figure 3-1.--Examples of available pre-cast caps, which provide the corner searcher with typical Forest Service markings.

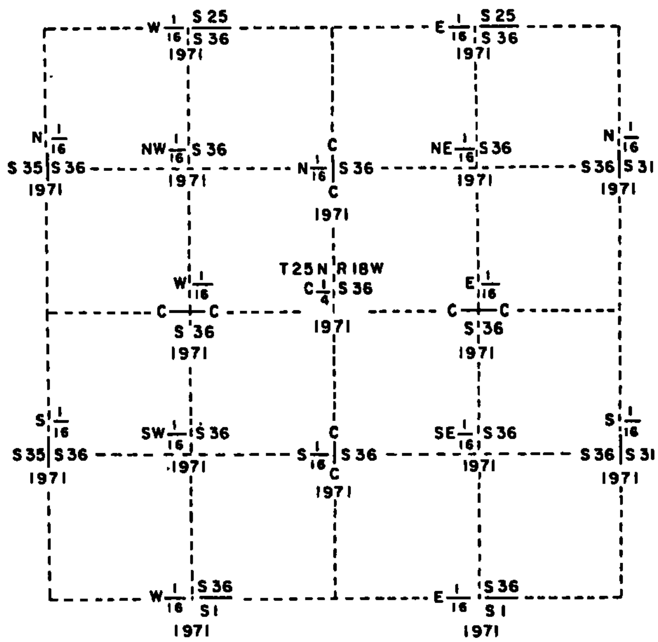


Figure 3-2.--Marks on monuments at interior quarter-section corner and all sixteenth-section corners. It is most important that field personnel become familiar with monument cap markings. Along the east and west section lines there are two north sixteenth corners and south sixteenth corners. These are distinguished by section numbers. Those sixteenth corner monuments that fall on the lines connecting opposite quarter corners are stamped with a C-C.

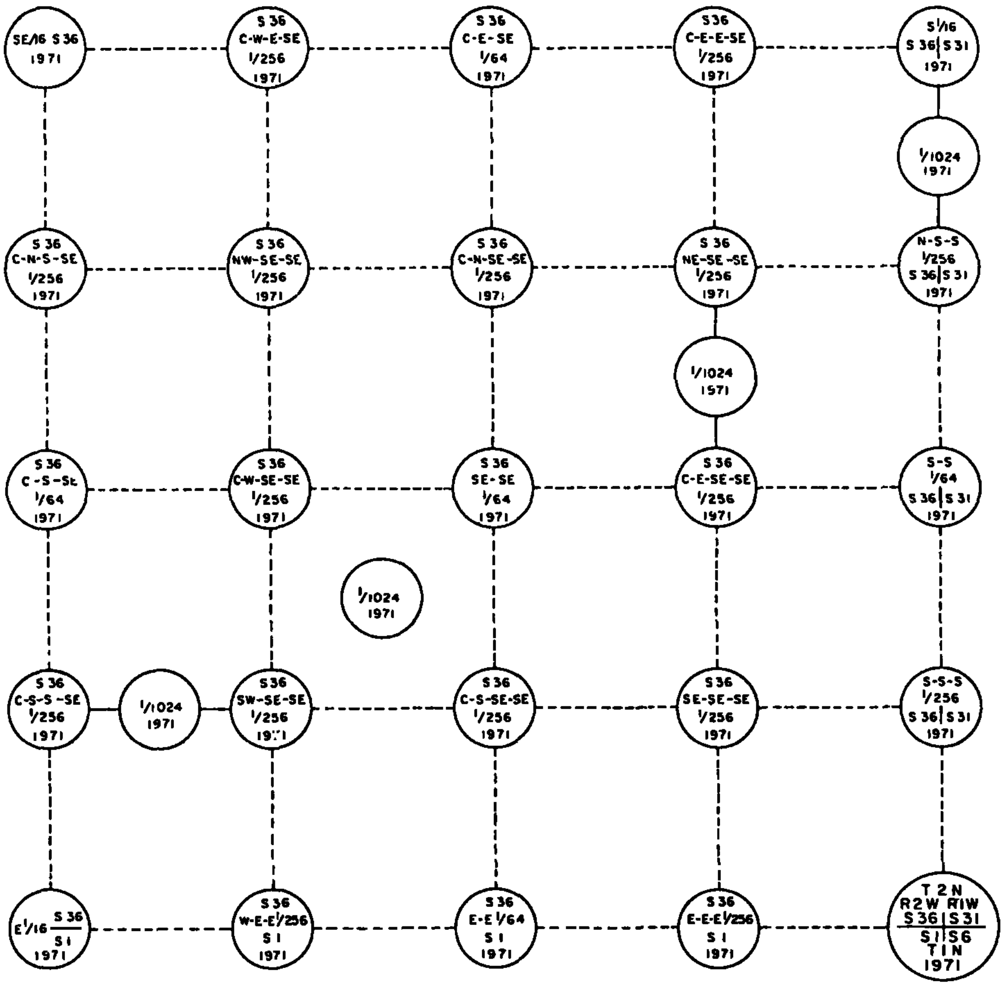


Figure 3-3.--Marks on monuments at corners of minor subdivisions. If 1/1024 section corners are established, only "1/1024" and the date are marked on the brass or aluminum cap. Note that this figure is for the southeast quarter of section 36. This system of marking is similar to that for sixteenth corners. For example, "C-N-SE-SE 1/256" represent the center-north-southeast-southeast 1/256 corner. (See diagram).

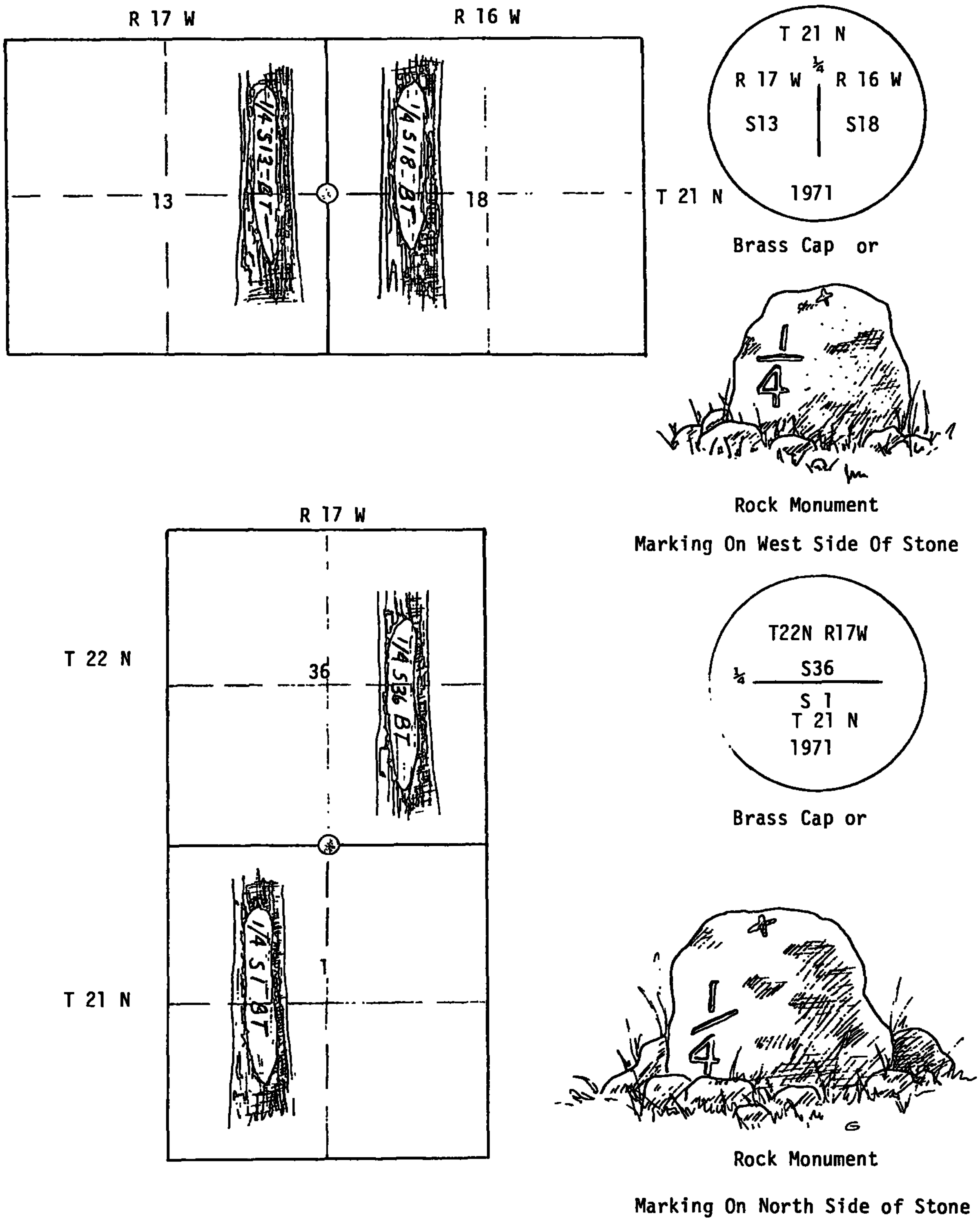


Figure 3-4.--Example of quarter-corner monument markings.

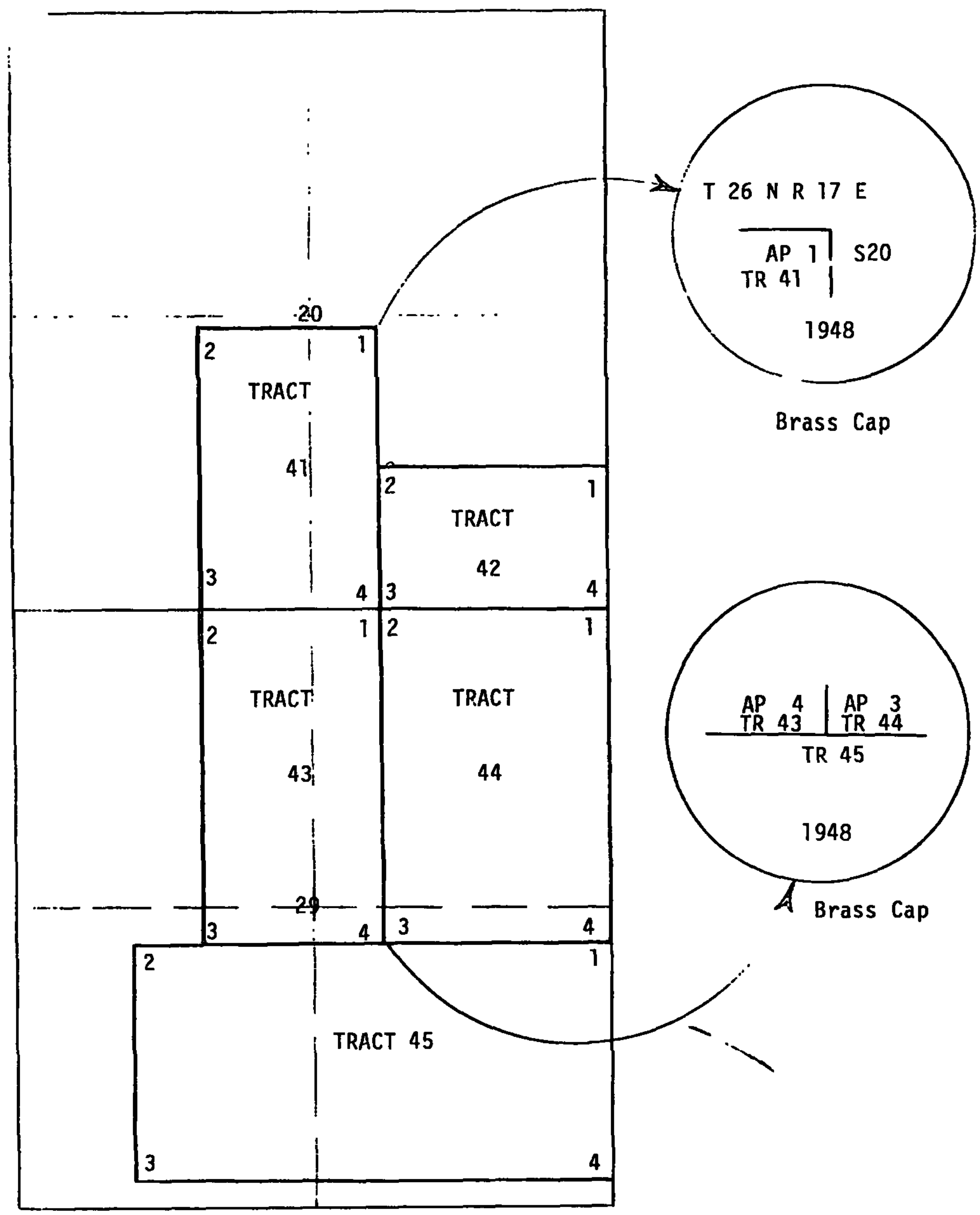


Figure 3-5.--Example markings of tract corners. The markings are in reference to dependent and independent resurveys with tract segregations. Frequently corners may be recovered; however, their purpose may not be understood. A section corner may be close to a tract corner, but it is not relevant to the private land ownership. The rectangular corners were set only to retain the integrity of the township survey.

Unit 4
Corner Accessories & Line Markings

The following excerpt from the 1947 BLM Manual of Surveying Instructions clearly illustrates what was expected of the earlier surveyors. These instructions are of interest to corner searchers as they provide an indication as to what to expect relative to original evidence along the true lines. The reader is directed to the manual for additional instructions to the original surveyors.

MARKING LINES BETWEEN CORNERS

> The marking of a survey upon the ground in such a manner as to fix forever the position of the legal lines in relation to the earth’s surface is the final step in the field work, and is accomplished in three ways, which, if well executed, will individually or collectively furnish the means of the identification of the survey at even remote future dates. Careful attention to these details is one of the most important phases of the engineer’s field work. (a) The regular corners of the public-land surveys are marked by fixed monuments of specified character as described in chapter IV; (b) the relation of the officially surveyed lines to natural topographical features is recorded in much detail as hereinafter outlined, and again exemplified in the specimen field notes; and (c) the locus of the legal lines, wherever living timber is encountered, is plainly marked upon the forest trees, which is accomplished by the process of “blazing” and by “hack” marks.
>
> A “blaze” is an artificial mark which is ordinarily made upon a tree trunk at about breast height, in which a flat scar is left upon the tree surface. The bark and a very small amount of the live wood tissue are removed, leaving a smooth surface which forever brands the tree. The size of the blaze depends somewhat upon the size of the tree, but is never made larger than the surface of an ax blade; a blaze 5 or 6 inches in height and from 2 to 4 inches in width is ample to mark any tree.
>
> A “hack” is also an artificial mark which is ordinarily made upon a tree trunk at about breast height, in which a horizontal notch is cut into the surface of the tree. The notch is made “V-shaped,” and is cut through the bark and well into the wood. Two hacks are cut in order to distinguish those made in the survey from accidental marks resulting from other causes; a vertical section of the completed official hack mark resembles a “double-V” extending across a tree from 2 to 6 inches in length, depending upon the diameter of the tree. The “hack” and “blaze” marks are equally permanent, but so different in character that one mark should never be mistaken for the other.
>
> The marking of trees along the surveyed lines is required by law as positively as the establishment of monuments (R. S. sec. 2395; 43 U.S.C., sec. 751). All lines on which are to be established the legal corners will be marked after this method, Viz: Those trees which may be intersected by the

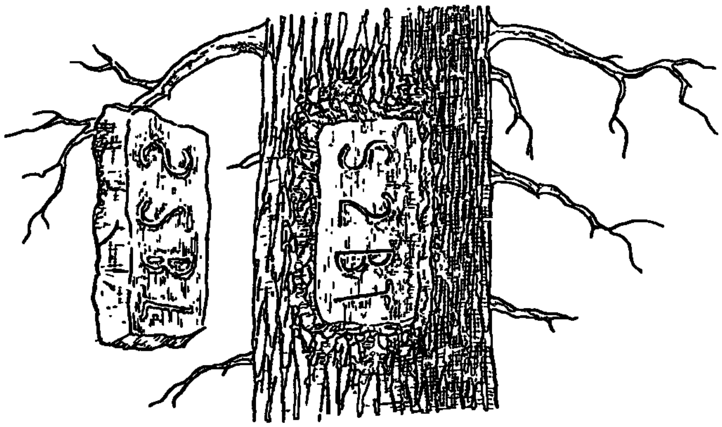


Figure 4-1.--Old bearing tree with overgrowth removed. The original marks are preserved and appear in reverse and relief on the overgrowth. The woody material often is sore dense or pitchy (if pine) than the parent material. When the tree dies or rots, this material is more resistant. Overgrowth should be removed only by an authorized surveyor.

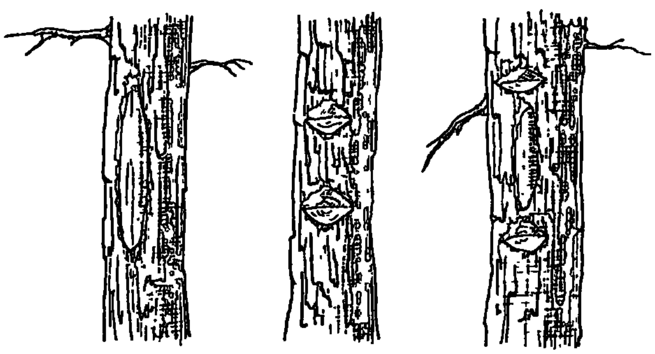


Figure 4-2.--Blazes and hacks. Early surveyors had peculiar individual methods of making their blazes. The blazes met the GLO requirements on size and placement. Study of original blazes make it possible to observe recognized individual styles. The age of the blaze can be estimated by removing a small core with an increment borer and counting growth rings. Another identifiable feature of authentic blazes is the following of a regular pattern.

line will have two hacks or notches cut on each of the sides facing the line, without any other marks whatever. These are called sight trees or line trees. A sufficient number of other trees standing within 50 links of the line, on either side of it, will be blazed on two sides quartering toward the line, in order to render the line conspicuous, and readily to be traced in either direction, the blazes to be opposite each other coinciding in direction with the line where the trees stand very near it, and to approach nearer each other toward the line the farther the line passes from the blazed trees.

Due care will ever be taken to have the lines so well marked as to be readily followed, and to cut the blazes plainly enough to leave recognizable scars as long as the trees stand. This can be accomplished by blazing just through the bark into live wood tissue. Where trees 2 inches or more in diameter occur along a line, the required blazes will not be omitted. Where trees have branches growing to the ground, the blazes will be omitted unless it is necessary to remove the branches to permit sighting.

Lines are also to be marked by cutting away enough of the undergrowth to facilitate correct sighting of instruments. Where lines cross deep wooded valleys, by sighting over the tops, the usual blazing of trees in the low ground when accessible will be performed. The undergrowth will especially be well cut along all lines within distances of 5 chains of corner monuments and within 2 chains of arteries of travel, but the cutting of the undergrowth may be omitted in deep untraveled ravines unless necessary for accurate sighting or measurement.

Line trees and blazing will be marked only with reference to the established true line, and where lines are run by the “random and true” line method, the marking of line trees and the blazing will be accomplished by returning over the line after all corrections or adjustments to the final line are definitely known. A sufficient number of temporary stakes should be set along a random line to render it generally unnecessary to rerun the true line instrumentally merely for the purpose of blazing the line through timber, as this can usually be accomplished by properly estimating the distance from the temporary stakes, but intersections with line trees will be made with precision, and distances thereto accurately measured.

ORIGINAL MARKS

Original line-tree marks, offline tree blazes, and scribe marks on bearing trees and tree corner-monuments whose age exceeds 100 years are found occasionally. Such marks of later surveys are recovered in much greater number. Different surveyors used distinctive marks. Some surveyors used hacks instead of blazes; some used hacks over and under the blazes; some employed distinctive forms of letters and figures. All these will be recognized while retracing the lines of the same survey and will serve to verify the identification of the work of a particular surveyor.

The field notes give the species and the diameter of the bearing trees and line trees. Some of the smooth-barked trees were marked on the surface, but most of the marks were made on a flat, smoothed surface of the live wood tissue. The marks remain as long as the tree is sound. The blaze and marks will be covered by a gradual overgrowth, showing a scar for many years. The overgrowth will have a lamination similar to the annual rings of the tree, which may be counted to verify the date of marking and to distinguish the original marks from later marks and blazes. On the more recent surveys, it is to be expected that the complete quota of marks should be found, clear cut and plainly legible. This cannot be expected in the older surveys.

It is advisable not to cut into a marked tree except as necessary to secure proof. The Forest Service authorizes only registered land surveyors to block out or scribe new bearing trees. If an old bearing tree is blocked out, a new bearing tree is required. The evidence is frequently so abundant, especially in the late surveys, that the proof is conclusive without inflicting an additional injury that would hasten the destruction of the tree.

A line tree or a connection to some natural object or to an improvement recorded in the original field notes that can be identified may fix a point of the original survey. The calls of the field notes for the various items of topography may assist materially in the recovery of the lines. It is the responsibility of the searcher to report the recovery of all suspected evidence of the original surveyed line. The recovery of a line tree can be most valuable as it can assume the status of an online monument. The mean position of a blazed line, when identified as the original line, will place a meridianal line for departure or a latitudinal line for latitude. These are matters that require the exercise of considerable judgment.

Line Trees

According to the BLM Manual of Surveying Instructions, under the law a definitely identified line tree is a monument of the original survey. It properly is used as a control point in the reestablishment of lost corners by the appropriate method. In this situation, it is treated just as is a recovered corner, and it becomes an angle point of the line. The key here is that the line tree be identified as such. This is not always a simple task, and, in lieu of other evidence, can be rather difficult. As the manual stresses, a problem arises where, as in some older surveys, line trees were improperly established on a random line (and so recorded in the field notes) rather than on the true line. Each case must be considered on its merits, but such line trees are generally of most value as guides in locating the original corners. It may occasionally be necessary to treat them as control points where there has been extensive obliteration of the corners themselves.

Figure 4-3.--Blazed survey line. This illustrates the method used by earlier surveyors to clearly mark a survey line. The blazes, especially line tree hacks, may serve as hard evidence of the true line. Such blazes are usually overgrown, but the existing scars remain.

Topographic Calls

During the execution of the early surveys, intersections with land features, objects, and water features were recorded. Use of topographic calls for corner search involves retracement survey, as a comparison of measured distances and bearings with the record data must be made.

The proper use of topographic calls of the original field notes may assist in recovering the locus of the original survey. Such evidence may merely disprove other questionable features, or it may be a valuable guide to the immediate vicinity of a line or corner. At best, it may fix the position of a line or corner beyond reasonable doubt.

A careful analysis should be made by the surveyor before using topographic calls to fix an original corner point. Indiscriminate use will lead to problems and disputes where two or more interpretations are possible. Sufficient field notes should be reviewed in order to gain a broad overall picture of the project. The determination of the original corner point from even fragmentary evidence of the original accessories, generally substantiated by the original topographic calls, is much stronger than determination from topographic calls alone. In questionable cases it is better practice, in the absence of other collateral evidence, to turn to the suitable means of proportionate means.

Topographic calls have been invaluable in recovery of corners where erroneous maps locations have misled surveyors. Such corner monuments have been recovered as much as one half mile or more from the map position. Close attention should be given to the manner in which the original survey was made. Instructions for chaining in the earlier manuals indicate that memory was an important factor in recording distances to items of topography. Early field notes often appear to have shown distances only to the nearest chain or even a wider approximation.

In comparing distances returned in the original field notes with those returned in the resurveys, gross differences appear in a significant number of instances. In some cases, the original surveyor apparently surveyed a line in one direction, but then reversed the direction in his record without making corresponding changes in distances to items of topography. These facts have sometimes caused distrust and virtual avoidance of the use of topography in corner restoration where proper application might be extremely helpful.

BEARING TREES

In the Act of May 18, 1796, Congress stated that trees near each land corner were to be marked to identify the corner. Realizing the fragility of corner monuments constructed of native materials along the frontier, they specified that trees be utilized in marking the survey upon the ground. Subsequent instructions gave specific details of marking the bearing trees, sometimes referred to as “witness trees.” Their size, species, compass direction, and distance from the corner were to be entered into the official record. These trees not only make the corner more readily identifiable, they also “bear witness” to the corner monument itself. If the corner monument is removed or destroyed, it can be correctly relocated using the recorded measurements to the nearby bearing trees.

The bearing trees are normally blazed with an axe to expose a vertical strip of live wood tissue, and the various symbols required to identify the corner are carved into the wood with a special scribing tool. The marks will remain as long as the tree is sound, although the blaze may heal over and become covered with a thick layer of overgrowth wood.

An old bearing tree with scribing more than 100 years old is often found standing in silent witness to a corner post that crumbled to dust two generations ago. As the bearing tree lives, it grows each year, producing a more or less distinct concentric growth ring. By counting the number of rings between the axe-smoothed face with its carved markings and the current growth, the age of the scribing can be determined--often to the exact year. This is most effectively accomplished with the aid of an increment borer, a device which conveniently removes a small core of wood from the bearing tree. The bearing tree records time from the moment the government surveyor blazes and scribes it. If such a tool is unavailable, the tree may be carefully notched to reveal the growth rings. If the date indicated by ring count corresponds to the time of the original survey, there can be little doubt as to the authenticity of the corner.

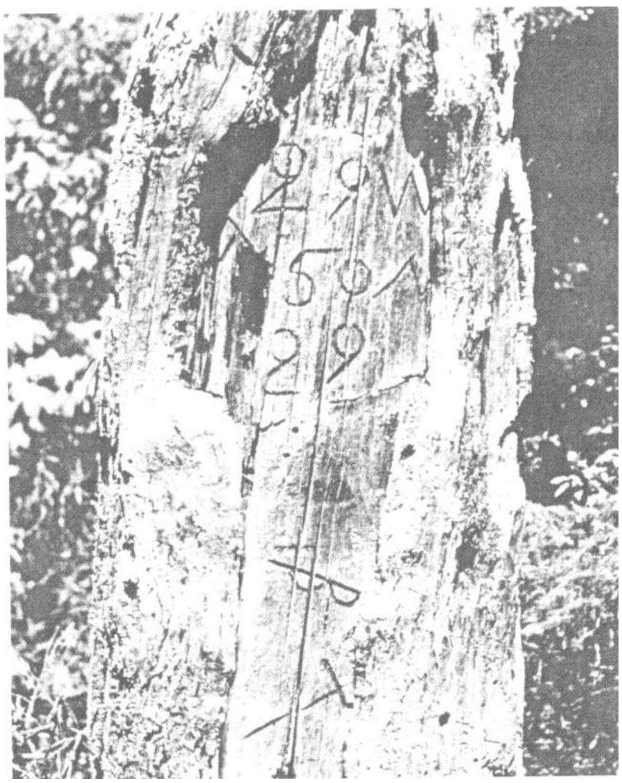


Figure 4-4.--Example of bearing tree scribing variations. Although the manual required markings to be performed in a specific manner, individual surveyors had their variations in marking-. Note the horizontal scribing and the skewed BT letters.

Of course it may be necessary to note the scribing when conflicting situations exist. Blocking out may then be necessary. The bearing tree can serve a most vital role in resolving those situations that arise where the validity of a corner is questioned, for example, when another monument or bearing tree is recovered in a different location. The correlation of this evidence with the description in the record will quickly verify the official accessories.

The best accessory to the corner is the bearing tree. Early surveyors frequently miscalled the species. If the species were miscalled in one township, the surveyor probably repeated the error elsewhere. In large old growth the surveyor would barkscribe instead of blazing. Barkscribing also was done to smooth-bark deciduous trees.

The surveyor was instructed to select hardy-type trees. In many cases, less than desirable species were used. In some cases the species used was the climax species that no longer exists in the area. Care should be taken not to dismiss the notes as faulty without a thorough search for fossil remnants of trees described.

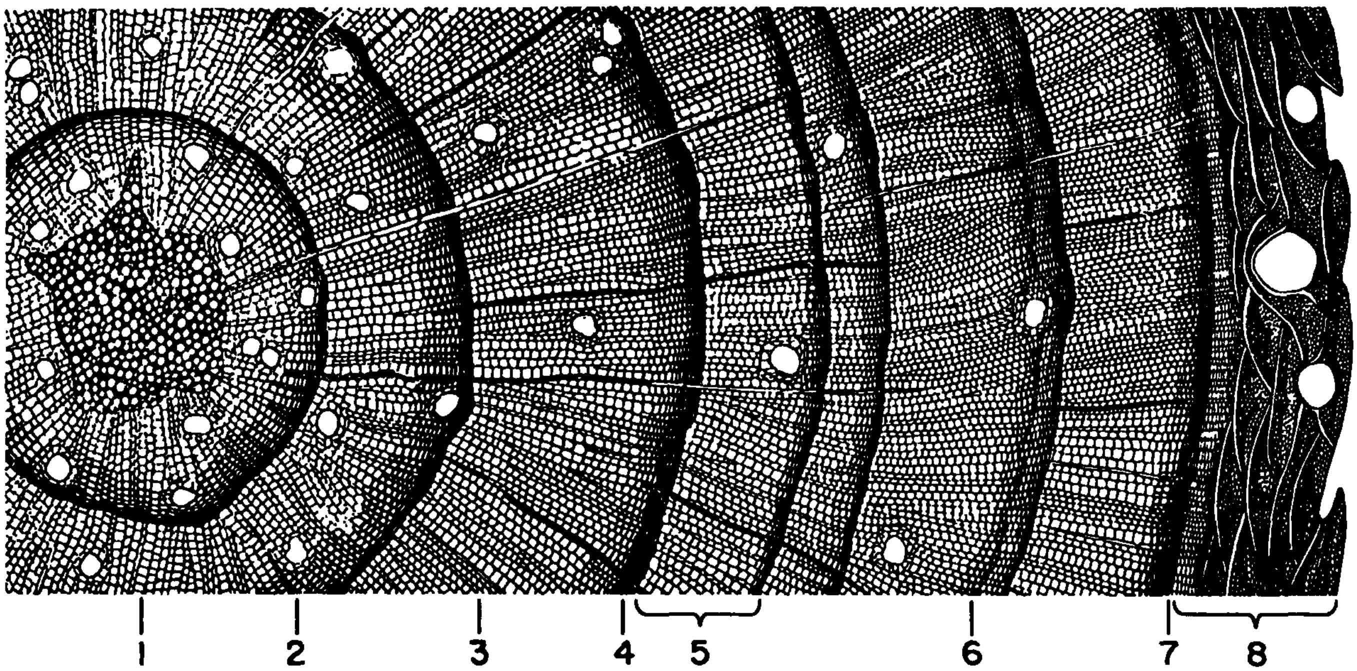


Figure 4-5.--Cross section of a typical conifer stem showing: (1) pith, (2) resin duct, (3) earlywood cells (light), (4) late wood cells (dark), (5) annual ring, (6) false interannular ring, (7) cambium, and (8) bark. Note: The false interannular rings are misleading and can lead to erroneous dating. Also observe the larger cellular growth represents spring and summer growth. (Illustration courtesy the Laboratory of Tree-Ring Research, University of Arizona, Tucson, Arizona.)

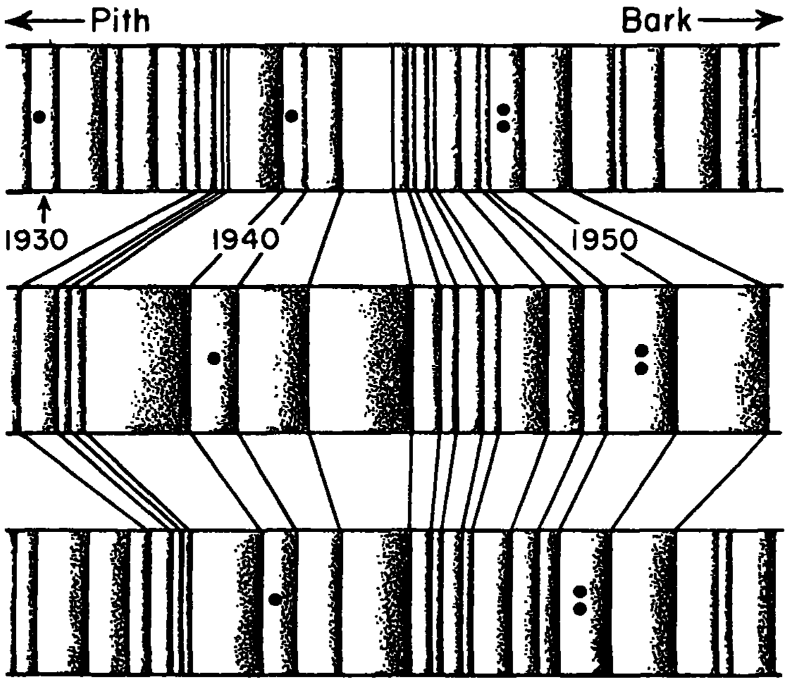


Figure 4-6.--Cross-dated ring patterns from three different trees. Rings vary in absolute width between specimens, but the relative widths are the same. Decade years are marked with a single pinhole, mid-century rings with two pinholes. (Illustration courtesy the Laboratory of Tree-Ring Research, University of Arizona, Tucson, Arizona.)

The method of measurement to bearing trees was not uniform among surveyors. Some measured from a measuring notch; some from the face of the blaze; others from the side center; frequently the surveyor measured on the slope, not horizontal. Only by test measurement from bearing trees can the system used by a surveyor be determined.

During search and evaluation for corners, bearing trees will not be opened unless it is under the direction of a licensed land surveyor. The best method is to take an increment boring at the location of the blaze scar. The scribed surface should be identifiable in the coring.

Dyeing the sample makes the count easier. For very accurate dating of blazing and scribing, the services of a dendrochronologist should be secured. This method as outlined may not suffice if only one suspected bearing tree is recovered and no original monument exists. The situation may then require “blocking out” the bearing tree by an authorized land surveyor to view the scribing.

Tree dating services are available through the Laboratory of Tree-Ring Research, the University of Arizona, Tucson, Arizona. Prior to submitting the core to the laboratory, the client should call or write the laboratory informing them of the tree type, etc. This service is provided for a fee.

Techniques to Aid in the Detection & Recognition of Scribing on Bark-Scribed Trees

(1) Attain correct sight angle.

(2) Stand at a distance from tree to obtain a proper perspective.

(3) Search field notes to learn or verify if bark scribing was indicated.

(4) Refer to original instructions in effect at the time of the survey.

Aids to Assist With Detection & Reading Blazed Bearing Trees

(1) Reflect light into cracks of rotted trees.

(2) A mirror is useful in reading the reverse cast of a scribed tree.

STUMP HOLES & STUMP PATTERNS

Many times there is no surface indication of original bearing trees. The stump holes and patterns in the vicinity of the corner position often can be located by probing with a chaining pin. The soil is not as compacted in the stump hole as is the native soil. A small (1-inch) soil tube sample of any decayed wood may be obtained without disturbing the area. This may permit further verification of the original bearing tree.

MOUNDS & PITS

Mounds and pits often were used to mark the position of a corner. The pits and mounds were to be constructed in accordance with the special instructions. In grassland country, the work was usually done faithfully. In time the mounds are washed away and the pits filled. If there is some stony material in the soil, a large concentration of pebbles will be found at the location of the mound; the pits will be filled with the fine and wind-blown soil. The soil in the pits is not as compacted as the native soil and usually encourages better growth of vegetation.

In rough land the pits are impracticable and a mound of stone would be constructed. A mound of stone can consist of as few as five stones or it can be skillfully laid of field stone, shoulder high. During a period of years, a stone mound will collect dirt and actually encourage growth of brush on it. A scattered mound of stone can still be identified because of the concentration of stones in one spot.

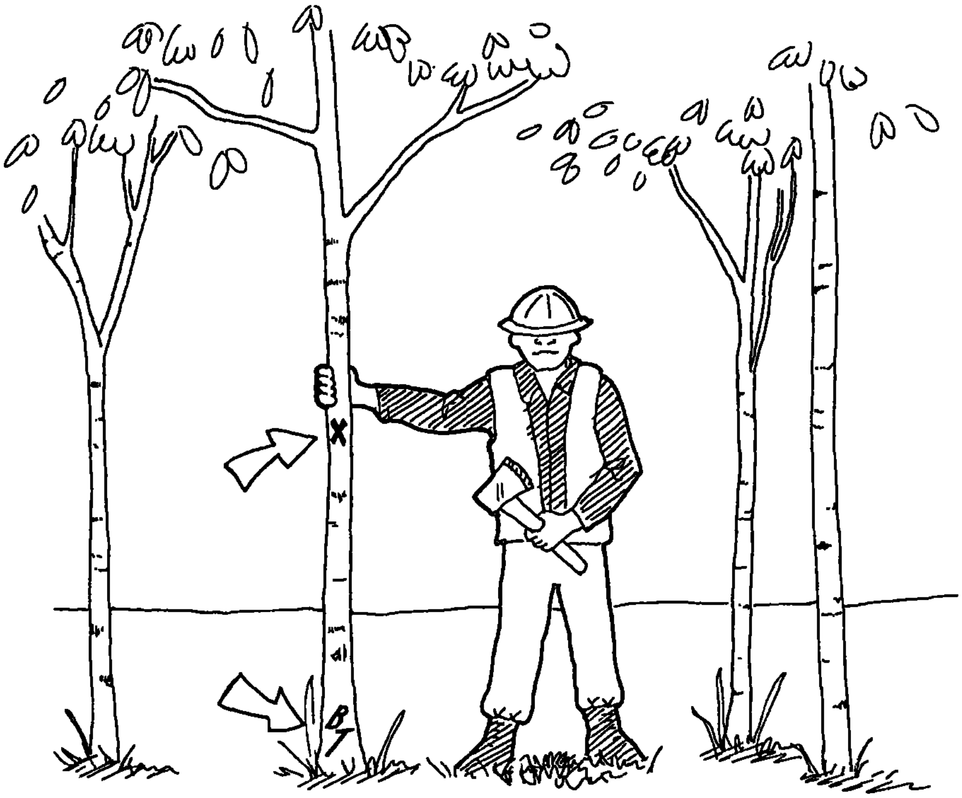


Figure 4-7.--Bearing trees under 4 inches in diameter are usually scribed with an “X” and a BT.” Aspen are normally bark-scribed, and over the years the scribing becomes grossly distorted longitudinally. Larger trees may have occasionally been scribed as such. Courtesy BLM Colorado State office training staff.

The recovering of original scribe marks, line-tree hacks, and offline tree blazes furnishes convincing evidence of the position of the original survey line.

Fence intersections frequently do not coincide with that position determined from the corner accessories. Under no circumstances should a fence intersection be considered the true corner unless the original accessories and other corner evidence has been declared lost by an authorized land surveyor. Even cut or fallen bearing trees can be used if their identity can be ascertained.

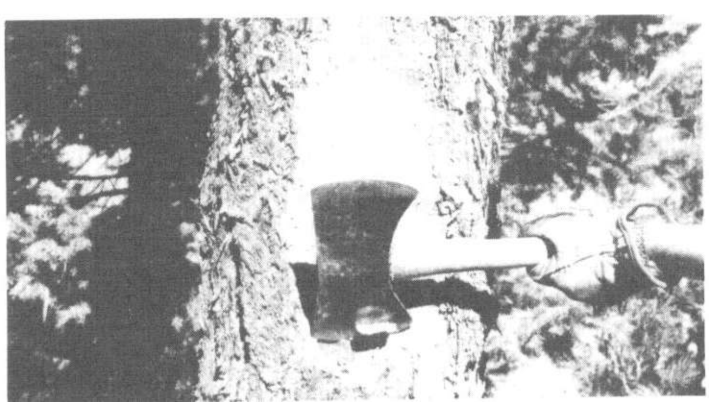


Figure 4-8.--Proper method for blazing a bearing tree. This step is usually left to an authorized land surveyor or crew. A bark knife used in conjunction with a hatchet is also useful and efficient. A clean, concise cut can be obtained by striking the knife. Hearing and eye protection is advisable.

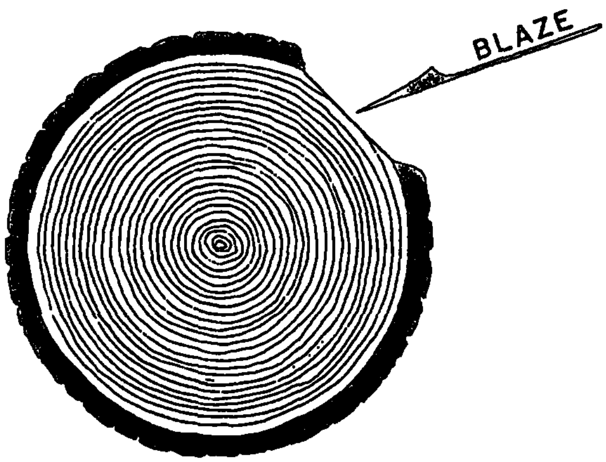


Figure 4-9.--scribing performed upon the blazed surface with the aid of a scribing tool. Note that the blazing must penetrate the cambium layer. The tree will attempt to heal the damage to the living tissue, but a scar will remain for many years (usually the life of the tree) and will remain recognizable until decayed.

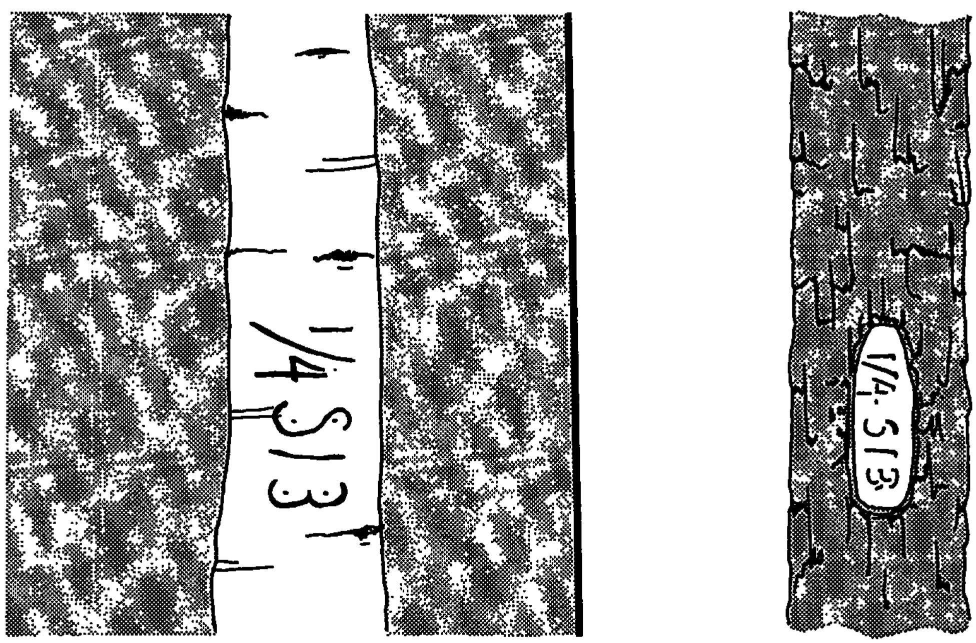


Figure 4-10.--Examples of bark-scribing and scribing on blazed tree. The tree on the left is aspen. The scribing expands laterally with tree growth. Scribing on the blaze on the right remains the same size over the years. (Courtesy of the BLM Colorado State office).

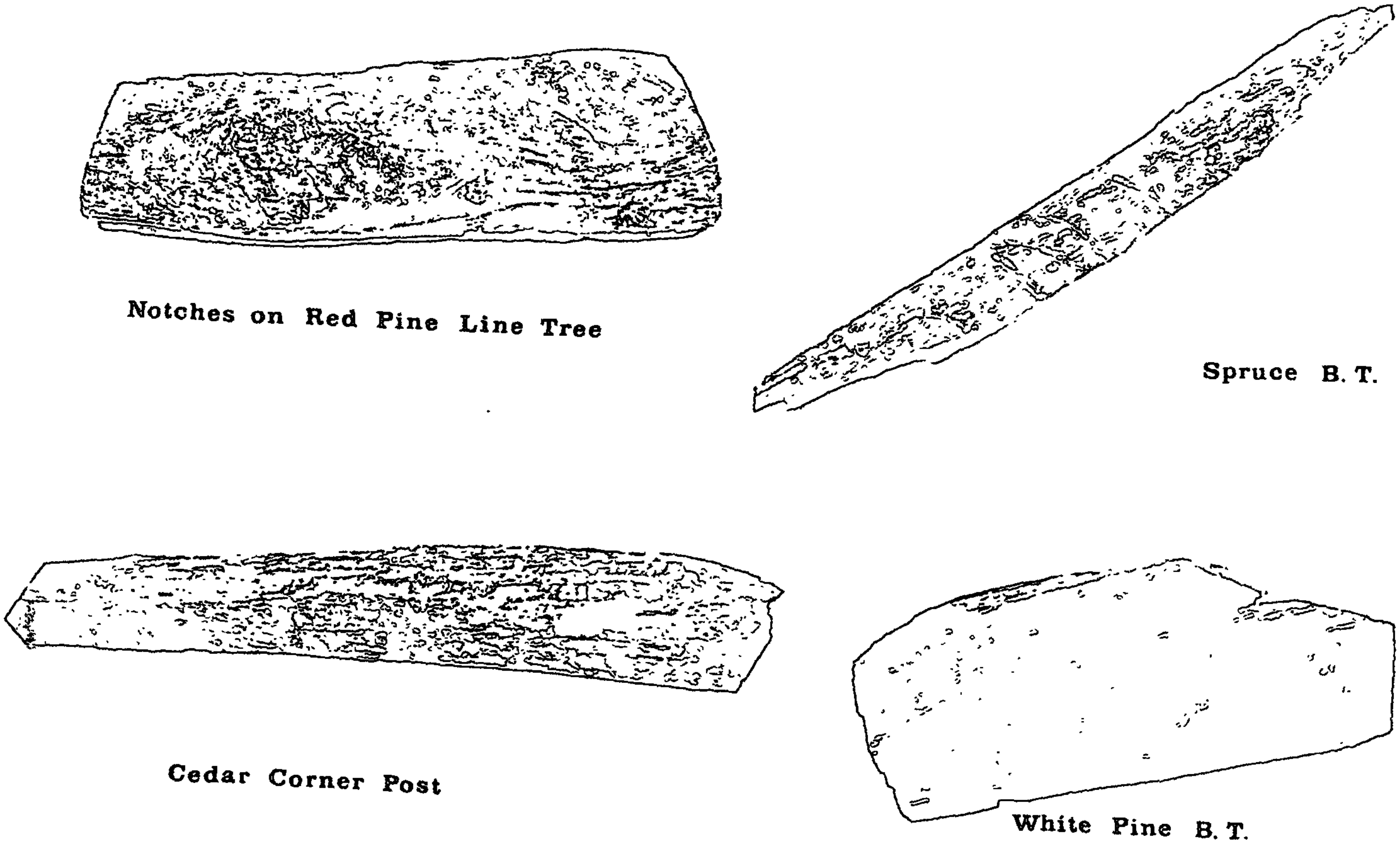


Figure 4-11.--Fragments of original bearing trees used to prove a corner. The species determination may rely on fragments of rotted wood, the smell of a freshly cut piece, the visible cell structure under magnification. A good reference is Decayed Wood Identification of Bearing Trees of Public Land Surveys by Richard Drahn, Ottawa National Forest, and Kilo Stefan, Nicolet National Forest, Wisconsin.

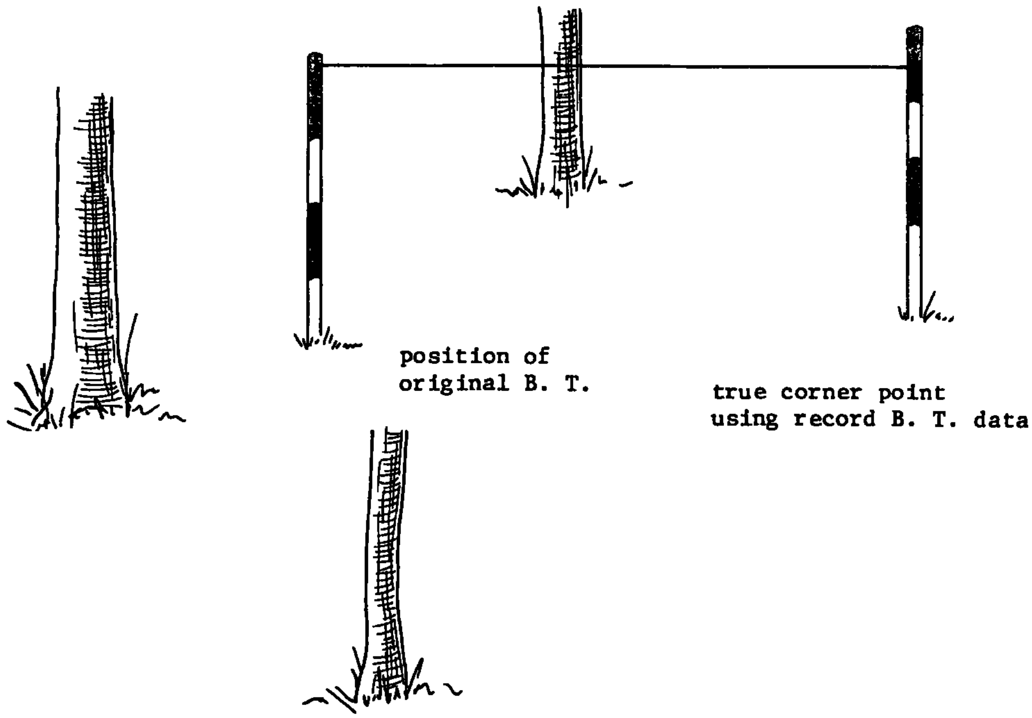


Figure 4-12.--Method to determine position of original bearing tree and corner. Younger trees may be a result of the original bearing tree.

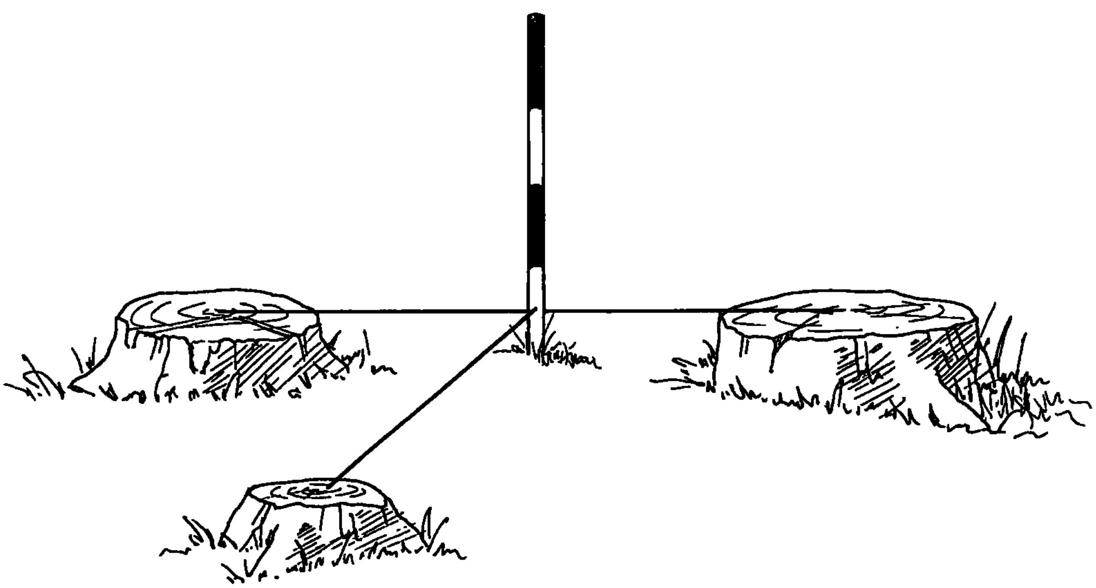


Figure 4-13.--Correct species of stumps related in position (in accordance with field notes). Note that for mineral surveys, distances were usually taken to a measuring notch or "X."

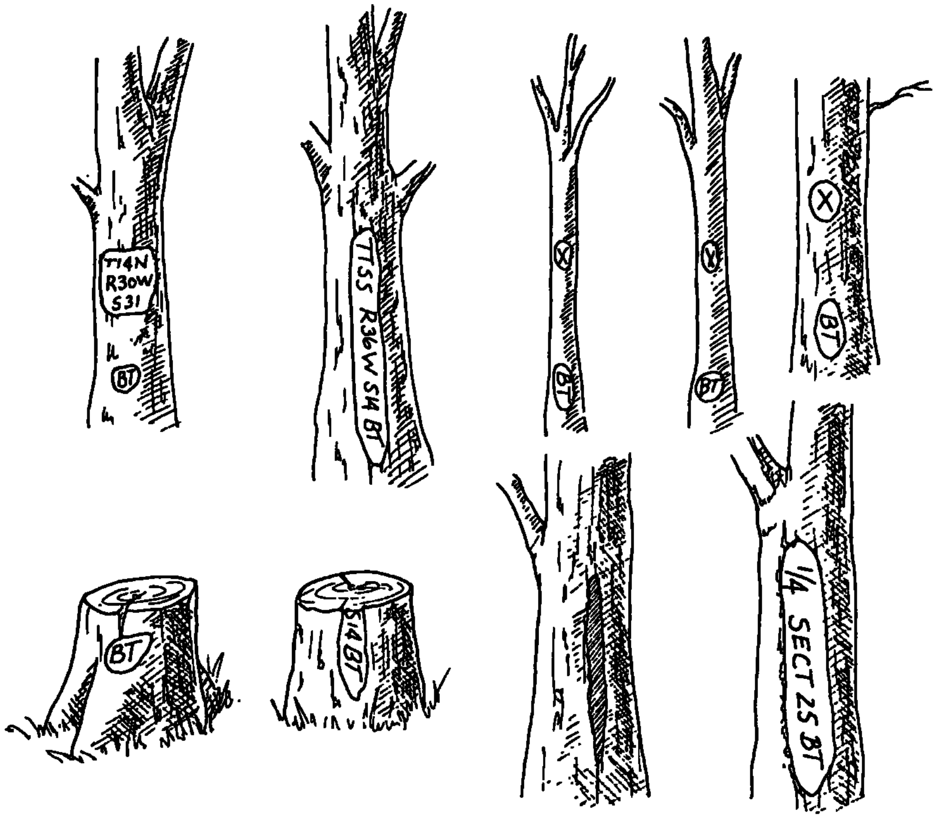


Figure 4-14.--scribing and blazing variations. These are often referred to as BT signatures." The height of the blaze and the manner it was made is often sufficient to identify the surveyor. The tool used for scribing, was it fine or coarse? Was it a jackknife or scribe? Were they Roman numerals or Arabic? Was the top of the T an arc or a slash? This is the information that determines whether a blaze is original or not. A blaze on a tree always stays at the same height. A bark scribe stays at the same height but the letters expand as the tree increases in diameter. A measuring notch cut at the crown of the roots many years ago can be buried by the accumulated duff and dirt.

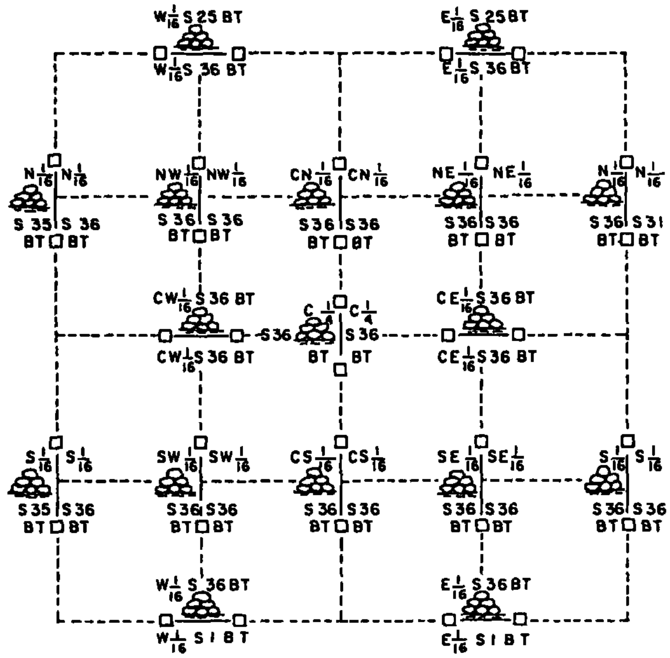


Figure 4-15.--Arrangement and marking of accessories for interior quarter-section and all sixteenth-section corners. The diagram shows the proper placement of mounds of stone and pits dug as required of the original surveyors. This is important to the corner searcher in that once a mound is recovered, a more precise search area for the monument is defined.

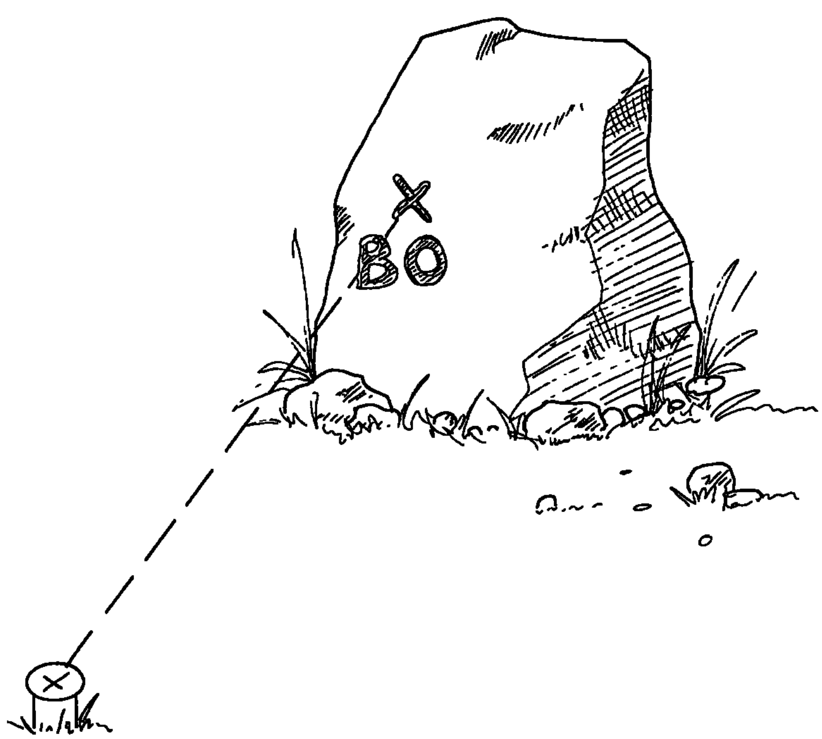


Figure 4-16.--Boulder used for bearing object to reference corner monuments. In the absence of trees, the surveyor often would select bearing objects near the corner. Such objects included boulders, cliffs, ledge rocks, and even cabins. Markings were usually chiseled into the exposed face. The bearing object stays in place, but the

surrounding surface may be altered by nature. The stone in place could be the tip of a large boulder. The cliff type bearing object may scale or flake but the relationship of the object to the corner remains the same. Boulders as large as 6 x 6 x 10 feet have been recovered in the field. Surveyors, in their search for evidence of the corner, may fail to recover this obvious reference object as they may not always refer to the original field notes.

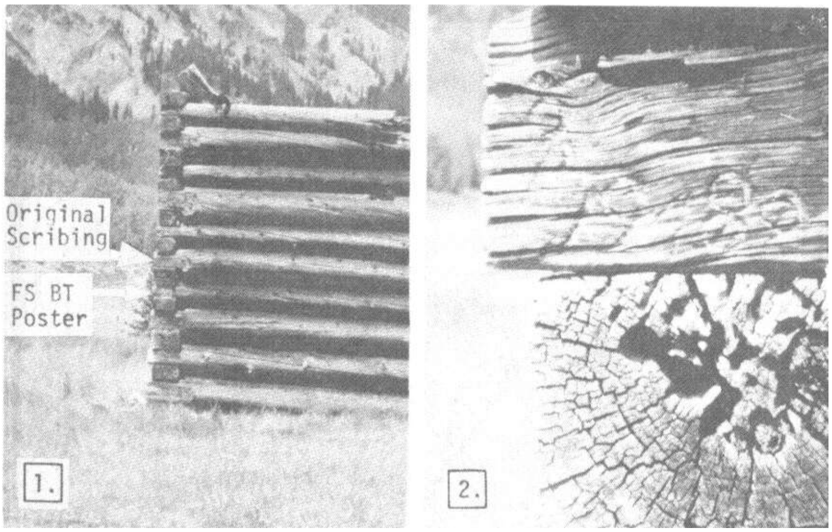


Figure 4-17.--A bearing house. Occasionally a variety of relatively stable structures were used in the absence of usable trees or rocks. The copies of photo 1 show the remains of an old log house (actually a blacksmith shop) that was referenced corner number 3 of Mineral Survey 19480. This is located in the Stunner Mining District near Platoro, Colorado, within township 36 north, Range 4 east, of the New Mexico Principal Meridian on the Rio Grande National Forest. Photo 2 shows a closeup view of the original scribing which reads 3/19480. The end of the same log was scribed B H X.

Figure 4-l8.--The position for a corner of the public land surveys recovered by reference to the recorded bearing trees or bearing objects as described in the field notes.

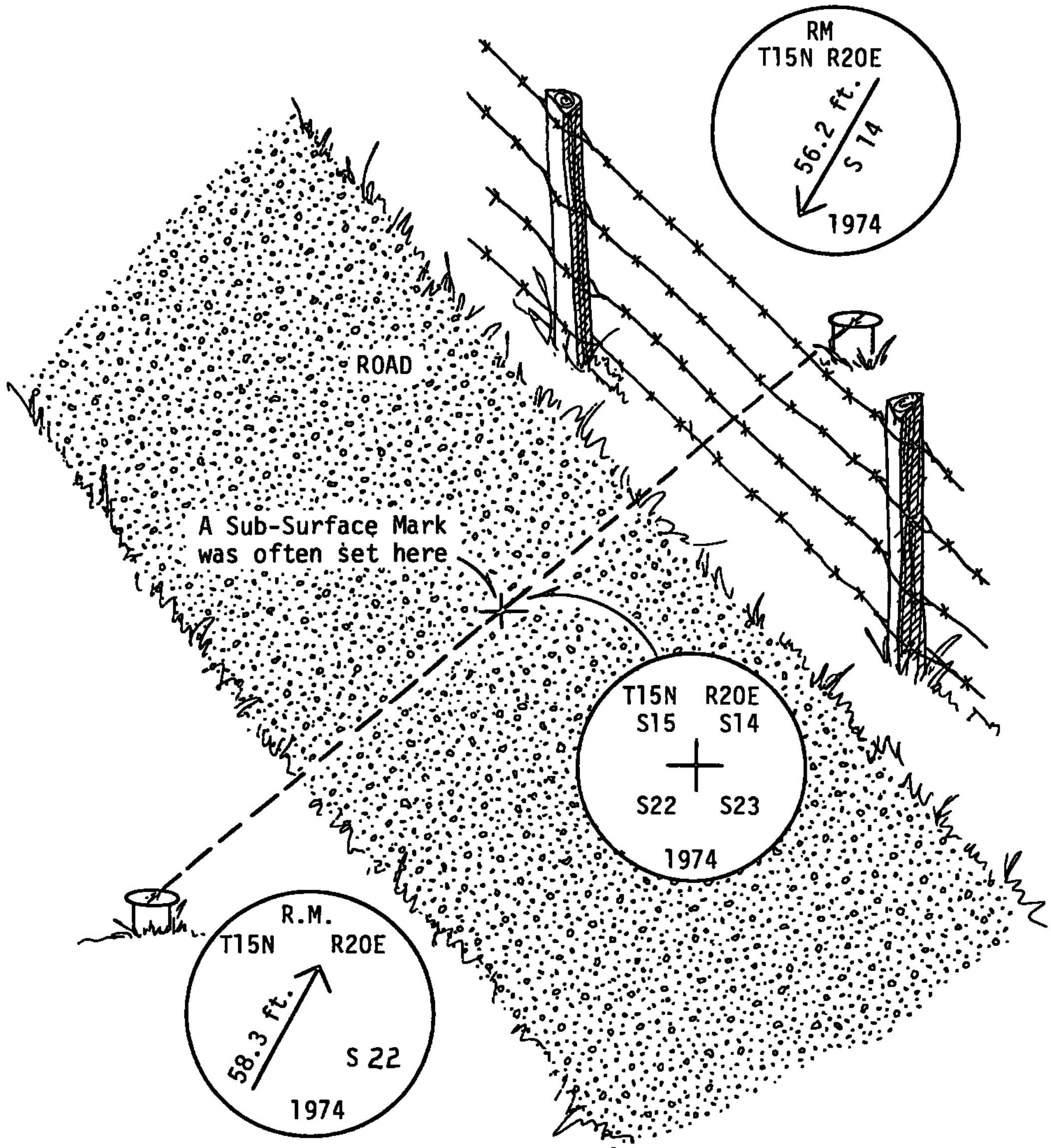


Figure 4-l9.--Reference monuments. Monuments were set to more permanently perpetuate a corner in the event the monument is lost or destroyed. They are useful when the corner falls in a road or trail. They may be at 90° to each other or in line with the monument. There are some variations in the marking of reference marks. The distance may be stamped in feet or links and the township and range may or may not be included. Refer to the BLM manual for other variations. Do not drive a marker into the corner point location, as valuable evidence below the surface can occur.

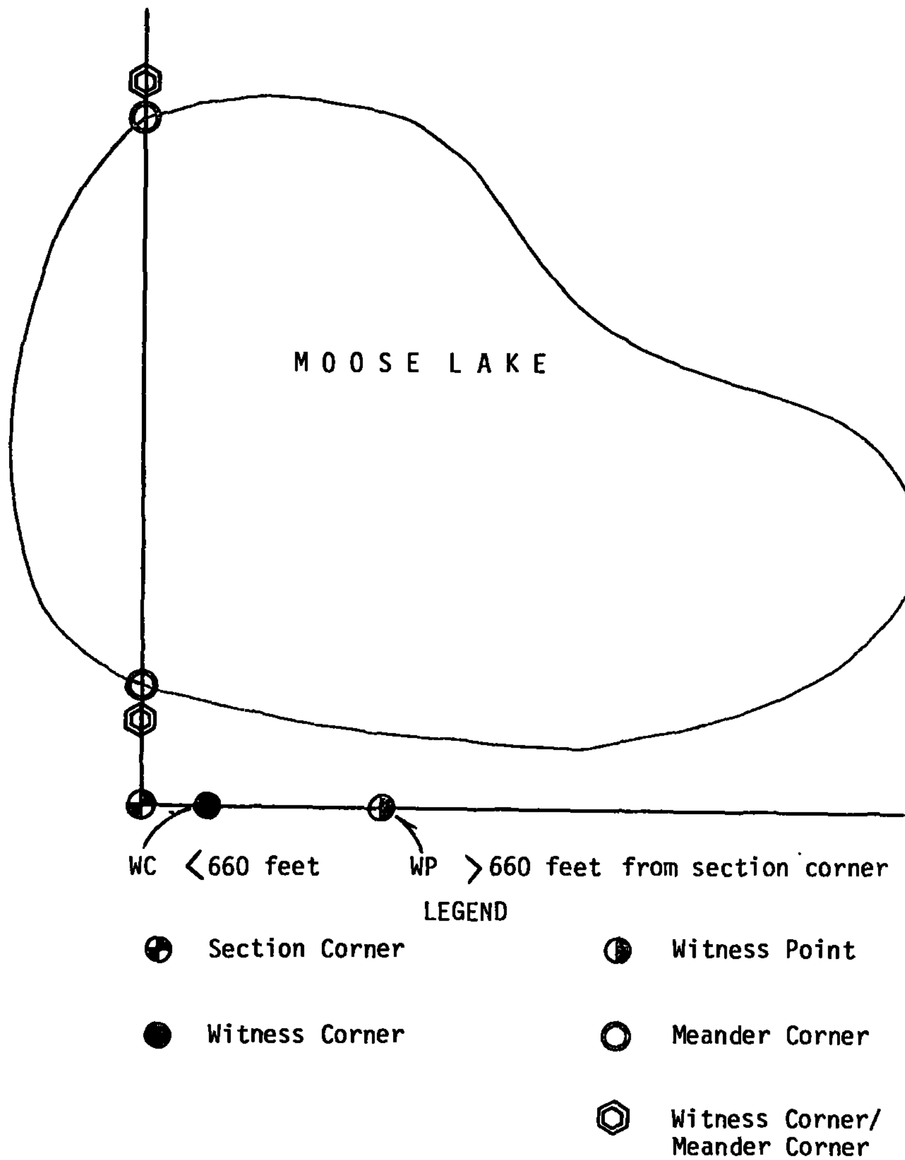


Figure 4-20.--A situation where the true corner may not be set due to obstruction. A witness corner is set within 10 chains (660 feet) and a witness point may have been set at a distance greater than 10 chains. A witness meander corner may have been set to reference a meander corner set under unstable conditions.

Unit 5
Homestead Entry Surveys

HOMESTEAD ENTRY SURVEYS

In 1891, large blocks of public domain land were set aside for the timber resource to ensure the future of this resource for citizens of the United States. Later, under the Act of 1906, Forest Examiners or Classifiers, under the authority of the District Forester, physically selected areas suitable for agricultural purposes. These areas were placed on a list. The use of pacing and compass was all that was required at the time. After application, a more complete survey was then done. The list was then taken to the local District Land Office and there posted in a conspicuous spot for 60 days.

Individuals could apply for listings designating areas they wished to homestead. As each application was processed at the Forest Supervisor’s Office, a sequential number was assigned to it. An examiner would then go out, classify the area, and give it a favorable or unfavorable report. If favorable, it would be listed, and all pertinent information would be sent to the Surveyor General in the State in which the listing was located. The Surveyor General’s authority came from the Secretary of the Interior and the General Land Office. Special instructions were then written giving the entry a homestead entry survey (HES) number and guidelines to perform the survey (see figure 5-1). These were issued to the Forest Office performing the survey.

If a listing was obtained, an entry number would be assigned from the District Land Office and the 5-year tenure would begin.

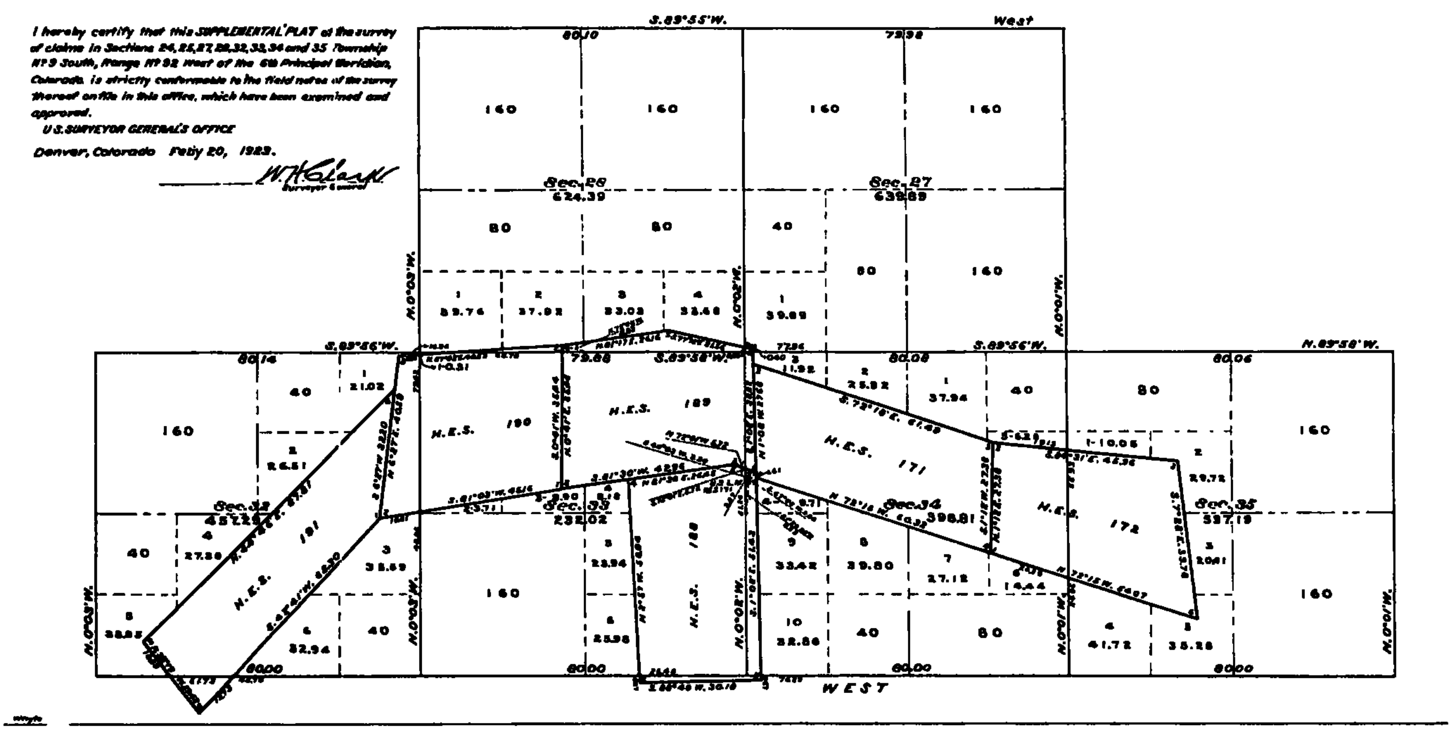


Figure 5-1.--An official homestead entry survey supplemental plat. A U.S. location monument is near corner 1 of HES 171. Note that this is a metes and bounds type survey. Such monuments are frequently substantially monumented and were tied to the various homestead entry surveys.

Survey of the application was usually done with a staff compass and two-chained tape and was measured in chains. If it was impossible to locate the desirable land by legal subdivision, then the application would be surveyed by metes and bounds.

The listing was tied to a public land corner or to an established Forest Service monument (FSM) within 2 miles (see figure 5-2). If neither was available within the limit, an FSM was established. The FSM could be used for several listings in the area or could be the beginning listing corner. Usually, it was a rock set in a mound of stone and marked as an FSM. Accessories also were established and marked MW (monument witness). Latitude was determined by solar observation, and longitude was derived from an accurate and reliable map if one was available. If Listing Corner No. 1 was not the FSM, them it would be marked H1, with accessories marked HW/1. Other corners were then consecutively numbered: H2, H3, and so on. Distances were to the center of the tree and measured in links. As the surveyor traversed from corner to corner, topographic calls with notations of the surrounding area were recorded in field books. A sketch showing the tract, timber stands, trails, roads, and meadows also was made. If the tract was located in an area that had steep hillsides with rock slides, or if a creek bottom was heavily covered with willows, then the examiner would give more details in the sketch. Contour lines and topographic highlights would be shown and the decision of favorable or unfavorable report would be indicated in the field book.

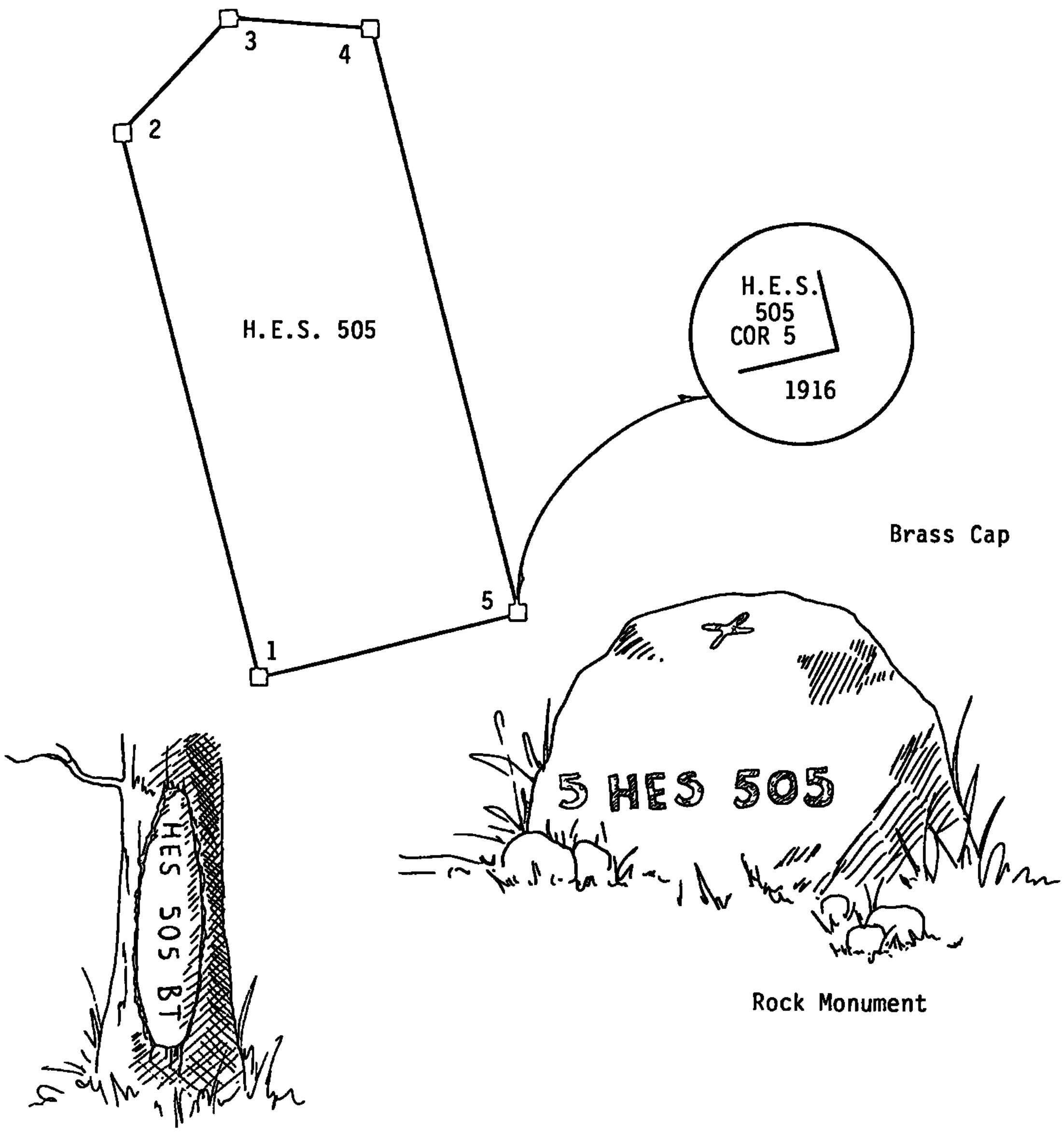


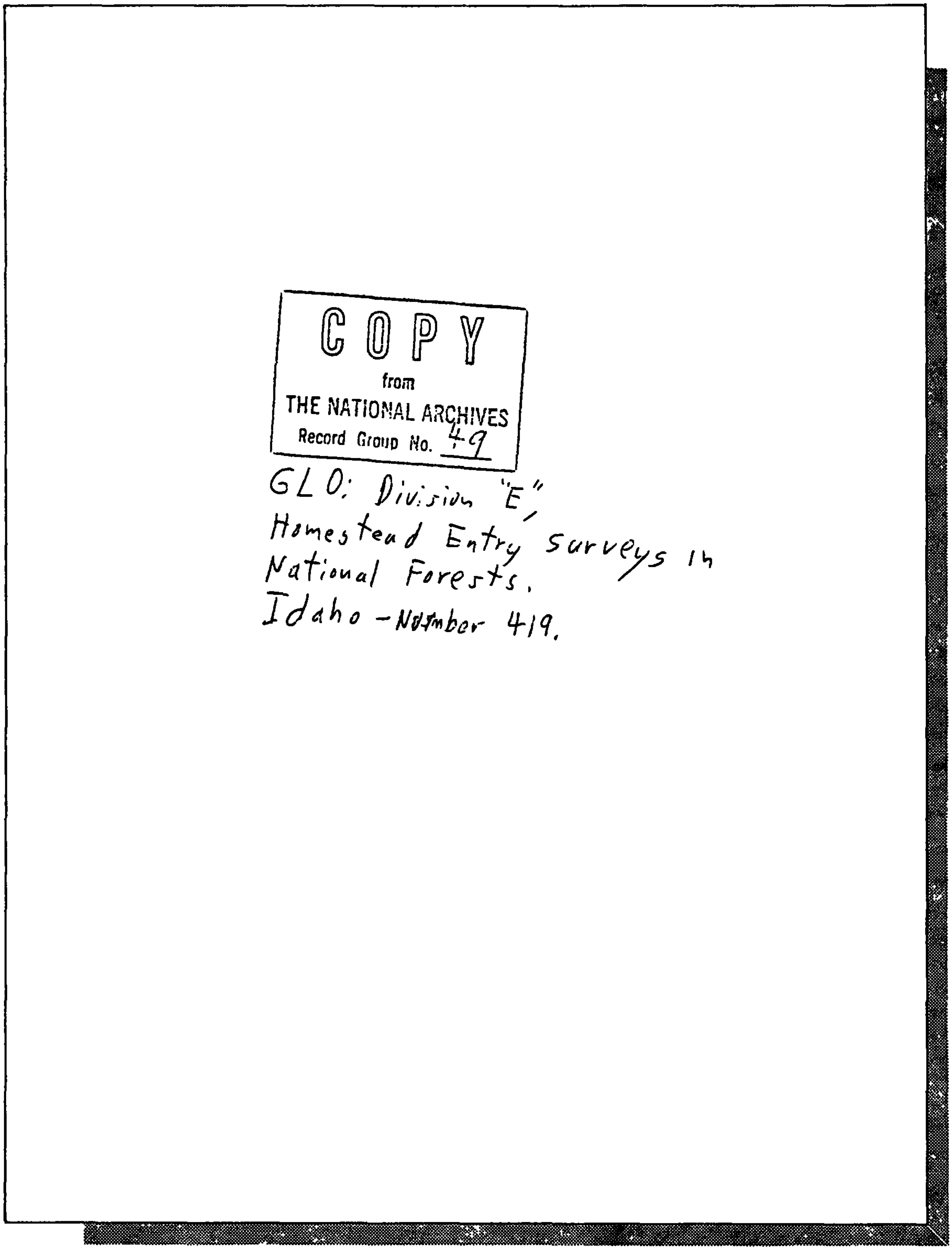
Figure 5-2.--Example markings of a homestead entry survey corner. Note that all markings face the homestead. The corner number may .also appear on the bearing tree.

LISTING SURVEYS & SPECIAL INSTRUCTIONS

Figure 5-3 contains copies of original documents relative to homestead entry surveys in National Forests. Copies of these records were obtained from the National Archives. They include a request for the official homestead entry survey, the listing survey field notes as prepared by a Forest Service surveyor, survey diagrams, and special instructions issued by the U.S. Surveyor General for Idaho. These particular documents convey the process involved in the final homestead entry survey process.

Such documents can provide vital information to corner searchers and surveyors. Certain information contained in these notes may otherwise go unnoticed. Documents of this nature often include contiguous mineral surveys and special problems, conflicts, or other valuable information. Many of these documents are quite old and therefore provide a very concrete history of the land in question.

Location monuments were frequently established when public land surveys were not available (see figure 5-4). Various homestead corners were connected by survey to these monuments for permanent reference. These monuments are often of assistance to the corner searcher.


COPY
from
THE NATIONAL ARCHIVES
Record Group No. 49

GLO: Division "E",
Homestead Entry surveys in
National Forests.
Idaho - Number 419.

Figure 5-3.--Homestead entry survey documents.

419

L
Challis - Settlement,
Williams, K. D., #88

The Honorable,

The Secretary of the Interior.

Sir:

I have the honor to request that the tract of land indicated on the enclosed blue prints and described in the accompanying field notes of survey, (List 4-1390) in the Challis National Forest, Idaho, be opened to settlement and entry in accordance with the Act of June 11, 1906, (34 Stat., 233):

Unsurveyed Township 11 North, Range 15 East, B. M., approximately Sections 26 and 27, Hailey Land District. Area 118.92 acres, more or less, except a strip of land 50 links wide within the exterior boundaries thereof, which strip is particularly described as follows:

Beginning at a point on the southwest boundary whence Corner #5 bears N. 66° 30' W., 3.67 chains and extending thence 25 links on each side of a line running N. 22° 20' E., 9.01 chains to a point where this roadway intersects the country road, from which point Corner #4 bears N. 75° 25' W., 6.14 chains, said excepted strip containing .45 acres. The net acreage hereby listed for entry is 118.47 acres.

Figure 5-3. (cont.)--Homestead entry survey documents.

No power possibilities exist.

K. D. Williams, Clayton, Idaho, applied for this tract on October 25, 1913, alleging settlement April 1, 1895.

It is recommended that entry be allowed, pursuant to the suggestions in your letter ("A" 102902-10) of January 20, 1911, addressed to this Department. The enclosed blue prints show the excepted area.

Very respectfully,

(Sgd.) C. F. Marvin,

Acting Secretary.

Enclosures.

Figure 5-3. (cont.)--Homestead entry survey documents.

Challis National Forest.

K. D. Williams Settlement No.88.

Approximately in unsurveyed T. 11 N., R. 15 E., Section 26 and 27 Boise Meridian. Number 88. List ________ Area 118.92 acres.

Variation.--This survey was run on a variation of 20° East . Said variation being that used by the Surveyor General for surveys in this vicinity.

Forest Service Monument.-- No monmment was established, the survey being tied to U.S.L.M. No. 5, Yankee Fork Mining District, Custer County, Idaho.

Beginning at corner No. 1, a limestone 12" x 10" x 24", marked H/1 and set 12" in the ground, whence a fir tree 24" in diameter and marked WH/1, bears N. 77° W. 56.5 links. U.S.L.M. No. 5 bears N. 22° 30' E. 7.57 chains.

Chains	Thence N. 31° 30' W.
5.00	Warm Spring Creek.
5.70	across creek.
11.36	corner No. 2, a granite wash stone, 12" x 12" x 24", set 12" in the ground, marked H/2, whence an X cut on a granite stone in place 4' x 4' x 3' above ground, bears N. 73° W. 23.8 links.
	Thence S. 49° 50' W.
3.63	east edge of hay land.
13.63	west edge of hay land.
20.36	across sagebrush flat to corner No. 3, a granite stone 8" x 10" x 22", set 12" in ground, marked H/3.

Figure 5-3. (cont.)--Homestead entry survey documents.

	A fir tree 12" in diameter, bears N. 9° 30' E. 31 links.
Chains	Thence S. 38° 50' E.
6.82	wagon road.
7.50	foot of rocky point.
9.47	up point to corner No. 4, a granite stone, 8" x 14" x 24", marked H/4 and set 12" in the ground. W.H.4, cut on a ledge, bears N. 81° 30' W. 15 links.
	Thence S. 6° 40' W.
3.20	down hill to creek bank
4.20	across creek.
8.48	up bank to corner No. 5, a wash granite stone in place, 4' x 4' x 3', marked H/5, an X cut for chaining point. A fir tree 24" in diameter, marked WH/5, bears N. 71° 30' W. 36.3 links.
	Thence S. 66° 30' E.
7.51	Corner No. 6, a granite wash stone, 10" x 10" x 22", set 12" in the ground and marked H/6 A pine tree 12" in diameter marked WH/6, bears N. 39° 30' E. 33 1/3 links. A fir tree 12" in diameter, marked WH/6, bears N. 80° 30' E. 30 links.
	Thence N. 65° 50' E.
4.00	top of bar
56.66	along bar and lower edge of timbered mountain to corner No. 7, a granite stone 16" x 36" x 12", above ground, marked H.7, the H. being used as

Figure 5-3. (cont.)--Homestead entry survey documents.

chaining point.

A fir tree 12" in diameter, marked WH/7, bears N. 84° 30' W. 1.84 chains.

Chains. Thence N. 5° 30' E.

.64 wagon road.

6.94 corner No. 8, a limestone 8" x 10" x 26", set 14" in the ground and marked H/8.

A fir tree 30" in diameter, marked WH/8 bears N. 40° 30' E. 70 links.

Thence N. 80° 35' W.

30.38 along edge of bar to corner No. 9, a wash granite stone 8" x 10" x 20", set 10" in the ground, marked H/9.

A fir tree 18" in diameter, marked WH/9, bears N. 15° 30' W. 66.6 links.

Thence S. 45° 15' W.

18.16 along east edge of point upon which the monument stands to corner No. 1, the place of beginning, containing 118.92 acres, be the same more or less.

Surveyed November 20 and 21, 1913; weather cold and snowing; elevation 5,800 feet.

(Signed) David Laing
Surveyor.

Plat and field notes compared and approved by

(Signed) David Laing
Forest Supervisor.

Figure 5-3. (cont.)--Homestead entry survey documents.

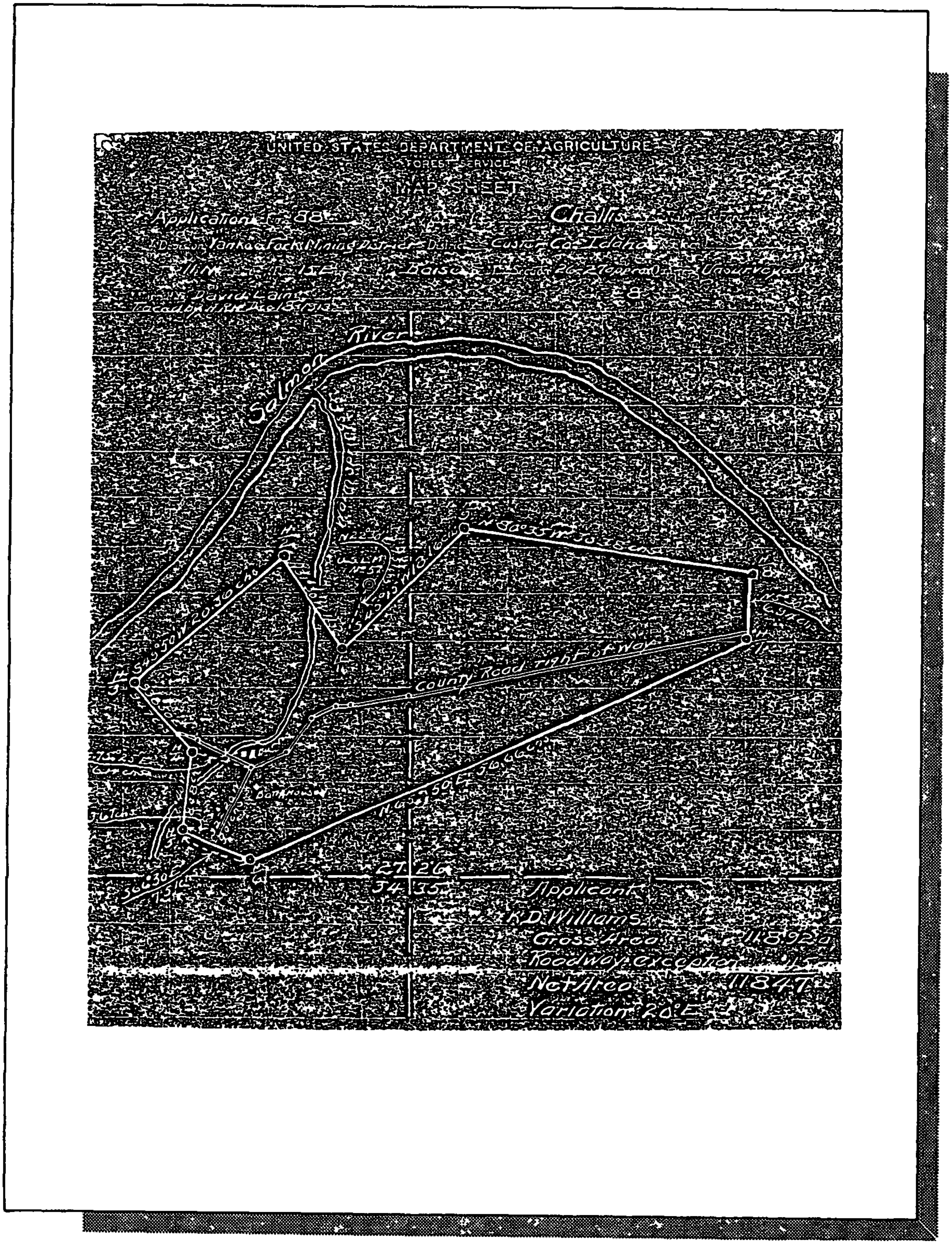


Figure 5-3. (cont.)--Homestead entry survey documents.

HES. 419

OK

Sfd.

DEPARTMENT OF THE INTERIOR

OFFICE OF U S. SURVEYOR GENERAL

L
Challis - Settlement,
Williams, K.D., #88.

Special Instructions,
H.E.Sur. No. 419,
Idaho. ADJ

Boise, Idaho, APR 28 1916

(616603)

Surveyor to be designated by

District Forester,

Ogden, Utah.

Survey accepted 2-2-18 G.E.E.

Sir:

At request of the District Forester, dated Jan. 13, 1916, the following special instructions are issued to you for survey of Homestead Ehtry of Chase A. Clark (marked upon the ground), application No. 88, dated Oct. 25, 1913, list No. 4-1390, dated March 17, 1914, serial No. 018410, Hailey, dated July 21, 1915, appproximately in secs. 26, and 27, T.11 N., R.15 E., unsurveyed, Challis National Forest, and designated as Homestead Entry Survey No. 419, Idaho.

88/9

Enclosed are:

Diagram of the claim showing available information.
Diagram and field notes of the listing survey.
Field notes, U.S.L.M.No.5, Yankee Fork Mining District.
Print and field notes of M.S. No.2258.

The position of the claim with reference to HES. No.136, accepted, was ascertained from connections given in HES.No.322, not approved. Connection should be made from a corner of HES. 419 to corner of HES. 136.

Lines of Mineral Survey No.2258 should be retraced as may be found necessary. Returns of your survey should show

RECEIVED MAY 3 1916

Figure 5-3. (cont.)--Homestead entry survey documents.

such retracements in detail and should give intersections with the boundaries of the mineral survey and area of conflict. Section 26 should be observed and field notes must show a statement that the inclusion is at the instance of the entryman.

[illegible] good

A road right of way is to be excluded from the survey. Corners will be numbered consecutively from Corner 1 to the first corner of the right of way. The series will be continued around the exception and will be completed around the balance of the boundary.

There are no known claims in the vicinity except those shown on accompanying sketch.

Authority is given for the inclusion within the survey of such adjacent unlisted land as may be deemed expedient.

The survey will be executed in accordance with the provisions of Circular 235.

Yours truly,

U.S. Surveyor General for Idaho.

IFS-AEK

Figure 5-3. (cont.)--Homestead entry survey documents.

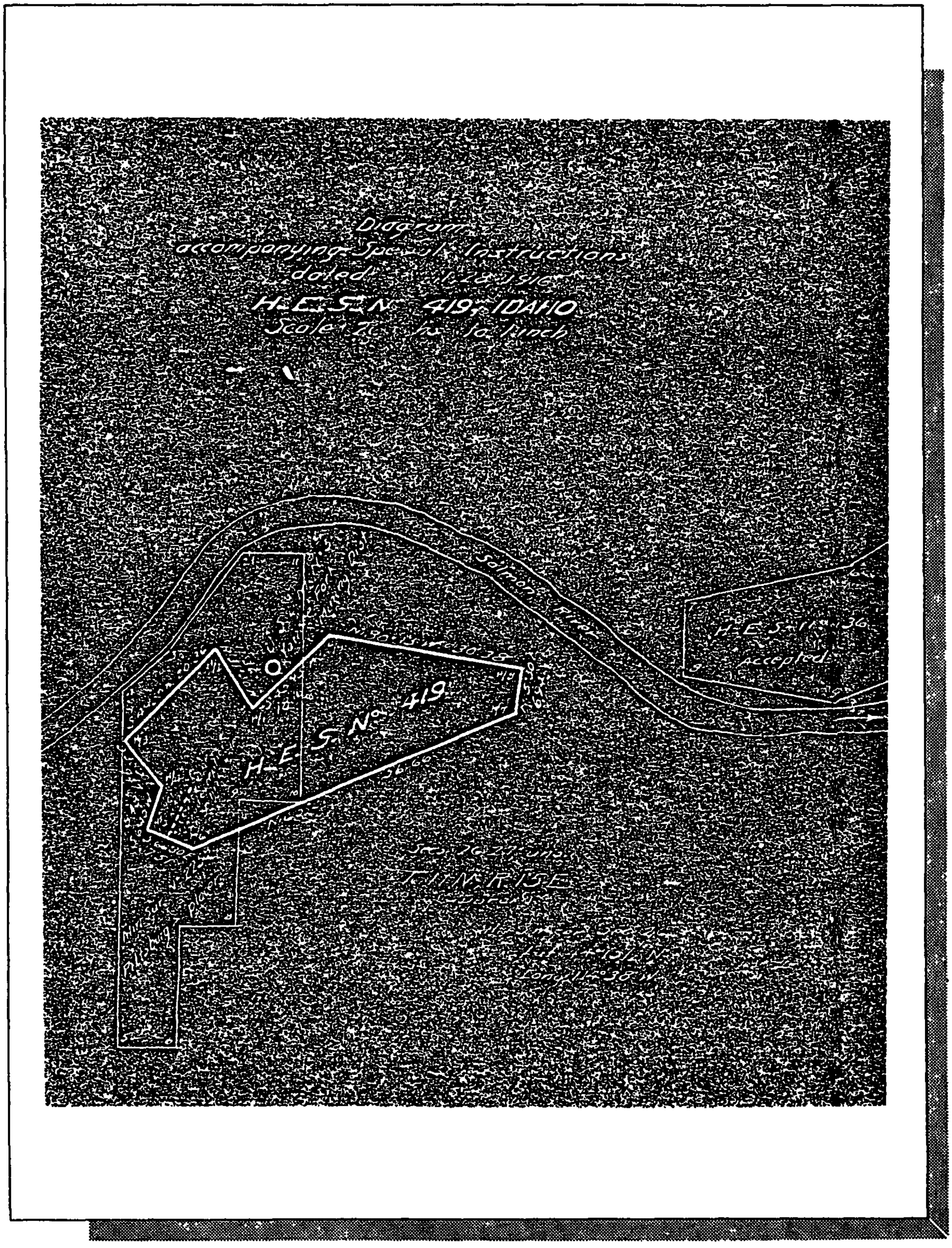


Figure 5-3. (cont.)--Homestead entry survey documents.

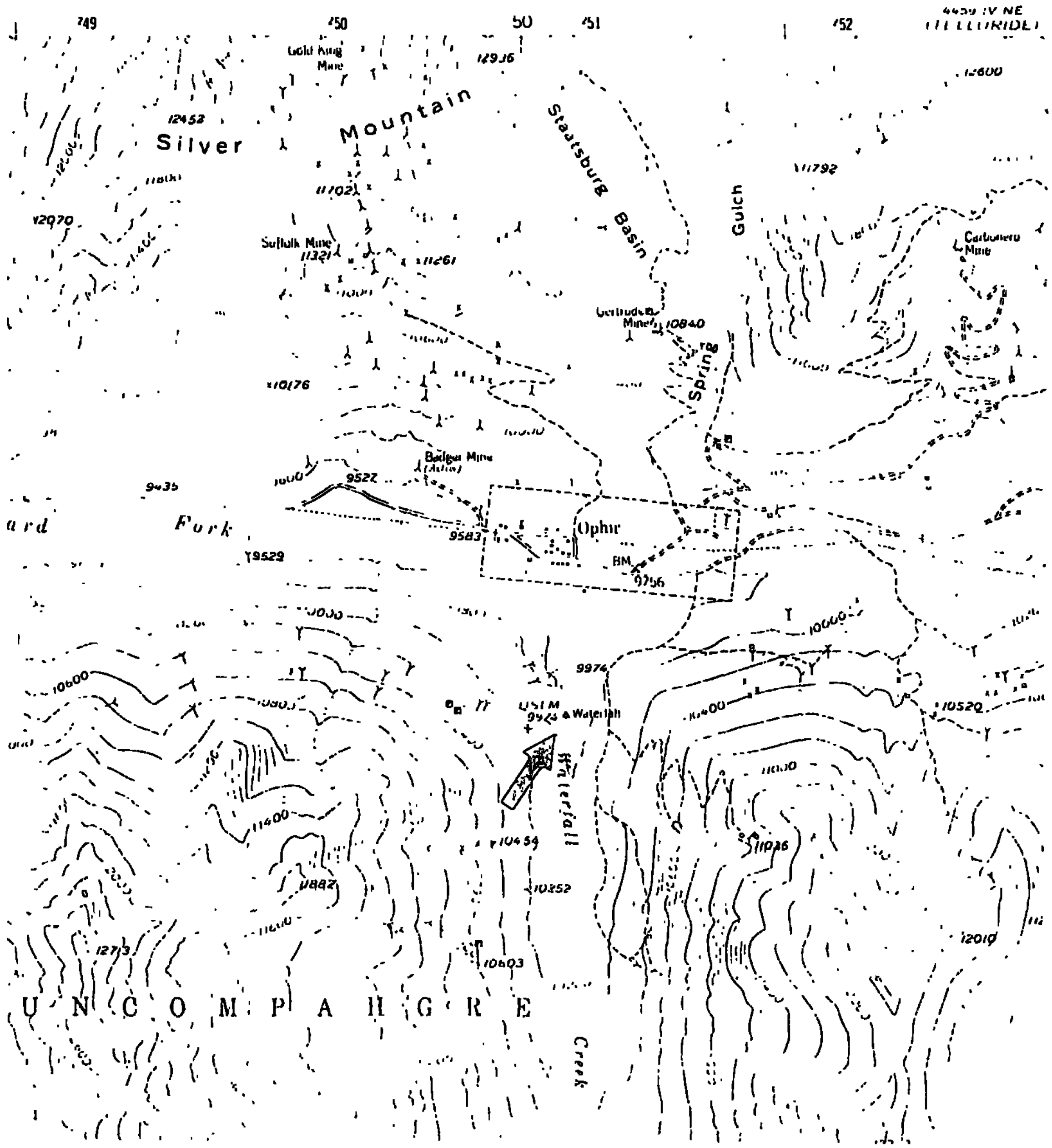


Figure 5-4.--Location monuments.

Unit 6
Mineral Surveys

MINERAL SURVEY CORNER SEARCH EVALUATION, REESTABLISHMENT, & REMONUMENTATION

Mineral patent lands have the sane legal status as any other private lands and must be monumented or remonumented and posted wherever such lands bound National Forest administered land.

Mineral survey corner search and evaluation requires essentially the same tools and equipment used for rectangular corner search. Field notes and plats of the mineral survey, status diagrams, aerial photographs, and quadrangle maps are standard materials. GLO or BLM field notes and plats of the rectangular surveys may also be most useful. Especially valuable are the U.S. Geological Survey maps of mineral districts or mining areas. It is seldom efficient to search and evaluate one claim or mineral survey in an area of much mineral activity without being prepared with a complete set of field notes and plats for the adjacent mineral surveys, since many such surveys are interdependent.

An effective method of locating mineral survey search areas is to use the record ties to rectangular corners that may be indicated on the plat. Record ties (bearings and distances) may also be shown to land monuments or mineral monuments. Such monuments are usually more permanent than the mineral survey monuments, as they nay consist of a large boulder or other natural feature. Of course, these ties will be more useful if they do not involve long distances. It may be difficult if not impossible to prepare search area-marked photos in advance for mineral survey corner search. For example, map positions may be inaccurate. It may be feasible to plot a known corner on the photo, thus establishing a beginning point for the search.

Quite often a starting point can be located by careful examination of the mineral survey plat, comparing locations (both physical and plat) of shafts, tunnels, dumps, or adits. Old-time residents and miners may know of the location of various corners by lode names rather than the mineral survey numbers. A starting corner also may be evident along access roads and trails, if one watches carefully for mounds of stone, wood posts, and blazed or scribed witness trees.

Once a starting corner is located and identified, the remainder of the mineral survey corners can usually be photoscaled to close limits to provide the search pattern. Congestion may be a restricting factor. Corners of patented mineral surveys should be posted with land survey monument and boundary signs. Mineral survey lines that are effective Forest boundaries should be posted to Forest Service manual standards by the authorized Forest land surveyor. Corner monuments of unpatented mineral surveys may be identified and posted with Forest Service land survey monument signs only. Several corners should be photoidentified to permit subsequent plotting of remaining claims for future surveys and photogrammetric personnel.

In situations where several adjoining lodes have endlines that are prolongations of one another, it may be practical to photoidentify and plot to the base map only those corners that are angle points of the block or group. This would prevent having photos needle-pricked so close together as to be confusing. However, each and every corner along such lines must be searched, monumented, and posted as authorized.

If the first located corner cannot be specifically identified, the searcher must attempt to locate other, more positively identifiable corners of the claim by photoscaling, measuring short courses, compass and pacing, or extensive ground search until positive identification of the various corners of the claims or mineral survey can be made. Then and only then is it practical to up”--sign the corner and fill out the corner report on Form 7100-52. Much time can be wasted in upgrading, sign posting, and report writing before finding out that the corner in question is a different corner of the same claim or mineral survey or even, in extreme cases, a different mineral survey.

Many mineral surveys on the Rio Grande Forest were monumented with wood posts, scribed with the mineral survey and corner number. Many of these have deteriorated badly over the years. When one considers that mineral survey number 62 (our lowest number) was surveyed and patented in 1877 and mineral survey number 20389 (one of our highest numbers) in 1923, it becomes apparent that much detective work will be required to positively identify these monuments and their markings. A sometimes effective method is to spray the surface lightly with red paint or enamel to bring out the tone contrast of very faint remains of the scribe marks.

All bearing trees of the field note record should be searched for and recorded, but chopped open only when no other means of identifying the corner is possible. “Opening” the bearing trees should be left to the authorized Forest surveyor or BLM surveyor.

Nonrecovered corners of mineral survey (lodes) are relatively simple to reestablish by the Forest land surveyor, since very seldom does a course exceed 1,500 feet and nearly all of the end lines are 300 or 600 feet. Placer claim corners can be somewhat involved, however, as they may be irregular in shape.

The remonumentation of mineral corners may present a problem in active mining areas. It should be carefully explained to interested parties that this search and remonumentation is done on a very impartial basis, and that the benefit of properly and positively identified corners and lines is certainly as great for the landowner as for the Government. They should be informed that these corners and lines are not relocated, but are reestablished where created by the original mineral survey.

In cases of large groups of claims or mineral survey, it is not necessary to search for and remonument corners in the interior of blocks or groups of lodes. Only those with common boundaries with Forest lands need be evaluated. In practice, however, the searcher will usually pass close by some of these corners, and it seems only practical at least to report them on Form 7100-52. Quite often the searcher will make use of some corners that are not necessary for boundary posting for control of search areas.

It is appropriate to mention the presence of “Forest islands” or gores” among overlapping or intermingled claims. These should be identified also. Perhaps posting of such small areas should be deferred unless specifically required by the land manager or Forest Supervisor, but all corners definitely require identification and monumentation. These “gores” may be later disposed officially by the Small Tract Act.

Most of Colorado’s thousands of patented mineral surveys were identified with such wooden post corners. One distinguishing feature of mineral surveys was the conscientious workmanship and the quantity and quality of witness marks and bearing trees.

Figure 6-1.--Rugged mining terrain. Caution should be exercised while driving on the access routes, as talus slopes can be unstable. Aerial photos can serve as a map defining such routes.

Figure 6-2.--Adits, discovery shafts, or other workings may assist the searcher in recovery of a mineral survey corner. Conversation with the claim owners also may assist with corner recovery. Verification of doubtful corners should be done by authorized Forest Service Cadastral surveyors, as the owner's impression of where the true corner falls may not agree with the qualified surveyor's position.

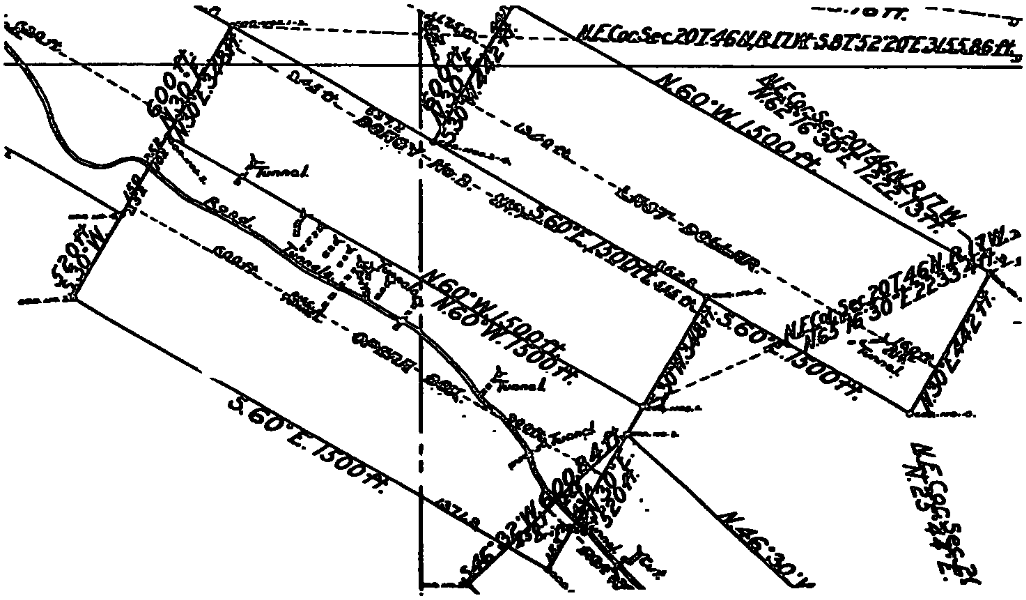


Figure 6-3.--Copy of a mineral survey illustrating various features common to mining claims as well as ties to the public land corners. Tunnels, discovery shafts, tailings, and mill sites all assist a searcher with recovery of corners.

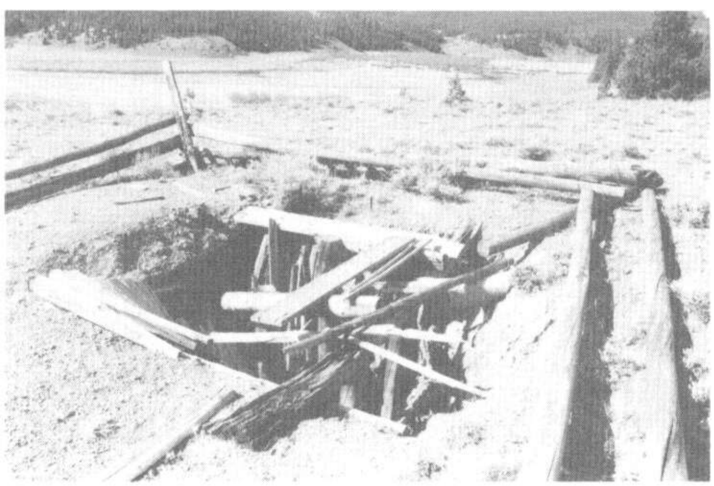


Figure 6-4.--Exploration shafts and cuts serve to orient the corner searcher. Care should be exercised when investigating old shafts, as supports are often decayed, thereby increasing the chance for collapse--in fact, they should usually be avoided. Ties to shafts (especially discovery shafts and tunnels, may be used for reestablishment of corners when other corner evidence is not available. Both shafts and cuts were usually located with the claims.

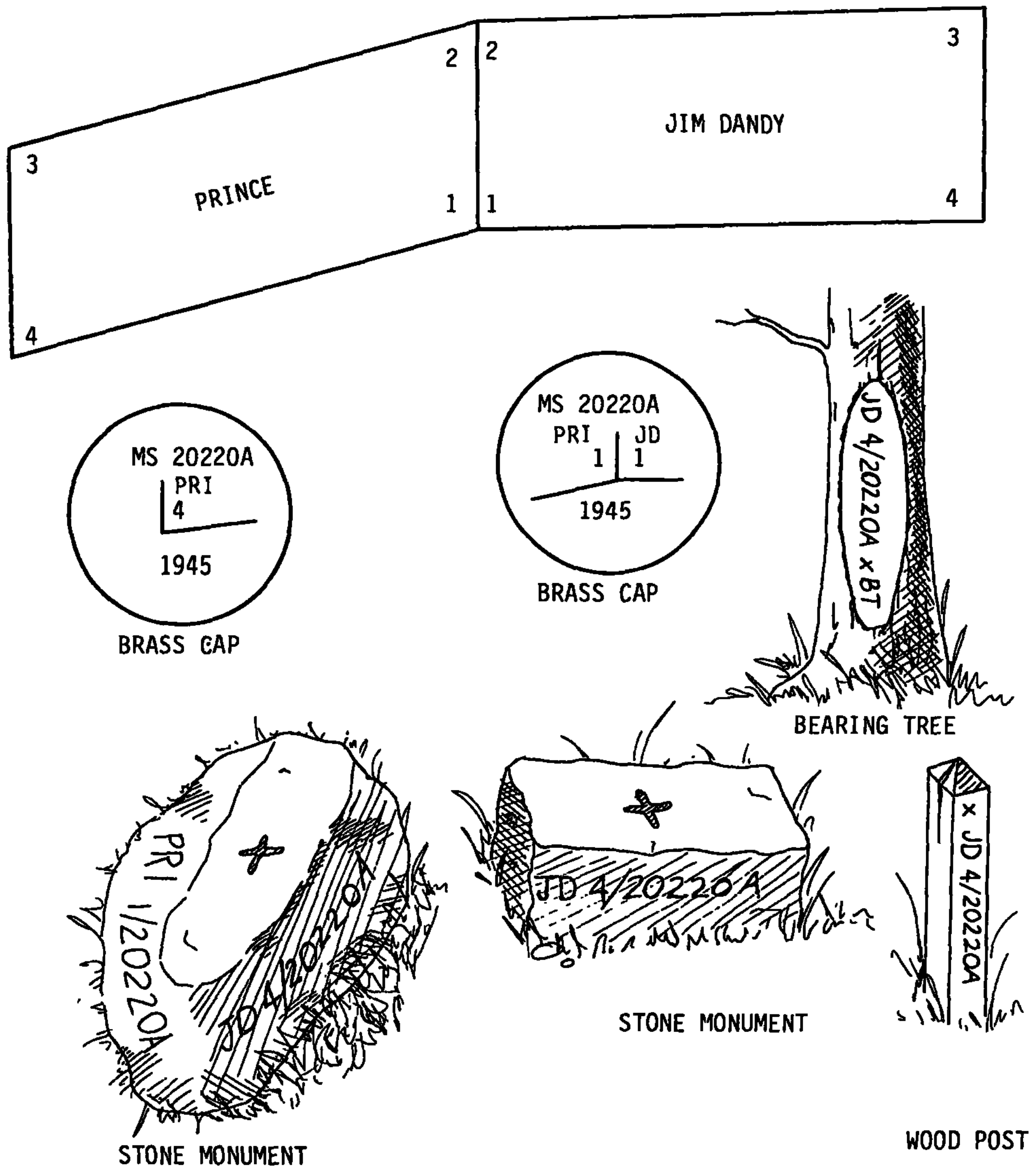


Figure 6-5.--Example mining claim corner markings (mineral survey corners). The respective stone markings face the claims. The bearing tree blazes face the claims. There are numerous variations in these original markings.

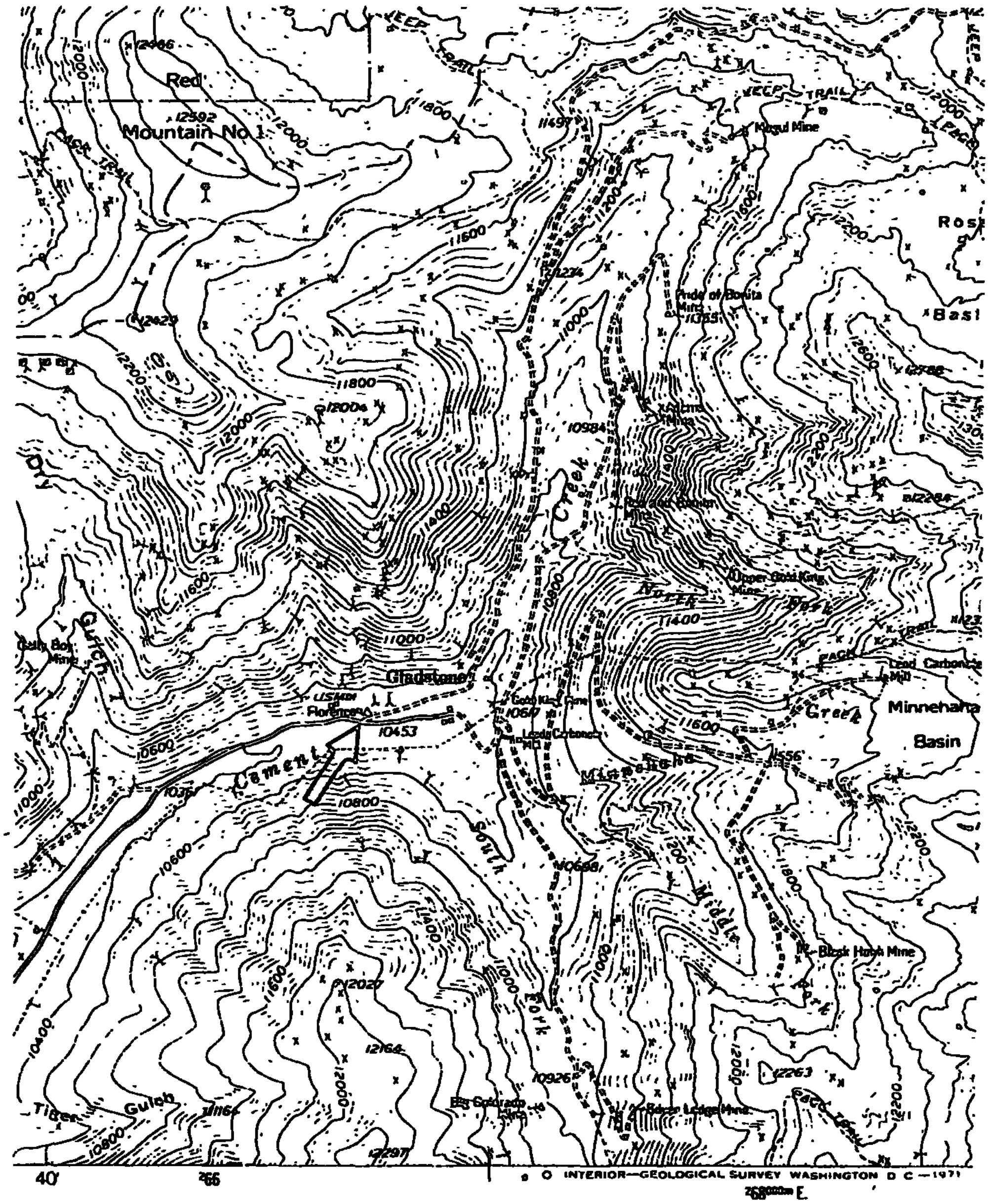


Figure 6-6.--Mineral monuments established in unsurveyed areas. Various mineral survey corners were "tied" by survey to the mineral monuments. Such monuments were often large boulders or other features of a permanent nature. They are therefore of assistance to corner searchers. Note the many prospect holes (X) and tunnels or shafts (Y).

Figure 6-7.--Location monument is typical of many established to permanently reference mineral surveys in the absence of rectangular survey monuments.

Figure 6-8.--Fallen bearing tree with clearly legible scribing. These may have an attached B.t. sign or location poster.

Figure 6-9.--Cabins and other improvements may be shown on the original plat. This cabin reflects the action of the elements over the years.

Figure 6-10.--A few structures have been maintained. An elderly lady lives in this cabin during the summer. Other inhabitants may be miners or even squatters.

Unit 7
Field Procedures

All the books and manuals cannot replace even 1 day of actual in-the-field training of personnel; therefore, it is recommended that employees receive some formal training from a competent Forest Land Surveyor or designated corner searcher.

The following is rundown of methods and procedures of corner search. Various key techniques also are conveyed.

CORNER SEARCH TYPES

Corner search may be broken down into four categories, depending on the time period the employee is working within.

(1) Chance Recovery. An employee may recover a corner monument while performing regular duties. This type of corner recovery is common and can be of considerable assistance in the land line program. Knowledge of proper recordation techniques can assist the employee in conveying information on the corner to the Forest land surveyor or other responsible employee. Adoption of standard recordation techniques will most likely eliminate the nonstandard methods of recordation, such as match books and scrap paper records. A supply of Corner Recovery Cards should be a part of every employee's standard equipment.

(2) Random Corner Search Method. For this type of search, a map or aerial photo is employed to identify the search area. No line is retraced from a found corner monument using record data. Once the searcher identifies the search area, the most direct route is followed to the area. The success of this method may be greatly improved by office plotting of record topographic calls on an aerial photograph as outlined in Unit 10, Corner Point Photoidentification.

(3) Compass-Pace Method. Record bearings and distances, as well as topographic calls, are applied with this method. This method is a form of retracement and is especially effective in areas where adequate accessories or corner evidence exist and the topography is gentle. Aerial photos and quadrangle maps are useful with this method. The searcher may have greater success in rugged areas with other methods, as pacing accuracy is sharply reduced. Any other obstructions, such as heavy oak brush and windfalls, reduce the pacing accuracy.

(4) Retracement Corner Search. The footsteps of the original surveyor are followed as closely as possible with this method. The old survey lines are rerun accurately in accordance with the record bearings and distances as shown on GLO and BLM plats and notes. Topographic calls are also used extensively in retracement corner search. If the corner monument is not recovered, the position is frequently reestablished by the methods of proportionate measurement. It must be emphasized that this method best locates the most probable search area. An intense search for the corner should be done prior to any establishment of a new corner. Retracement Corner Search requires time and a full survey crew. The BLM Forest Service and private surveyors employ this method extensively during resurveys. Most corner search performed by employees will utilize other methods.

WHICH METHOD of CORNER SEARCH IS BEST?

Figures 7-1 and 7-2 illustrate what may result if the appropriate method is not employed. The township diagram in figure 7-1 represents the results of a corner search by the random search method.

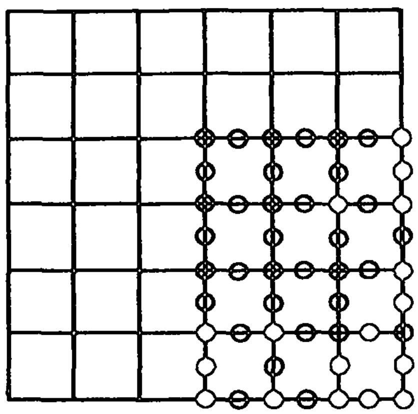


Figure 7-1.--Results of random search method.

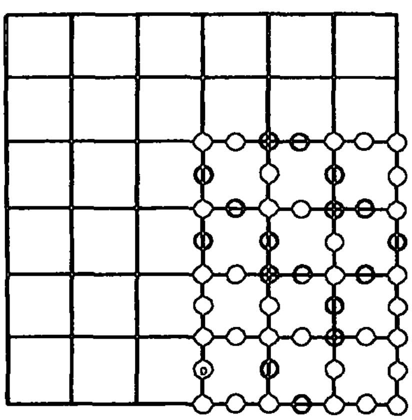


Figure 7-2.--Results of retracement corner search method.

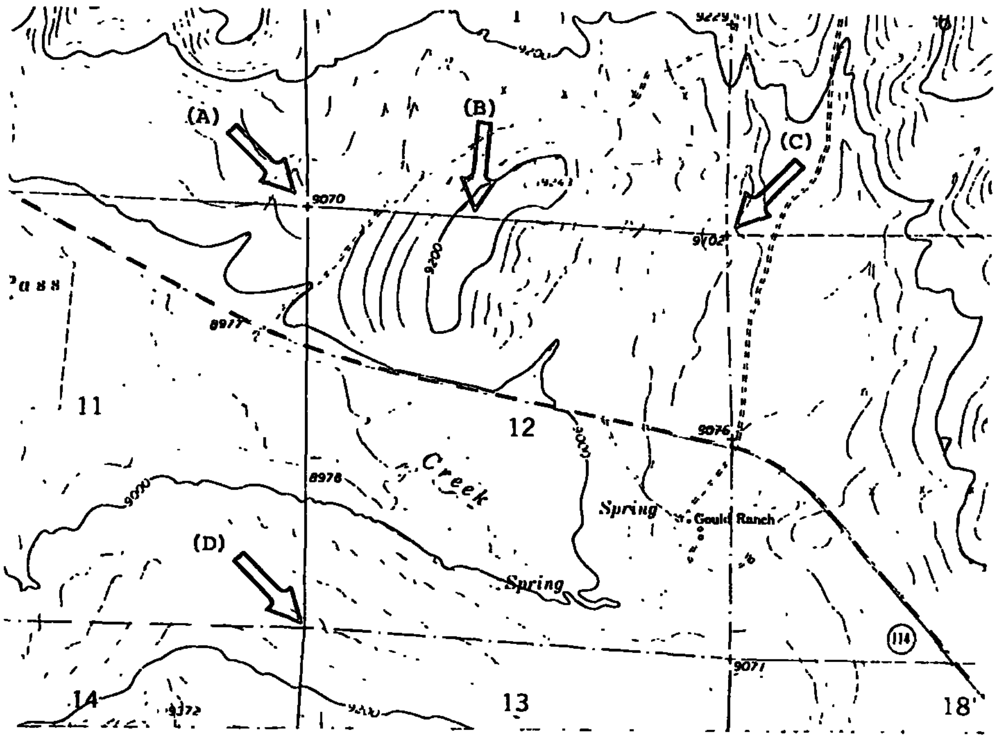


Figure 7-3.--An initial direction must be determined in the field usually before retracement work can be done properly. In the above example, a transit or theodolite may be set up at point B and a "balancing-in" point established. This point becomes the backsight for the setup at point A at which time the record angle is turned (angle right) to point D. The record distance can then be measured to determine the search area for the corner at D.

Several years later, a BLM crew executing a dependent resurvey recovered many additional corner monuments (see figure 7-2). This stresses the need for application of proper methods. The success of the retracement method over the random search method was due mainly to the heavy oak brush and rugged terrain. Many hours of random search yielded few recovered corners.

PREPARATION for CORNER SEARCH

Prior to initial field work, the following should be considered:

(1) The type of corner search should be determined. Will this be merely an unplanned approach or a thorough preplanned search?

(

a) Random method using quadrangle maps, aerial photos, and available corner records.

(b) Compass-pace, compass-chain, or compass-EDM (electronic distance meter) with essential maps, photos, and field notes.

(c) Retracement survey with appropriate surveying equipment. This method may employ astronomic bearings or compass bearings and all available maps, photos, and field notes.

(2) A convenient starting point should be determined. If available, any found corner within a reasonable distance of the required corners may serve as a beginning point. All available maps, photos, corner records, plats, and field notes should be assembled. Various procedures are outlined:

Aerial Photograph Utilization

(1) Arrange photographs by flight lines and mark flight line number on each photograph with suitable markers. Lamination provides a protective surface for the photographs so they may be used over and over.

(2) Prepare an index map showing the photo center for each photograph, photo numbers, and flight line numbers.

(3) Obtain and transfer to these photographs all available, reliable photoidentified corners pertinent to the project area. A stereoscope, an instrument that permits three-dimensional viewing of the photos, is most valuable for this phase. Various types of stereoscopes are available and include the larger mirror type and the direct lens type. Use of a quality instrument will lend credibility to any photo-related work. Lower magnification (2X to 3X) is usually recommended for this type of work. Care must be used to transfer the corner positions. Corners plotted wrongly on photos result in much confusion and lost time!

(4) Select and mark on the photographs the search area for each corner to be searched in the field. Topographic survey calls (such as creek crossings or ridges), as extracted from the field notes, can be marked on clear plastic templates and correlated with quadrangle maps and aerial photos. A best fit for the original survey line can be obtained.

Photo scale variations may be resolved with the use of a special overhead map projector, Sketchmaster, radial arm plotter, or other suitable photograminetric equipment. These instruments achieve the same scale for both map and photo (they do not remove errors in scale resulting from airplane tilt and other factors). Thus, the corner search areas can be relatively accurately determined. Again, erroneous placement of these search areas will mislead the field person and seriously impede the search progress.

(5) Place the photographs in suitable folders for field use and label them.

Accessing the Search Area

Once the search areas have been plotted, a study of the photos and maps will usually reveal the best access route to the search area. Recent photos serve conveniently as a base map and may reflect recent logging roads, private roads, and trails. The photos often indicate heavy brush, timber types, clearings, ponds, and other useful features more dependably than maps.

Landowners, Forest Service employees, or surveyors may be helpful in providing information relative to access routes. Available recovery notes also may be of assistance.

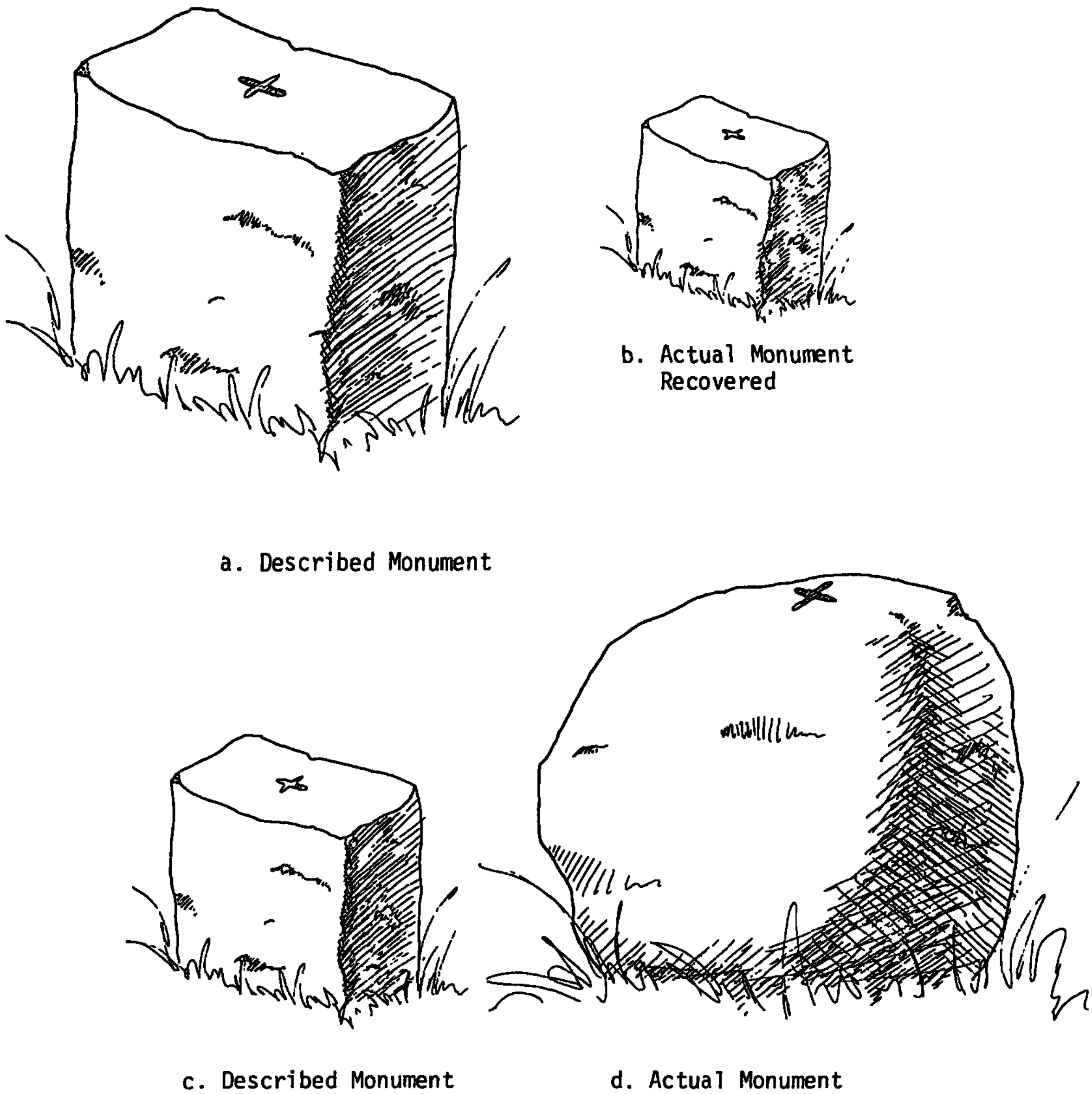


Figure 7-4.--The recovered monument may not be as described in the field notes. It may be larger or smaller and of much different shape than described.

Ground search will be confined to the area delineated on the photograph unless there is reason to believe that corner evidence lies outside the area. Sometimes it is feasible and desirable to find evidence of a survey line that may be outside the plotted area and to follow the line into the corner. The amount of time to be spent searching for any one corner cannot be stipulated; it will vary considerably with different conditions and must be left to the good judgment of the searcher.

The original surveyor was issued special instructions as to what manual to follow and the manner in which to conduct the survey. The instructions make it possible to follow the footsteps of the original surveyor. Copies of the manuals in effect since 1851 should be in every library for reference as needed.

The survey notes and plats will be carefully reviewed for the objects for which the search will be made. If there are more than one searcher involved it is best to photocopy the notes so each will have a copy. Some planning also will be necessary so that the search can be well organized. Areas can then be covered more thoroughly and time will be used most effectively. Searchers should remain as a unit as opposed to searching independently. This also may prevent them from getting separated and possibly lost.

It is critical that the search crew ascertain its exact position on the photos at all times. Prior to leaving the vehicle, the search crew should locate the trail, drainage, ridge, or hillside they will be crossing en route to the search area. If searching in a flat or low, rolling, sagebrush-covered area, the crew or searcher should determine the bearing to the search area from the photos. A final check should be made prior to leaving the vehicle to ensure that the pack contains all the necessary posting materials for the corner or corners being searched. For those situations where the sole purpose of the field trip is not corner search, it may only be possible to carry a few basic items, such as recovery cards, location posters, bearing tree tags, and flagging (see Unit 9, Equipment & Materials).

A stereoscopic review of the photos is often recommended at regular intervals while walking to the search area.

WHAT TO LOOK FOR

A thorough systematic search will be made of the area. With experience, searchers soon develop their own systems of search. Some prefer to crisscross in a grid pattern.

Regardless of the system used, it must ensure a thorough search with effective use of time and information.

The crew should be alert for any sign of survey while working in an area that has been surveyed, such as tree blazes, old fences, line chopping, flagging remnants, broken lath, or any other items associated with surveying. Many earlier Forest Service personnel made a practice of placing iron or wooden posts with attached signs along the line of the survey. They often placed boundary signs at the junction of a survey line and a trail. Location posters ("K” tags) were also placed near the found corners. The person who attached the signs may be of assistance if available. Though rusted, bent, or partially buried, these signs often remain as good evidence of a nearby corner, or what was used as a corner. Such posters may be a detriment rather than an asset. For example, a landowner may believe a fence corner is the true corner, when in fact it is not.

Use lines (such as fences) can be deceptive. Use lines are often established for convenience and not to show the limit of ownership. Old use lines established shortly after the original survey may be more reliable than those established in recent years. If the use line is supposed to be on the section line, walking it with field notes in hand and comparing the topography calls can determine if it is of any value in locating the corner.

The original notes must be available to the searcher, or at a minimum they should be studied to determine the size, material, and markings of the corner monument. Notes should be recorded. The kind, size, direction, distance, and number of accessories to the corner should also be determined. Accessories, such as a mound of stone or earth, generally remain but are often in a worn condition. Clumps of brush should be examined carefully during a search because the soil disturbed during the time of establishment of the pipe, rock, or wooden post often encouraged the growth of vegetation.

Mounds and pits were often used to mark the position of a corner. In time the mounds were washed away and the pits filled. If there is some stony material in the soil, a large concentration of pebbles will be found at the location of the mound; the pits will be filled with the fine and wind-blown soil. The soil in the pits is not as compacted as the native soil and usually encourages better growth of vegetation.

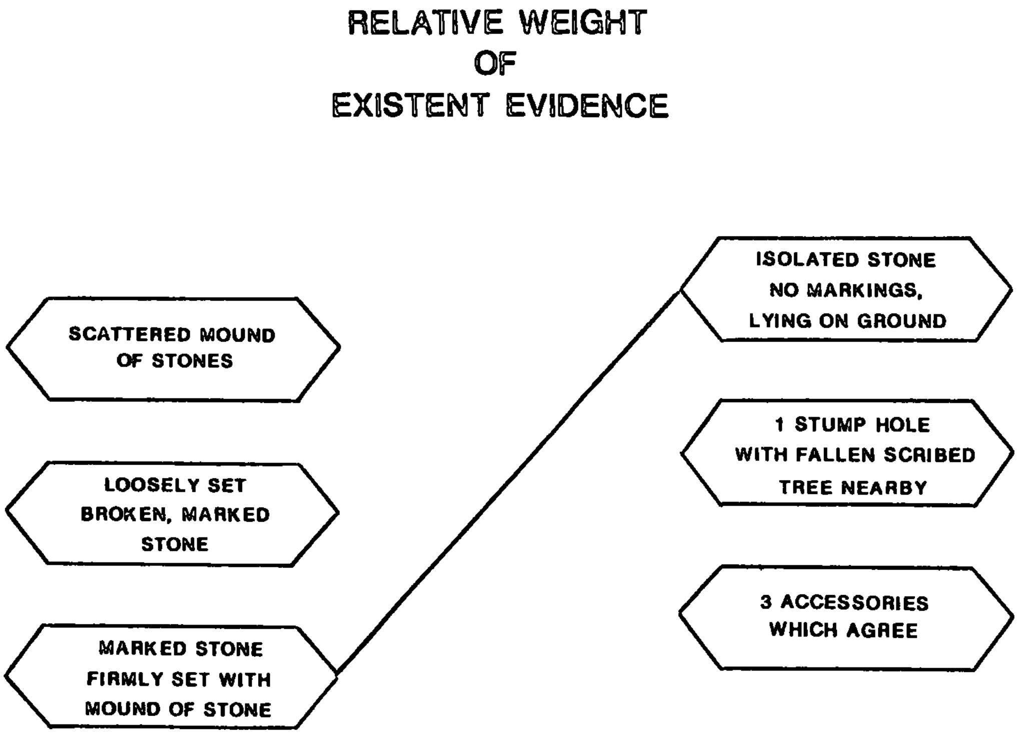


Figure 7-5. Chart for weighing field evidence. Corner searchers and surveyors are frequently confronted with weighing and evaluating evidence. The simplified chart illustrates types of evidence and the weighting concept. The decision-making process is not always this simple as there are frequently many factors and variables which enter into the final decision. The example indicates the marked stone would be given a much greater weight than the isolated stone with no markings. NOTE: When weighing evidence, the broad picture must be viewed and all parameters systematically reviewed and considered.

Evidence of wooden post monuments may seldom be found in some localities because of the natural elements of weathering. Of course, this is dependent largely upon certain variables such as the environment and the wood type. Some cedar posts have been recovered that were more than 100 years old, particularly in swamps. Other posts (such as aspen or pine) may have long decayed. There is a tendency to start digging carelessly and much evidence may be destroyed by this action. If the accessories to these wooden monuments were trees, and no apparent bearing trees can be found standing in the search area, careful examination of the fallen trees in the area sometimes will result in the recovery of the accessories. Care should be exercised, however, not to disturb the fallen accessory any more than necessary for the purpose of verification.

Stone monuments may be most difficult to identify on a hillside of stones and boulders or when hidden by dense cover.

Positively identified accessories prove most useful for locating corner positions and monuments under such conditions.

Corner monuments are often lost on steep bare hillsides, on river banks, or in heavily logged areas. In such situations, if an accessory is located, the original corner can be reestablished with reference to the bearing and distance as noted in the original survey notes.

The evidence found in a search area should not differ too much from that recorded in the survey notes. Certain discrepancies, such as sizes of stones and bearing trees, often occur because the old surveyors generally estimated these sizes. Their instructions called for minimum sizes and they often stretched dimension in their notes to comply with instructions. The present size of bearing trees will often reflect growth relative to the original date of scribing. The old surveyors were not always geologists or foresters and therefore called rocks and bearing trees by names other than those familiar to us today. All such discrepancies should be noted by the searchers, and they should document exactly what they find, leaving verification to the Forest Service or the BLM cadastral surveyor. If insufficient evidence is located in the search area, it is good practice to plot the search area again and check the topographical features on the ground with those in the survey notes. Objective thinking and a positive attitude often result in found monuments.

TECHNIQUES & TIPS TO AID FIELD SEARCH

(1) The following are aids that may be useful in searching for a marked stone:

- (a) Light reflections off markings on stone.
- (b) Wash off rock with water.
- (c) Brush moss off rock with wire brush.
- (d) Exposed caliche indicating manmade mound.
- (e) Variety of stones close together may indicate man-disturbed stones.
- (f) Orientation of stone or marks on stone.

(2) Aerial photos often show old roads in open plains. This may be helpful in searching for corners by roads, trails, and cattle paths often made along fence lines. When the fence lines were along the section lines, these roads may be a clue to the section lines and therefore the corners.

(3) The proper procedure for finding evidence of a wooden stake monument that has long since decayed and rotted away is to take a shovel edge, axe, or machete and scrape the top of the ground, looking for discoloration of the soil in the shape of a squared wood stake.

(4) Ants’ nests may be an ideal search area because when the original surveyor set the monument, it disturbed the soil. Ants find that building nests in loose soil is easy and therefore often build their nests beside a monument.

(5) When searching, the searcher should look under fallen logs because trees often fall with the scribing face down. Fallen trees also may land on top of the original monument.

(6) Mounds consisting of a variety of rocks are good clues to human disturbance and indicate a manmade mound.

(7) A retracement distance between two found corners on sloping ground that is short of the record distance would indicate that the original surveyor chained on the slope.

(8) When the bearings between found corners on a retracement are consistently off to the right or left by approximately the same amount, a possible wrong compass setting was made by the original surveyor.

(9) Quadrangle map locations and use of topography may help.

(10) Cut lines, although they may not represent the true line, may well represent evidence of a survey. These lines often lead to other corner evidence. Old sapling stumps may represent a clue to an existing corner. Logged-over areas on the other hand can mask cut lines, thereby making them more difficult to use.

(11) Local control monuments may or may not represent the correct positions of original surveys. They also may assist with the recovery of nearby Government corners.

(12) Fence lines often were built on the original property lines. They just as frequently, if not more so, were erected along more convenient routes that do not coincide with the true boundary line. They should be investigated in case they are in fact on the true line. Old fence lines may have remnants of blow sand caused by the original fence line.

(13) Accessories, including bearing trees, bearing objects, old posters, and reference marks may be visible.

(14) Blazed lines may lead to corner monuments.

(15) Mining claim notices in old tobacco cans may reflect a nearby corner.

(16) Grazing practices often create noticeable contrast changes.

(17) Manmade disturbances and improvements such as shafts, pits, diggings, adit's, and cabins offer useful evidence.

IF THE CORNER MONUMENT IS NOT RECOVERED, WHAT THEN?

The following suggestions may be considered by a corner searcher:

(1) Move around in a systematic pattern, but also sit down, think, and review the map, plat, and field notes often. Rest your eyes and check bearings (refer to figure 7-6).

(2) Be alert to changes in ground features relative to the plat or map, such as stream channel changes.

(3) Check area from a vantage point. If fairly recently surveyed, cut lines or accessories often are more visible from above (as through heavy oak brush).

(4) Assume the monument or some evidence exists--think positive.

(5) Try beginning from a different point.

(6) If the corner monument is not found, the searcher may do well to use another corner search method, if feasible. Others may be familiar with corners in the area. Again, check to see if you have <u>all</u> the record.

NOTE: The proper pattern must be used to cover the search area in the most thorough manner. Two methods are shown in figure 7-7.

If insufficient evidence is located in the search area, it is good practice to plot the search area again and check the topographical features on the ground with those in the survey notes. During the initial plotting of the various lines, a “best fit” relative to topographic calls in the field notes should be developed using templates as described by figure 7-8.

Figure 7-6.--Bearings of distant topographic features may be listed in the field notes. This example illustrates the application of these data. The searcher may take frequent bearings to these objects or features as he or she proceeds along a trial line. If two features are listed, intersections may be established.

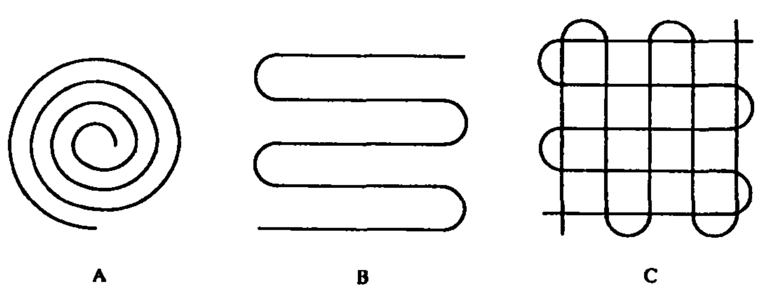


Figure 7-7.--Patterns for search. Example A may be more suited to level or even ground (topography). Example B works best for slopes and more rugged terrain.

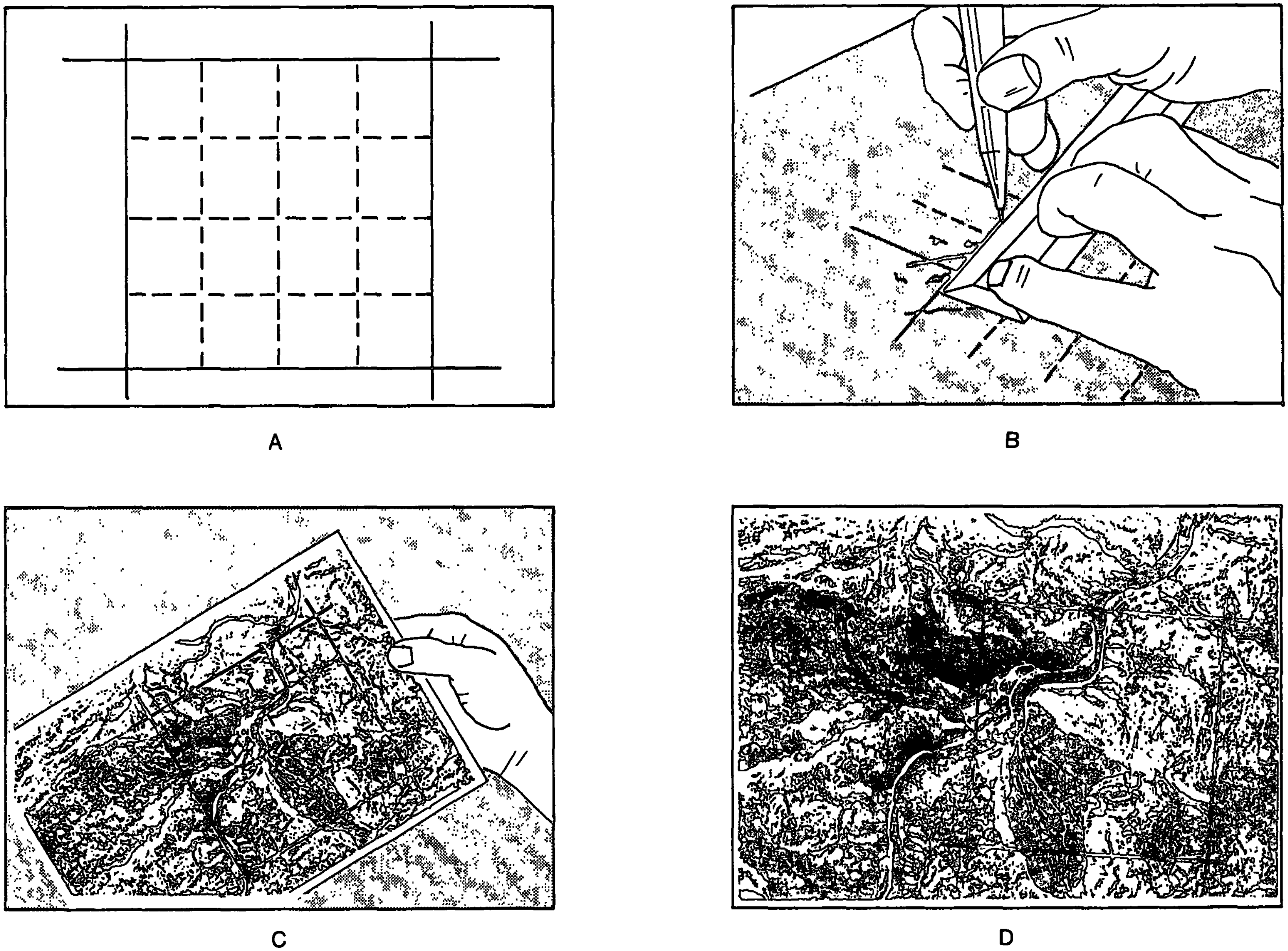


Figure 7-8.--(A) Make a grid on transparent film with 1 mile plotted at the same scale as the photograph. (B) Plot the calls from the notes onto the film at photo scale. (C,D) Slide the calls, as plotted onto the grid, around on the photograph to get the best possible fit at each corner in turn.

Unit 8
Example Field Situations

EXAMPLE FIELD SITUATION

Situation

Corner A in figure 8-1 was recovered. The fence lines were presumed to be constructed on or near the true line. Search areas were established on prolongations of both fences. No corner was recovered; therefore, an effort to recover the spring was made (note the access route). The spring was recovered and, by following the calls in the field notes, the corner was found.

Point

Field personnel in their search for corner monuments frequently are misled by improvements they assume have been placed on or near the true line. This is especially true of fences. A good deal of time is expended through this process. A thorough examination of the field notes and plat will often reveal sound evidence to search for. This evidence will often lead to the corner monument itself.

Conflicting Evidence

The private surveyor may interpret evidence differently. Figure 8-3 contains a situation where the surveyor assumed the blazed tree marked the true line. Apparently the random line was blazed. Also, since the original blazed tree agreed with the fence, it was further evidence that the true line was along the fence line. An experienced searcher, with objective and thorough investigation, recovered the original monument west of the private surveyor’s monument.

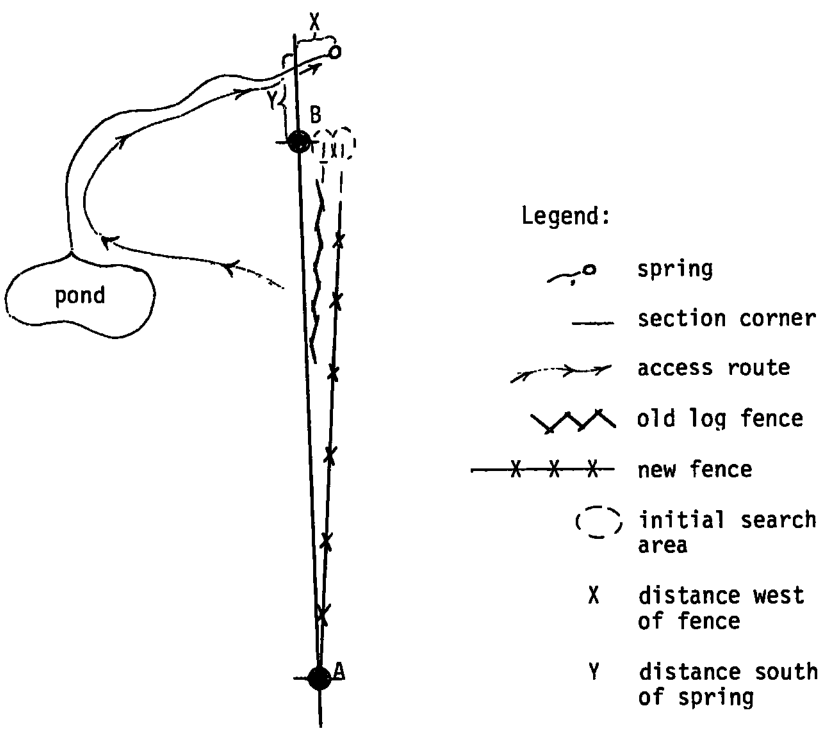
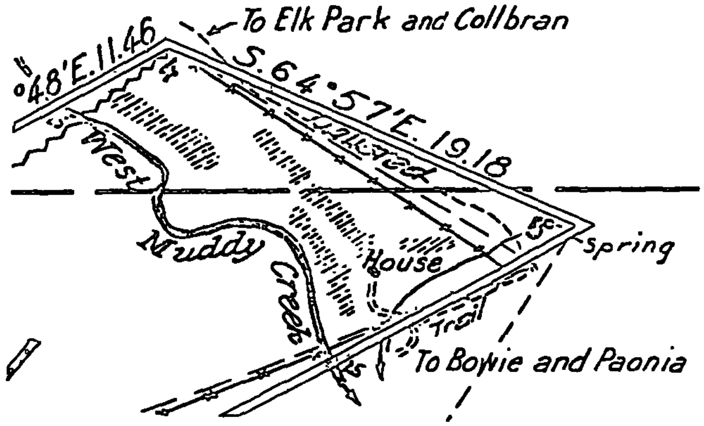


Figure 8-1.--Unreliable evidence versus more reliable evidence as *called for in the survey notes and plat.*



Improvements.

From cor. No. 5 the following improvement is located:

The E. cor. of a frame dwelling
bears S. 79° 07' W., 8.76 chs.
dist., size 24 x 12 ft.
Approximate value, $200.00

Figure 8-2.--Portion of the plat for HES 282 illustrating an actual field situation. A tie to the frame dwelling was noted and although the structure was nearly obliterated, enough remains of the foundation existed to permit recovery of a bearing tree and the mound of stones. The spring, although no longer flowing, provided additional evidence.

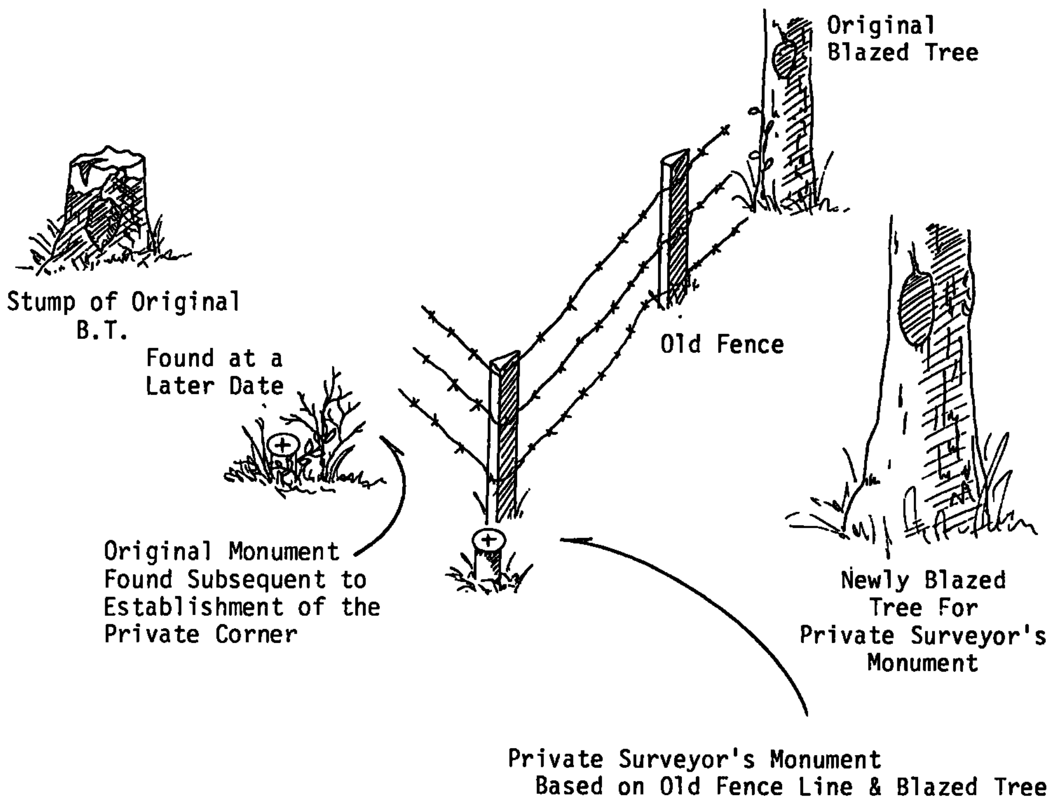


Figure 8-3.--Example of conflicting evidence.

Other patterns may be detected for other areas and surveyors. The corner searcher should remain observant to these personal variations in perpetuation techniques, as they can result in a savings of time.

Point

Accepting and perpetuating a private surveyor’s corner without further investigation can very definitely prove to be a mistake. The evidence should be reported, but in the absence of original accessories, memorials, or monuments, it may not be advisable to erect posts and signs. Doing so confirms the acceptance of the corners by the Forest Service. Any corner that is questionable will be investigated by the Forest Service or BLM cadastral surveyor.

In figure 8-4, the record bearing and distance to the one bearing tree is in conflict with the field measured data. The corner searcher should record this discrepancy and should not attempt to reset the monument. The resolution of the conflict is left to the authorized cadastral surveyor.

Figure 8-5 illustrates what a disturbed monument and accessory may convey. The scattered stones may indicate the approximate original position of the mound of stones. This position, used in conjunction with the record distance, would place the monument as indicated in figure 8-5 by the dashed lines. The broken monument and markings facing away from the claim are indicative of a disturbed monument. All available evidence must be correlated. Again, the searcher’s duty is to report on the corner recovery card any discrepancies noted. It is not the searcher’s duty to move and reset the monument.

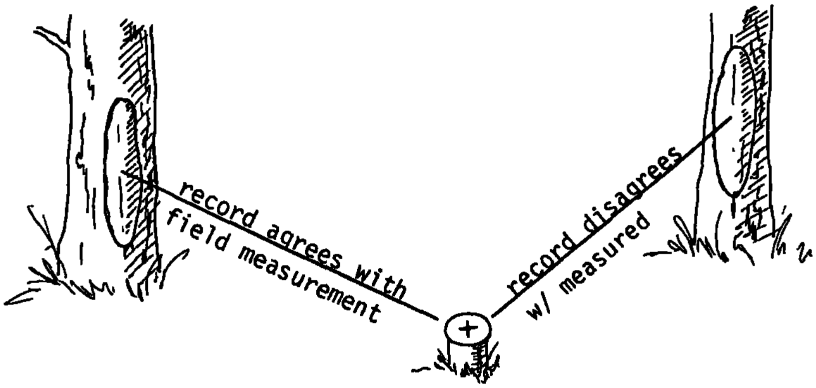


Figure 8-4.--Verification measurements to original bearing trees.

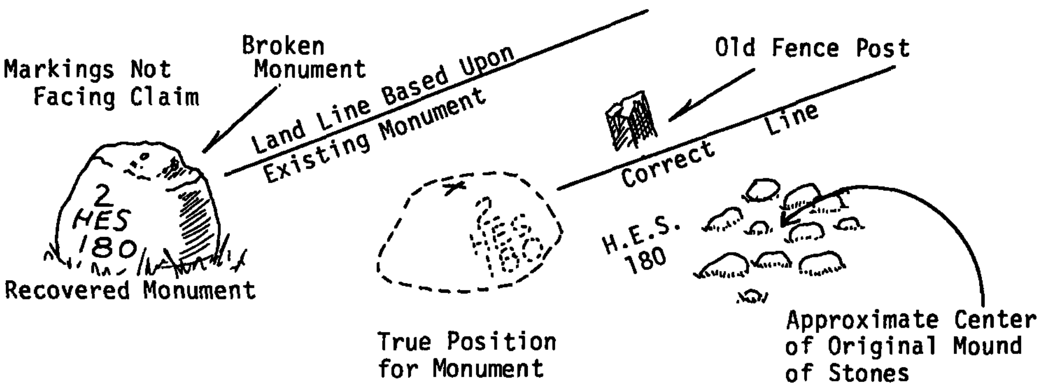


Figure 8-5.--Disturbed original monument.

ERRONEOUS CORNER ACCESSORY FIELD DATA

The corner searcher must remain objective to any alternate search areas. For example, assume that one of two bearing trees in figure 8-6 has been recovered. An initial search area was determined, but the corner monument was not recovered.

Search area A yielded no found monument. However, the search was not abandoned. Rather, an attempt to determine an alternate search area was made. A possible bearing tree was identified. The second search area B was then located. A persistent and thorough search resulted in the found corner, despite the discrepancy in the field data.

Point

The field situation as outlined above emphasizes the need for objective thinking. The searcher should be constantly alert for errors or blunders that occasionally occur in the field notes.

It also is fairly common for a searcher to fail to recover a monument or other corner evidence as a result of reluctance to expand the search area. These monuments frequently are recovered at a later date by surveyors, landowners, or other interested parties, thereby resulting in serious land ownership problems. Costly litigation may ensue. Any suspected problems or discrepancies encountered by the corner searcher should be reported on the recovery card.

Dynamic Environmental Changes

Field personnel must be alert to stream channel changes and other natural changes. Such dynamic changes may mask the original conditions and mislead the searcher. Again, objective thinking and a “detective” mind is required. Springs dry up; rivers erode their banks (often at alarming rates); ice action can result in rapid changes; mud slides or other erosional factors destroy or conceal monuments and corner evidence. The searcher who is aware of such natural dynamics will recover corner monuments with greater frequency than a searcher who fails to recognize such changes or actions. The field notes may appear erroneous where the environmental conditions have changed.

Situation

Figure 8-7 illustrates a situation where persons have reestablished or perpetuated corners erroneously. There have been occasions where a claim owner placed his assumed “lost” corners where he thought was the best position. He may have had the original field notes and possibly marked bearing trees as called for in the notes. Surveyors might then perpetuate such corners. An isolated corner search may not detect that something is incorrect, as the accessories appear to be the true and original ones. A retracement survey normally is required to resolve these survey situations.

In figure 8-7, there actually were three corner monuments in the vicinity of corner 4. Only one of the two bearing trees at corner 3 fit the date of the original tree. Retracement survey permitted recovery of the original mound of stone and rotted post monument. At this point, other supporting evidence was sought.

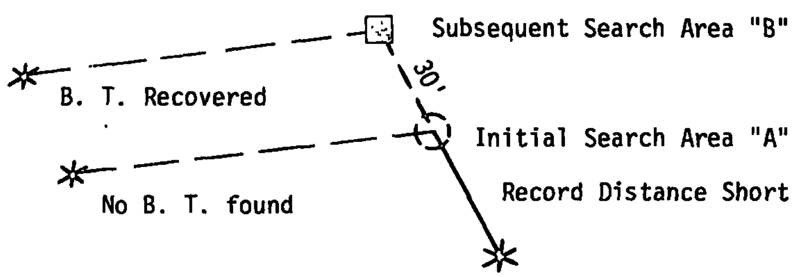


Figure 8-6.--Erroneous field data. Original field notes may contain inaccurate data.

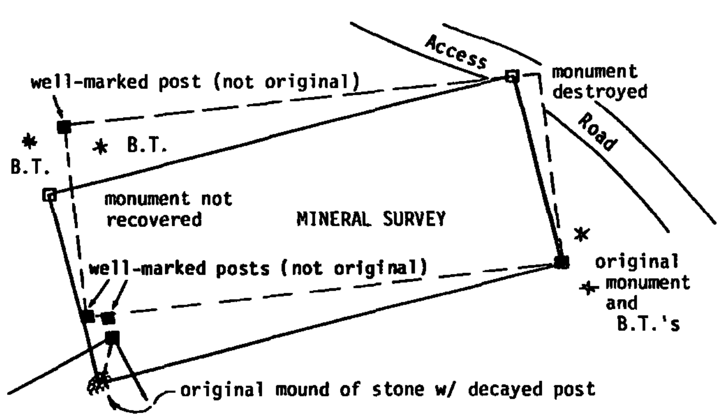


Figure 8-7.--Example of erroneously perpetuated corners.

This included topographic calls, discovery pits, and actual coring of bearing trees for dating. The “closest and best” tie to a nearby mineral survey corner (another claim) also was weighed in the final resolution of the proper corners.

Point

Blind acceptance of corners without a supporting retracement survey can lead to the acceptance of erroneous corner monuments. Posting and signing such corners can create difficult situations.

Situation

For this example, consider the condition where topography can provide a sound basis for the search area (see figure 8-8). Topographic calls were not always estimated or recorded from memory. Many were very accurately measured and recorded. The firmly entrenched stream may be a sharp contrast in accuracy to the meandering stream. The cliff is a well-defined feature. The west section line has been retraced and the distances are compared with the record. A greater weight often is given to the well-defined features. The orientation of the meandering stream can yield a large number of solutions.

If the search positions do not result in found corner monuments, the topographic calls in conjunction with other possible evidence may be used in reestablishment of corners. One should be alert to the fact that topographic calls may fit quite well a good distance away from the mapped position of a section or township line. Corner monuments have been found up to a mile away from the map position.

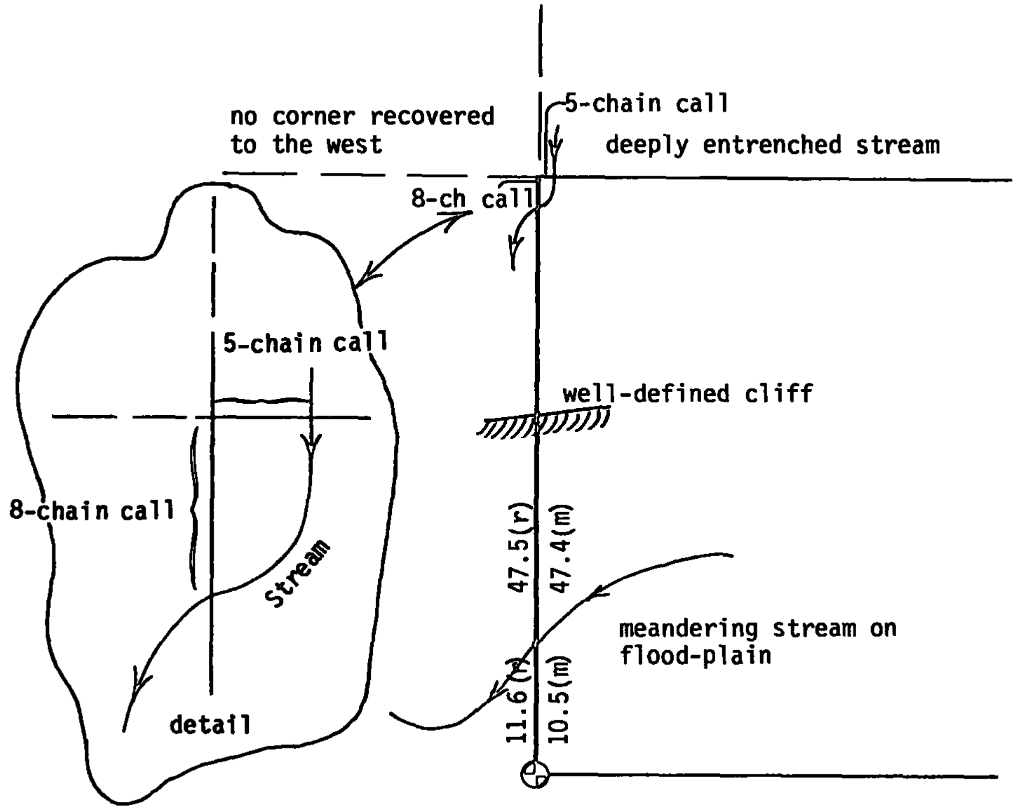


Figure 8-8.--Topography as a basis for a search area. Topographic calls may fit very well in vicinity of a found corner. However, it may deteriorate as one proceeds away from existent corners. This fact may be indicative that only selected corners were monumented.

Unit 9
Equipment & Materials

EQUIPMENT

Certain materials and equipment are needed for any type of corner search, including random corner search. Construction may threaten a corner, and corner recovery may permit referencing or protection. This may be accomplished only if the proper equipment is available to the field personnel. The various pertinent signs, tags, and recovery cards may be included in the side pocket or utility box of the vehicle. The following is a comprehensive list of items necessary for a corner search. Please note that this list applies to full-time corner searchers. Others can select those few essential items, such as location posters, quad maps, plats, recovery cards, flagging, and so on.

(1) Forest Service maps and U.S. Geological Survey quadrangle maps.

(2) Recent aerial photographs. These can serve as an up-to-date map, especially in developed or timbered areas.

(3) Copies of the original GLO or BLM field notes and plats. These may be obtained directly from the BLM or indirectly through the Forest land surveyor.

(4) Copies of any resurvey field notes and plats completed by the BLM, other Federal agencies, or private surveyors. County surveyors should be visited.

(5) Corner card, Form 7100-50, should be available in every vehicle, as well as in the field pack or notebook.

(6) Forest Service land line signs and tags, including bearing tree tags, location posters, and land survey monument signs. Standard red posts also are handy. Poppy-red (orange-red) posts have superior visibility.

(7) Corner search diagram and corner recovery cards. Frequently field projects fall within an area where previous corner search was performed. By thoroughly checking the record, much time can be saved.

(8) Other field equipment that may prove convenient, including a cutting tool, compass (with declination setting), USGS 1:24,000 scale, pencil, stereoscope, nails (galvanized), hammer, sledge, tape (loggers’ 100-foot and 25-foot, graduated in feet and tenths of feet), tally meter (for counting 100 units of pacing), pedometer (a device for pacing), and/or a hip chain or Walktax distance measurer, paint, and flagging. For those whose duties involve extensive corner search, other specialized equipment includes a scribe tool for bearing tree marking, map wheel (measurer), increment borer, bark knife, roofer’s hatchet. A Sanvic is a superior cutting tool.

Field personnel may stumble across a corner monument by accident. Corner search and perpetuation may not be their primary duties, but if properly equipped, they can accomplish some valuable work in a few minutes time. For example, a Forest Service location poster may be nailed to a tree and a corner card filled out in a very short time. Validation of such corners can be conducted by a cadastral surveyor.

RECORDS & SOURCES

Adequate records should be obtained before any field work is begun. Monuments have been recovered in the absence of plats and notes, but confusion more often is the result of this approach. The following are possible records and contacts that may be helpful to the corner searcher:

(1) Original GLO or BLM plats and notes.

(2) BLM resurvey plats and notes with tract segregations.

(3) Private surveyor plats and notes.

(4) Highway department and other State agencies’ survey plats and notes.

(5) Remonumentation notes.

(6) Recovery cards and maps.

(7) District personnel, including rangers.

(8) Landowners (for access, testimony, and corner information).

(9) County surveyors.

(10) County clerks and records and abstractors.

(11) Other Federal agencies, including the U.S. Geological Survey, Corps of Engineers, National Park Service and Water and Power Resources, National Geodetic Survey (USC and GS).

(12) Realtors.

(13) Airport managers (who may be aware of recent airport surveys).

(14) County Commissioner meeting minutes and proceedings.

Before conducting a corner search involving private lands, it is very important to contact the District Offices and inform them of your intentions. They can arrange access and permission and can inform you of any problems that may be encountered.

Unit 10
Corner Point Photoidentification

CADASTRAL PHOTOIDENTIFICATION

Photoidentification of corners shall be performed in accordance with the following three methods:

(1) Direct Identification. A “direct” identification is acceptable provided the station is at the edge of, or constitutes a portion of, the image pricked. When the corner to be located is a distinct physical object that can definitely be seen on a photograph, such as a fence corner or road intersection, the field work consists of accurately pricking the image on a photograph and labeling it. A sketch also is most valuable for subsequent users.

(2) Precise Identification. When the corner to be located is not definitely visible on a photograph, nearby objects that are positively identifiable on a photograph will be selected, pricked, labeled, and tied by accurate bearing and distance measurements. It is preferable to select two or more substitute stations and make the measurements from each; however, in rare cases, one substitute station will suffice. The bearing and distance must be measured from the corner to the image point by two independent pointings. If a compass is used to determine the bearing, a minimum of two substitute stations must be observed. Compass bearings will be used only when the image point is less than 100 feet from the corner.

(3) Reference Measurements. When it is impractical to obtain a bearing for the location of a substitute object, the identification may be made by reference measurements. In this method, the horizontal distances will be measured from the actual point to three or more substitute objects identified and pricked on the photography so that the point position can be plotted from the intersection of arcs. The horizontal distance between two of the substitute objects also must be measured so the local scale of the photograph can be determined. The points should be nearly in the same horizontal plane and they should intersect at angles not less than 30 degrees. Note: this method is the least desirable method of photoidentification.

The following precautions should be considered in performing the photoidentification:

(1) Use of the Stereoscope. Accurate station identification requires a stereoscopic study of the photographs at the station site; this provides the best view of the photographs and, consequently, the best selection of well-defined images. Each photoidentified control point is pinpricked and symbolized on one and only one photograph in the field. Each photoidentified point must be able to be viewed in stereo on at least one stereo pair. Since this is critically important, it may be necessary to locate and photoidentify a second control point (another substitute point) in the same area so that at least one or the other will be visible on each of the overlapping photographs.

Photoidentification may be most difficult, if not impossible, in heavy oak brush or timber. Larger scale photos will greatly assist with photoidentification in such areas, but brush or timber may still prevent a dependable identification.

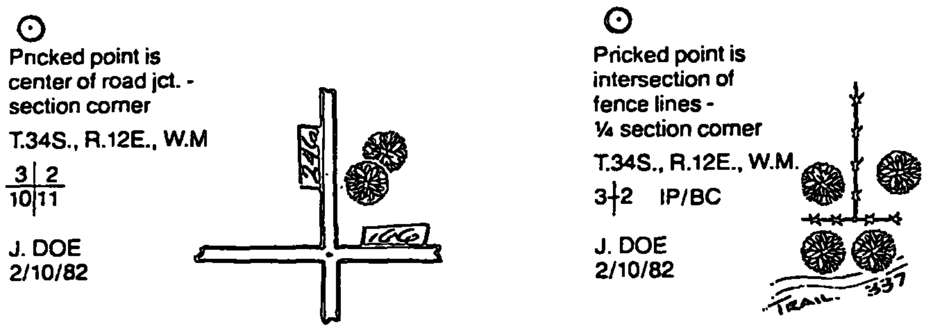


Figure 10-1.--Direct identification of corner.

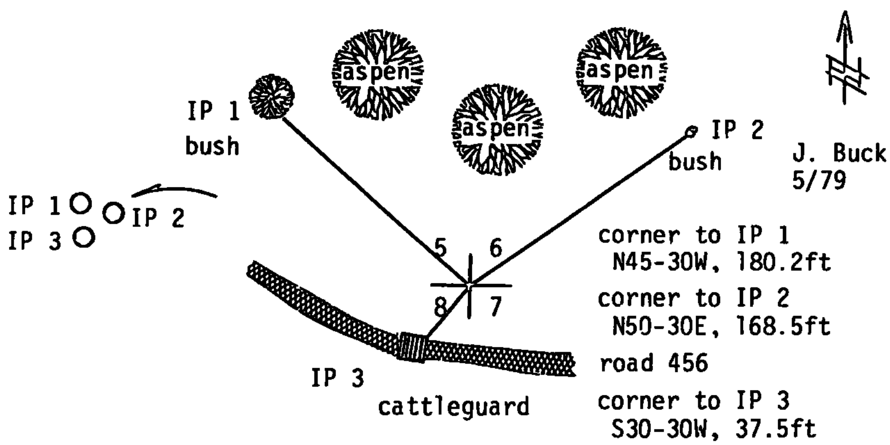


Figure 10-2.--Precise identification of corner.

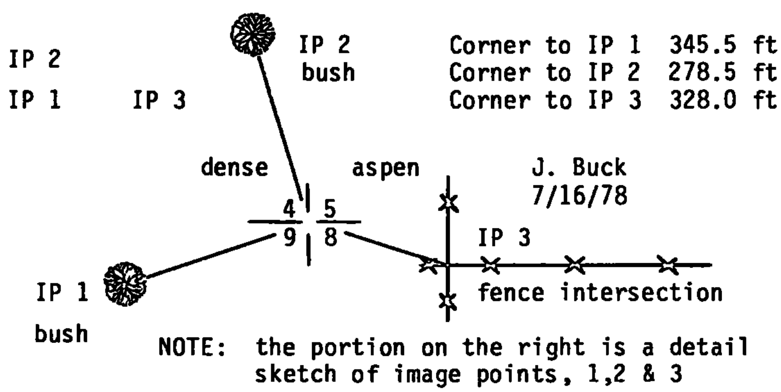


Figure 10-3.--Reference measurements identification of corner.

The reference measurement method may be applicable for these situations. If positive identification is not feasible, then the corner should not be identified. It will only result in confusion in the future.

(2) Station and Image Point Identification. Once the ground object is positively photoidentified, it should be pinpricked on the photo having the clearest image of the object. The photo image of the station or its substitute station is indicated by a fine point pricked on the photograph. Pinpricking is done with a fine sharp needle. This operation is always done under a stereoscope; the magnification permits small detail to be seen, and the three-dimensional

view makes it much more certain that the image point pricked is the exact point intended. The needle should penetrate the photographic emulsion and only partially through the paper backing. It should not penetrate completely through the photograph emulsion. This method of pinpricking produces a fine, precise mark that does minimum damage to the image itself and the surrounding imagery. When a pinprick is properly done, it is barely visible to the naked eye, and the picture must be held up to a bright light for it to be seen clearly. Enlarging or “skidding” the prick mark or making a confusion of several prick marks is not acceptable work.

The pinprick should then be enhanced with a circle 1/4 inch in diameter or larger. The circle should leave an area of unobscured imagery around the pinprick. A concise description of the image is then written on the back of the photo. The description should leave no doubt as to the location of the image being described. Terms such as “left” and “right” should not be used; cardinal directions (N, S, B, W) should be used instead. If other similar images appear nearby, the description must identify the one selected.

The position of each identified point should be shown by a sketch on the back of the photograph. Show date and by whom identified.

(3) Image Point Types Selection. Image points may serve as horizontal control, vertical control, or both. In any case, the image should appear as a precisely defined point on the photograph. This is most important for horizontal images. Depending on the scale of photography, different objects will serve this purpose. The 1:24,000-scale resource color photos present some difficulty in image point identification. These may be used in conjunction with the older 1:15,840 aerial photographs (if available), provided the terrain and vegetation has not changed to any great extent. Color infrared photos are very usable for this work but may not be available. Identification of the image point must be certain, otherwise the point should not be used. A wrong identification will often result in hours of frustrating search. Care should be taken to note which point was pricked, for example, the center of a tree base. The following are criteria to be used in the selection of image points:

(a) Identifiable with certainty.

(b) Small but clearly defined (medium to high contrast).

(c) Medium to high contrast.

(d) Permanence.

(e) Recoverability.

The following are various objects and features usable for image points:

(a) Small bush.

(b) Base of isolated tree.

(c) Sagebrush.

(d) Corner of a larger area of low vegetation.

(e) Stumps.

(f) Irrigation flume and drainage.

(g) Headgates.

(h) End of culvert with road.

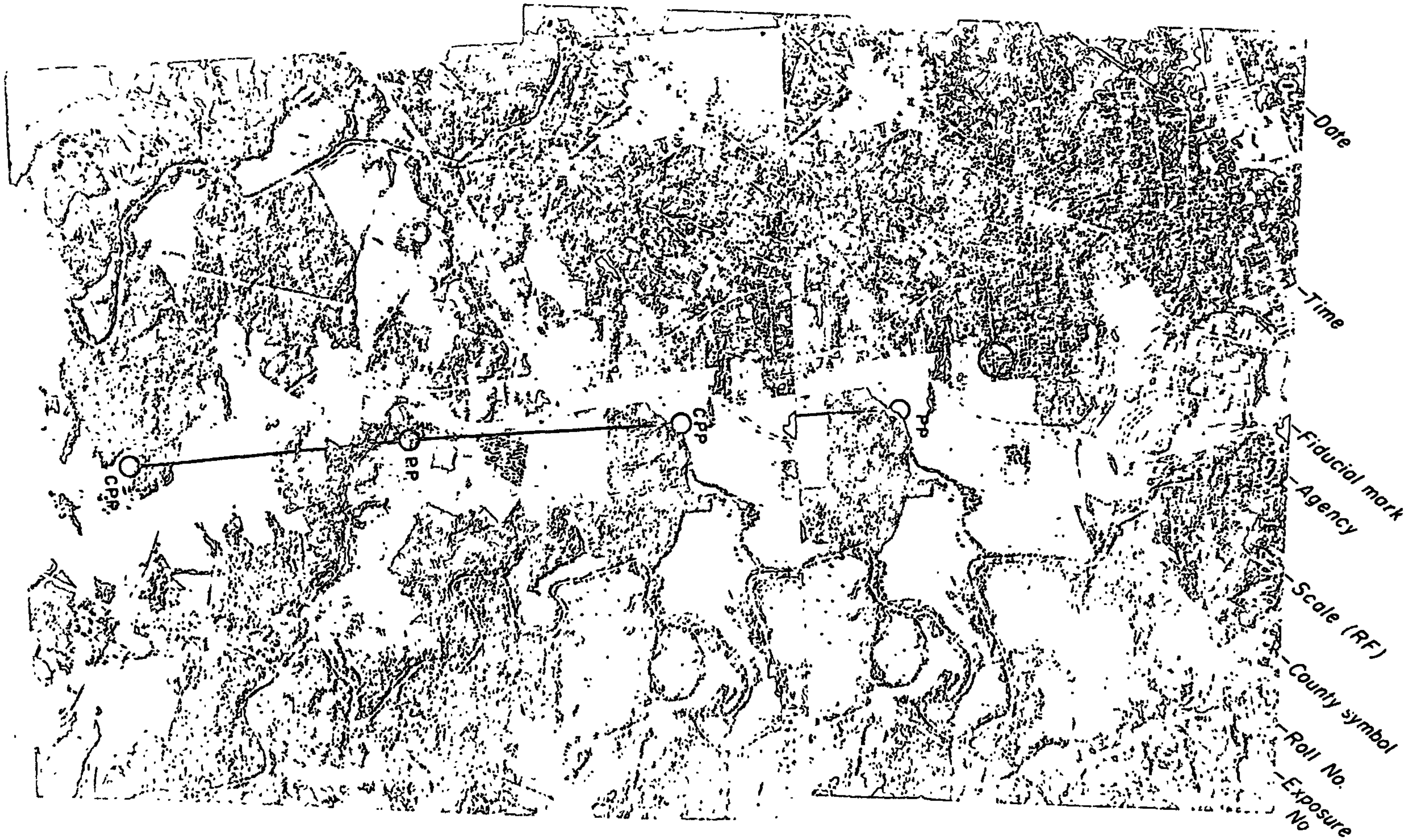


Figure 10-4.--An aerial stereo-pair, from 9-inch by 9-inch contact prints. Note that the print showing the time of day is the last one in the flight line. The principal point (PP) of one photo coincides with the conjugate principal point (CPP) on the overlapping print. The flight path of the aircraft is indicated by the lines connecting the PP and CPP.

(i) Drainages.

(j) Corner of building.

(k) Corner of paved area.

(l) Road junctions.

(m) Fence intersections.

(n) Pavement stripes.

(o) Boulder.

(p) Snag or fallen timber which forms an

(q) Cattleguards.

(r) Signs.

(4) Sources of Error in Photoidentification. Seasonal and manmade changes are contributing sources for misinterpretation resulting in misidentification. The possibility of such changes are always present, and to interpret and correlate the ground appearance properly with the photographs, it is necessary to evaluate any changes that may have taken place between the date of the photography and the time of the field work.

(5) Confirming the Identification. Since it is imperative that the identification be positive, it should be confirmed by a careful and detailed check of the surrounding features. This is done by starting at a point that can be positively identified on the photograph(s). From this point to the point under confirmation, ground features along the intervening route are identified systematically with the corresponding image details by the similarity of their relative positions and by their size and shape and other distinguishing characteristics, taking into consideration differences in scale and perspective between the ground view and that of the aerial camera. Lastly, the identification is confirmed by checking the visible ground features systematically around the horizon with the corresponding image details.

(6) Materials and Equipment. The following are materials and equipment needed for stereoscopic photoidentification:

(a) Aerial photographs of the applicable stereo pair of photos (preferably unlaminated).

(b) Pocket stereoscope for field examination. (Abrahms is a superior instrument equipped with multiple magnification.)

Cc) Mirror stereoscope for office examination (optional).

(d) Hand lens or magnifying glass.

(e) Sewing needle with sharp point.

(f) Rapidograph and India ink.

Cg) Marking pens (for example, Staedtler lumocolor superfine).

(h) Supply of acetate for overlays.

(i) Plastic envelops or case for transporting and protecting photos.

(j) Special clip board (slotted type for viewing the hidden area) for stereo viewing.

(k) Aluminum clipboard with cover.

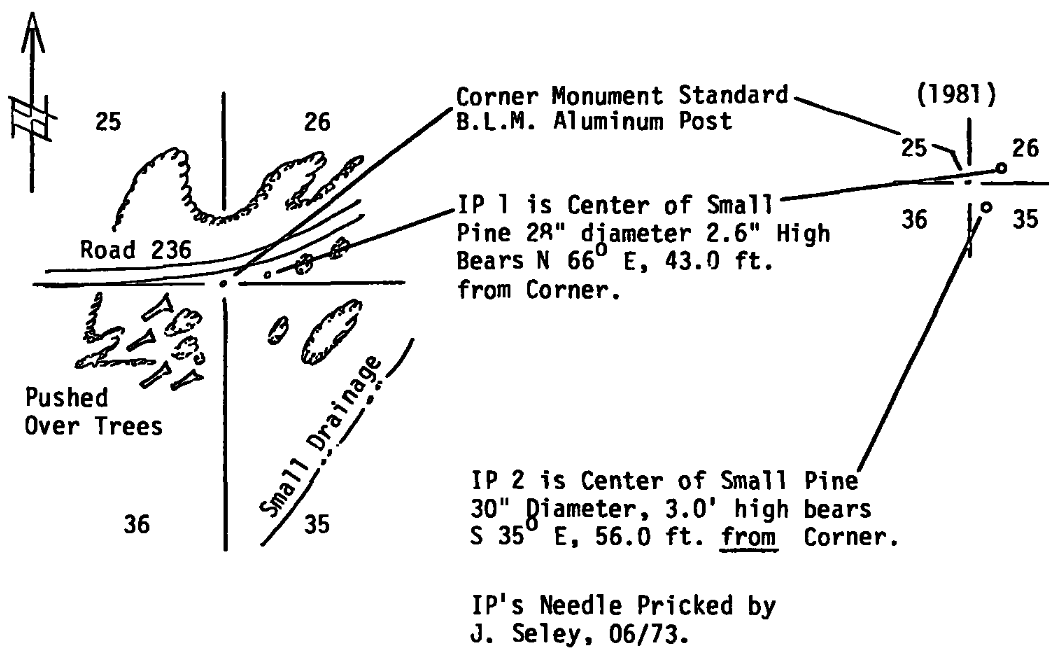


Figure 10-5.--Frequently the corner monument point or monument may not be pricked directly, therefore image points must be selected and photoidentified (pricked). A sketch clearly indicating the relationship between the station and the image points is mandatory. The relationship of the image points to ground features is most critical and is illustrated by the above sketch. Note that the sketch on the left represents a detail of the ground features for the actual photoidentified (pricked) images on the right. If congestion is a problem, sketches may be placed on copies of aerial photographs which may be attached to the original photo.

U. S. DEPT. OF AGRICULTURE
FOREST SERVICE

CONTROL STATION IDENTIFICATION

STATION	STATE	COUNTY
Give name stamped on tablet	Self explanatory	Self explanatory

OBSERVED BY	PARTY CHIEF	ORDER
Self explanatory	Self explanatory	Self explanatory

MAP	PHOTO NO.		DATE
Give sheet name or S.E. coordinates	Symbol & Photo No.		

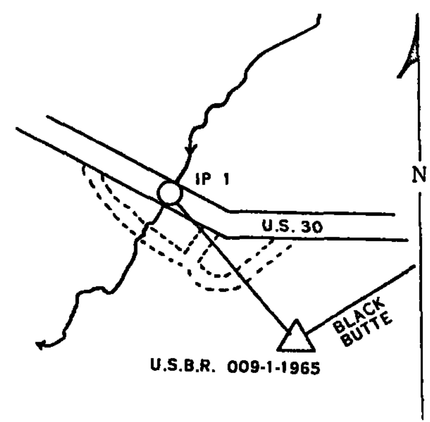
DESCRIPTION OF IMAGE PT. 1

EXAMPLE

Image point is centerline of highway where it crosses stream.

IMAGE POINT 1

EXAMPLE



INFORMATION REQUIRED-IMAGE PT. 1.

INST. STATION	Name of station occupied	
AZ. STATION	Name of AZ. station & agency	
∠ To Station	Clockwise angle to IP	
DISTANCE	Feet	Meters

DESCRIPTION OF PT. DIRECTLY IDENTIFIED OR IMAGE PT. 2

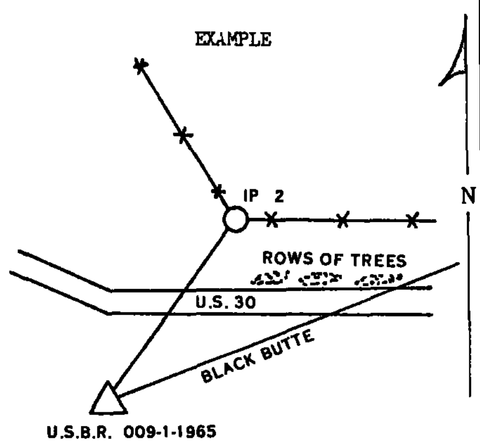
EXAMPLE

Image point is corner fence post.

Approximately 35' North of the center of highway.

IMAGE POINT 2

EXAMPLE



INFORMATION REQUIRED-IMAGE PT. 2.

INST. STATION	USBR 009-1-1965	
AZ. STATION	BLACK BUTTE (USGS)	
∠ To Station	321° 15' 21.6"	
DISTANCE	Feet 97.8	Meters

Form 7100-76 Mar. 1968

Figure 10-6.--Example of Form 7100-76 available for those who desire to use it. The form permits organization of data and a permanent record.

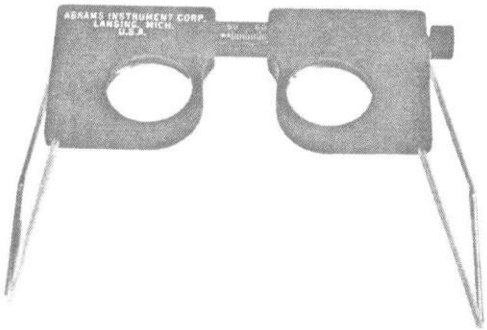


Figure 10-7.--Lens stereoscope. Accurate station identification requires a stereoscopic study of the photographs at the station site; this provides the best view of the photographs and consequently the best selection of well-defined images. A magnifying glass can be useful for the preliminary study of the photographs.

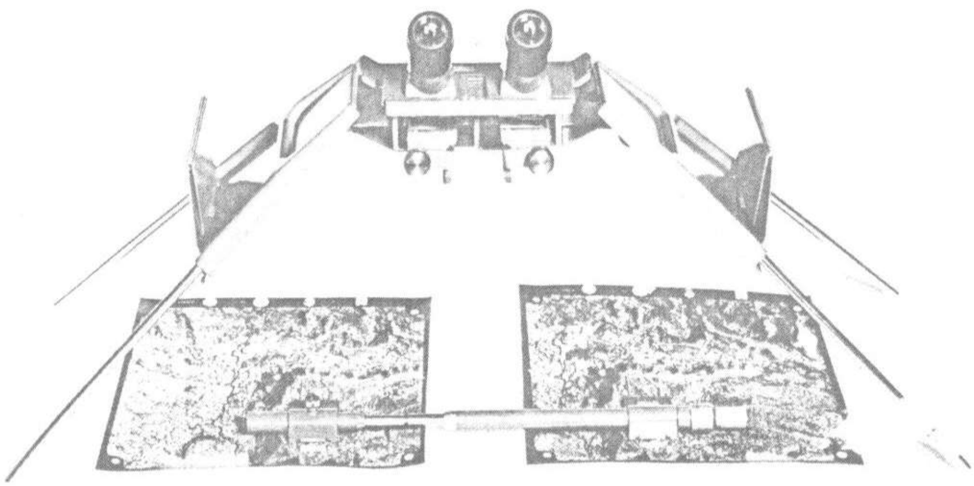


Figure 10-8.--Modern mirror stereoscope with inclined magnifying binoculars. Positioned across the *two photographs is a parallax bar (stereometer) for measuring heights of objects. (Courtesy of Wild-Heerbrugg Instruments, Inc.)*

Figure 10-9.--Sketchmaster which is used primarily for transferring detail from aerial photographs to map sheet.

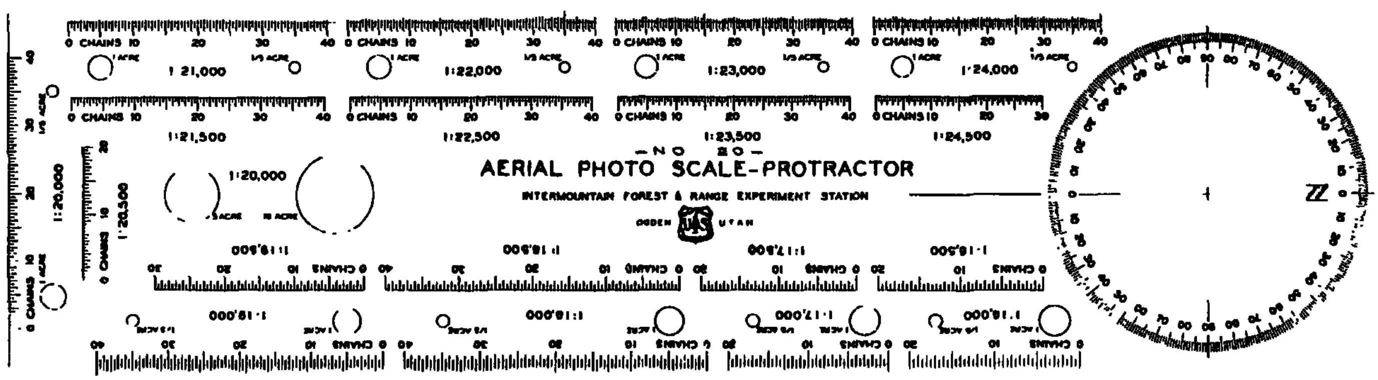


Figure 10-10.--Aerial Photo Scale-Protractor. This protractor is useful when using photographs with different scales and may be available through the Intermountain Forest and Range Experiment Station, 507 25th Street, Ogden, Utah. A similar scale without the protractor is available through Photogram, P.O. Box 46, Maupin, Oregon. The above *offices may be contacted for specific information. A photo-map scale is also available through the U.S. Geological Survey. Still other scales and combination scales/protractors are available commercially.*

Unit 11
Field Notes & Plats

SURVEY FIELD NOTES

Survey notes are the written record of a survey. They describe the direction and distance the survey lines are run, the nature of the vegetation and terrain, the type and size of monuments set to mark the survey, and the general features of the area surveyed. Some of the older survey notes also include information about unusual problems encountered and special interest items such as Indian raids, storms, mineral occurrence, springs, and natural phenomena. Survey notes are transcribed from the daily notes recorded during the survey and become the official notes when they are accepted and approved by the authorized BLM official.

The survey notes provide the information necessary for preparing the plat of survey, and together they form the completed official record upon approval.

In addition to being used to prepare the plat of survey, the field note record is used to locate specific land areas on the ground. The notes contain a written description of lines surveyed and of the identifying items needed to find the corner monuments of the survey.

In the left-hand margin are the distances (chains) from the last established corner. Rectangular corners normally were established at the 40- and 80-chain distances.

The field notes and plats are considered the primary records of any survey. For this reason they serve as the basis for any and all corner searches.

Evidence of original marks shall agree with the record in the field notes of the original survey, subject to natural changes. For example, blazes on bearing trees may have decayed or overgrown, or pits may have filled in. Topographic calls may not always agree with the actual field topography. There are occasions where the field notes are fraudulent (developed in the office tent).

Field notes are available upon request from the Forest Service Land Surveyor, provided ample lead time is allowed. Once a project area is firm, the forest personnel should request the plat and notes for the specific area.

Field notes usually contain topographic calls. As the surveyor traversed the line, the distances were recorded to selected topographic features including streams, ridges, and so on. The nearer the call is to the corner position, the less likelihood of error in relationship. A call for a rock ledge on line at 6 chains is more definable than a ridgetop at the same distance. The more distinctive the feature, the more definable it is.

Ties to auxiliary points (such as mining claims, homesteads) can be useful if the ties are on the section line intersection with the claim line. For example, Corner 1 MS 955 bears N 730 E -5.56 chns" is a call that can fix the positions of a line better than A ridge bears west approximately 18 chns. The former call is measured to a point; the latter is estimated and ill-defined.

SUPPLEMENTAL PLATS

During the records search, there may be a tendency for the field personnel to overlook a supplemental plat. Since these represent many months of work, this can be costly. The corner searcher or surveyor should be extremely thorough in his or her search of records.

17.00	Foot of ridge brs. N.W. and S. E.
40.00	Set a granite stone 13, 9, 7 ins. 10 ins. deep for 1/4 sec cor. marked 1/4 on W face and raised a mound of stone. Pits impracticable
80.00	Set a granite stone 15 x 10 x 6 ins. 10 ins deep for cor. to secs. 7. 8. 17 - 18. marked with 4 notches on S. and 3 on E. edges and raised a mound of stone. Pits impracticable.
	Land rolling.
	Soil. 2nd. rate.
	Veg. grass and sage.
	October 3 rd. 1882.
	East on a random line bet. Secs. 8 and 17.
	Va. 17° 25' East.
12.00	Fort Washakie and Rawlins. wagon road brs. N. 30° W. and S. 30° E.
16.00	Fort Washakie and Rawlins. Telegraph line brs. N. 30° W. and S. 30° E.
22.00	Draw 20 lks. wide descends N. 15° W.
40.00	Set a stone for temp. 1/4 sec. cor.
79.92	Intersect N. and S. line 8 lks. N. of cor. to secs. 8. 9. 16 - 17. Thence I run N. 89° 57' W. on a true line bet. Secs. 8 and 17. with same variation.
39.96	Set a granite boulder 14 x 9 x 6 ins. 10 ins. deep for 1/4 sec. cor. marked 1/4 on N. face, and raised a mound of stone. Pits impracticable.
79.92	The cor. to secs. 7. 8. 17 - 18.
	Land rolling.
	Soil 2 nd. rate.
	Veg. grass and sage
	West on a random line bet. Secs. 7 and 18.
	Va. 17° 25' East.
15.00	Enter river bottom brs. N. E. and S. W.
20.00	To the S. E. cor. of Mr. Tillie's claim.
40.00	Set a stone for temp. 1/4 sec. cor.
44.90	Little Popo Agie river 50 lks wide runs N. E.

Figure 11-1.--Handwritten field notes of an original cadastral survey in Wyoming (1882).

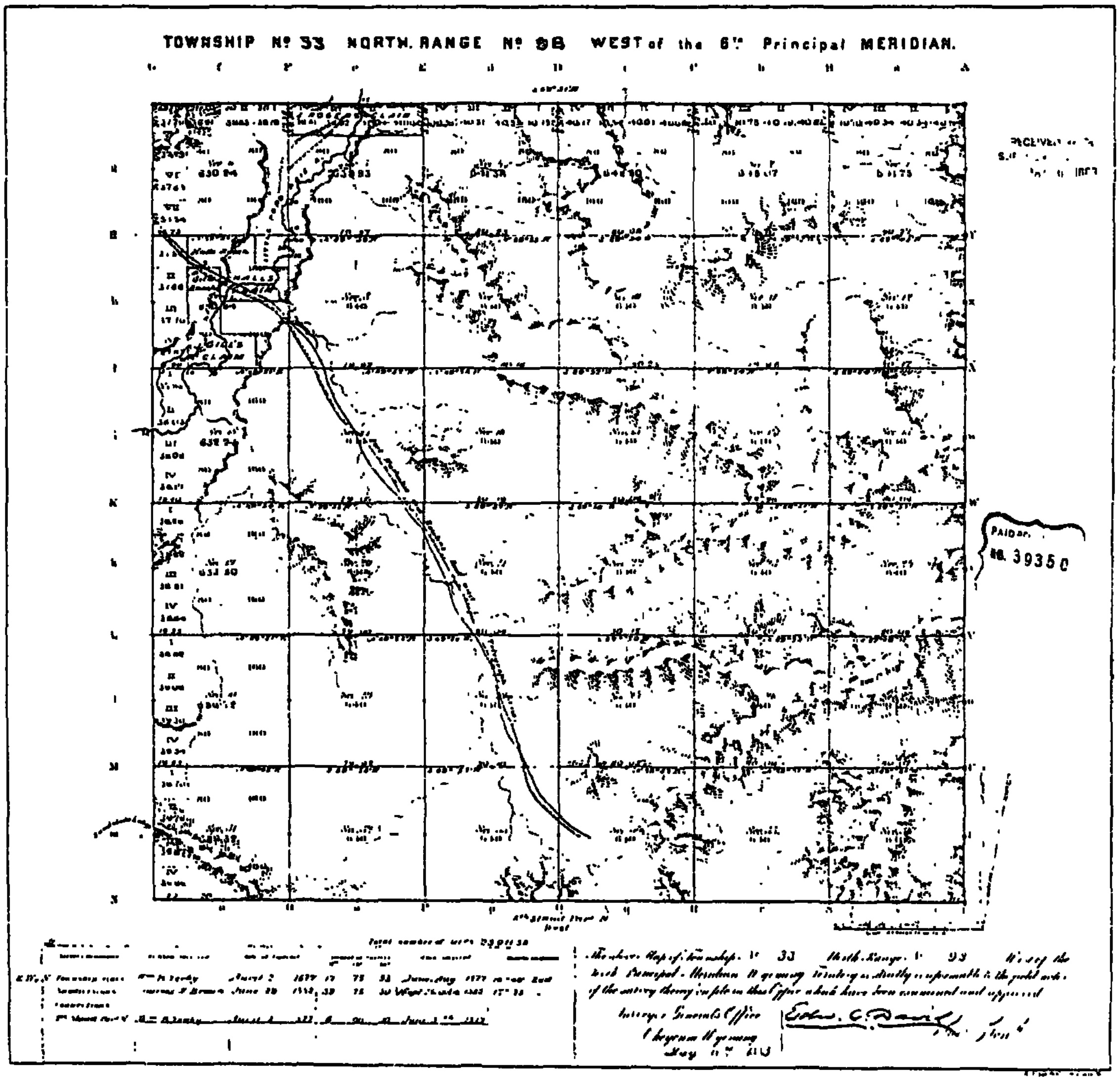


Figure 11-2.--Original survey plat of a Wyoming township.

SPECIMEN

FIELD NOTES

OF THE SURVEY OF THE

THIRD STANDARD PARALLEL NORTH

ALONG THE SOUTH BOUNDARY OF TOWNSHIP 13 NORTH,

THROUGH RANGES 21, 22, 23, AND 24 EAST;

THE SIXTH GUIDE MERIDIAN EAST

THROUGH TOWNSHIPS 13, 14, 15, AND 16 NORTH,

BETWEEN RANGES 24 AND 25 EAST;

AND THE

WEST AND NORTH BOUNDARIES OF

TOWNSHIP 13 NORTH, RANGE 24 EAST.

(Note: Remainder of title omitted.)

Figure 11-3.--Sample field notes.

3d Stan. Par. N., S. Bdy. of T. 13 N., R. 21 E., ____ Mer., (State)

CHAINS

A yellow pine, 10 ins. diam., bears N. 64½° E., 48 lks. dist., mkd. ¼ S31 SC BT.

A blue spruce, 8 ins. diam., bears N. 11¼° W., 127 lks. dist., mkd. ¼ S31 SC BT.

46.50 Enter clearing, edge bears N. 35° E. and S. 35° W.

47.00 Road, dirt, 25 lks. wide, follows edge of clearing.

58.00 SE cor. of cabin, 20 x 10 ft., bears North, 16 chs. dist., long side bears E and W.

63.50 Enter heavy timber, edge bears N and S.

80.00 Point for the stan. cor. of secs. 31 and 32, on the secant.

Set an iron post, 28 ins. long, 2½ ins. diam., 24 ins. in the ground, with brass cap mkd.

SC
T 13 N | R 21 E
S 31 | S 32
1972

from which

A yellow pine, 9 ins. diam., bears N. 31 3/4° E., 22 lks. dist., mkd. T13N R21E S32 SC BT.

A yellow pine, 8 ins. diam., bears N. 67° W., 114 lks. dist., mkd. T13N R21E S31 SC BT.

Land, gently rolling.
Soil, loam.
Timber, yellow pine and blue spruce, with some juniper; no undergrowth.

East, on the S. bdy. of sec. 32, on a transit line describing the secant, which bears N. 89°58.7' E.

Over rolling land, through heavy timber.

12.00 Begin descent of 60 ft. over NE. slope.

18.40 Turkey Creek, 20 lks. wide, course S. 50° E.; asc. 175 ft. over broken SW slope.

40.00 Point for the stan. ¼ sec. cor. of sec. 32, South 1 lk. from the secant, falls on a sandstone boulder, 7 x 5 x 2 ft. above ground.

Set a brass tablet, 3¼ ins. diam., 3½-in. stem, in drill hole in boulder, with top mkd.

SC
T 13 N R 21 E
¼ S 32
1972

from which

A juniper, 8 ins. diam., bears N. 33¼° E., 22 lks. dist., mkd. ¼ S32 SC BT.

A juniper, 11 ins. diam., bears N. 84½° W., 192 lks. dist., mkd. ¼ S32 SC BT.

Form 9180-7 (October 1964) (formerly 4-47...) USDI—BLM

FIELD NOTE PAPER

Figure 11-3. (cont.)--Sample field notes.

CHAINS

The Third Standard Parallel North, through Range 20 East, was surveyed by Joseph P. Smith in 1884. The Fourth Standard Parallel North, through Range 24 East, was surveyed by John C. Collins in 1887 and was resurveyed by Andrew Porter in 1906.

The following field notes describe the survey of the Third Standard Parallel North along the south boundary of Township 13 North, through Ranges 21, 22, 23, and 24 East; the Sixth Guide Meridian East between Ranges 24 and 25 East, through Townships 13, 14, 15, and 16 North; and the west and north boundaries of Township 13 North, Range 24 East.

The survey was executed in accordance with the Manual of Surveying Instructions, (Year), and Special Instructions for Group No. ____, (State), dated ________________.

The directions of lines refer to the true meridian as determined by observations of Polaris, projected by fore- and backsights. Standard lines were chained twice, and the mean of the measurements is given in the field notes.

The geographic position of the standard corner of Tps. 13 N., Rs. 24 and 25 E., as scaled from the quadrangle map, "SHEEPSHEAD ROCK," published by the Geological Survey in 1963, is as follows:

Latitude 36° 59.6' N.   Longitude 104° 38.3' W.

The mean magnetic declination is 18° 10' E.

Third Standard Parallel North, on the South Boundary of T. 13 N., R. 21 E., ____ Meridian, (State)

Beginning at the stan. cor. of Tps. 13 N., Rs. 20 and 21 E., monumented with a granite stone, 12 x 10 x 8 ins. above ground, firmly set, mkd. SC 13N on N, 20E on W, and 21E on E face, from which the original bearing trees

A yellow pine, 10 ins. diam., bears N. 10° E., 30 lks. dist., with healed blaze.

A yellow pine, 18 ins. diam., bears N. 25° W., 50 lks. dist., with healed blaze.

East, with the establishment of the 3d Stan. Par. N., on the S. bdy. of sec. 31, T. 13 N., R. 21 E., on a transit line describing the secant, which starts from a point 4 lks. South of the Tp. cor., and bears N. 89° 58' E.

Over gently rolling land, through scattering timber.

28.10 Enter heavy timber, edge bears NW and SE.

40.00 Point for the stan. ¼ sec. cor. of sec. 31, North 2 lks. from the secant.

Set an iron post, 28 ins. long, 2½ ins. diam., 24 ins. in the ground, with brass cap mkd.

SC
T 13 N R 21 E
¼ S 31
1972

from which

Form 9160-7 (October 1964) (formerly 4-473b) USDI—BLM   FIELD NOTE PAPER

Figure 11-3. (cont.)--Sample field notes.

3d Stan. Par. N., S. Bdy. of T. 13 N., R. 21 E., ____ Mer., (State)

CHAINS	
46.20	Top of sandstone rimrock, 12 ft. high, bears N. 45° W. and S. 60° E.; thence over nearly level land.
55.72	A bench mark of the U.S. Geological Survey, published elevation 7,946.987 ft. above mean sea level, bears South, 5.62 chs. dist.; a brass tablet seated in a sandstone boulder, conforming to the Geological Survey record.
80.00	Point for the stan. cor. of secs. 32 and 33, South 2 lks. from the secant.

Set an iron post, 28 ins. long, 2½ ins. diam., 18 ins. in the ground to bedrock, encircled by a mound of stone, 3 ft. base to top of brass cap, mkd.

SC
T 13 N | R 21 E
S 32 | S 33
1972

from which

A yellow pine, 9 ins. diam., bears N. 43 3/4° E., 27 lks. dist., mkd. T13N R21E S33 SC BT.

A large sandstone outcropping, the highest point of which bears N. 57°35' W., 87 lks. dist., mkd. X BO.

Land, rolling west of creek; level table land above top of slope east of creek.
Soil, rich sandy loam and rocky loam.
Timber, mostly juniper, with some yellow pine and blue spruce; undergrowth, sagebrush.

NOTE. —— The field notes of the survey of the S. bdy. of secs. 33, 34, and 35 continue on the same form, and are omitted. The field notes of the survey of the S. bdy. of sec. 36 have been varied in order to show certain other forms of record.

East, along the S. bdy. of sec. 36, on a transit line describing the secant, which bears S. 89°58.7' E.

Over level land, through dense undergrowth.

40.00 Point for the stan. ¼ sec. cor. of sec. 36, North 2 lks. from the secant.

Set a sandstone, 24 x 10 x 6 ins., 16 ins. in the ground, mkd. SC¼ on N face.

Raise a mound of stone, 4 ft. base, 2 ft. high, N of cor.

45.00 Begin gradual descent.

48.92 Bank of Crystal Lake, bears N. 42° E. and S. 37° W.; point for the meander cor. of sec. 36, North 2.4 lks. from the secant.

Set a sandstone, 27 x 8 x 8 ins., 18 ins. in the ground, mkd.

6 grooves on N,
MC on E, and
6 grooves on W face.

Form 9180—7 (October 1964) (formerly 4—471h) USDI—BLM FIELD NOTE PAPER

Figure 11-3. (cont.)--Sample field notes.

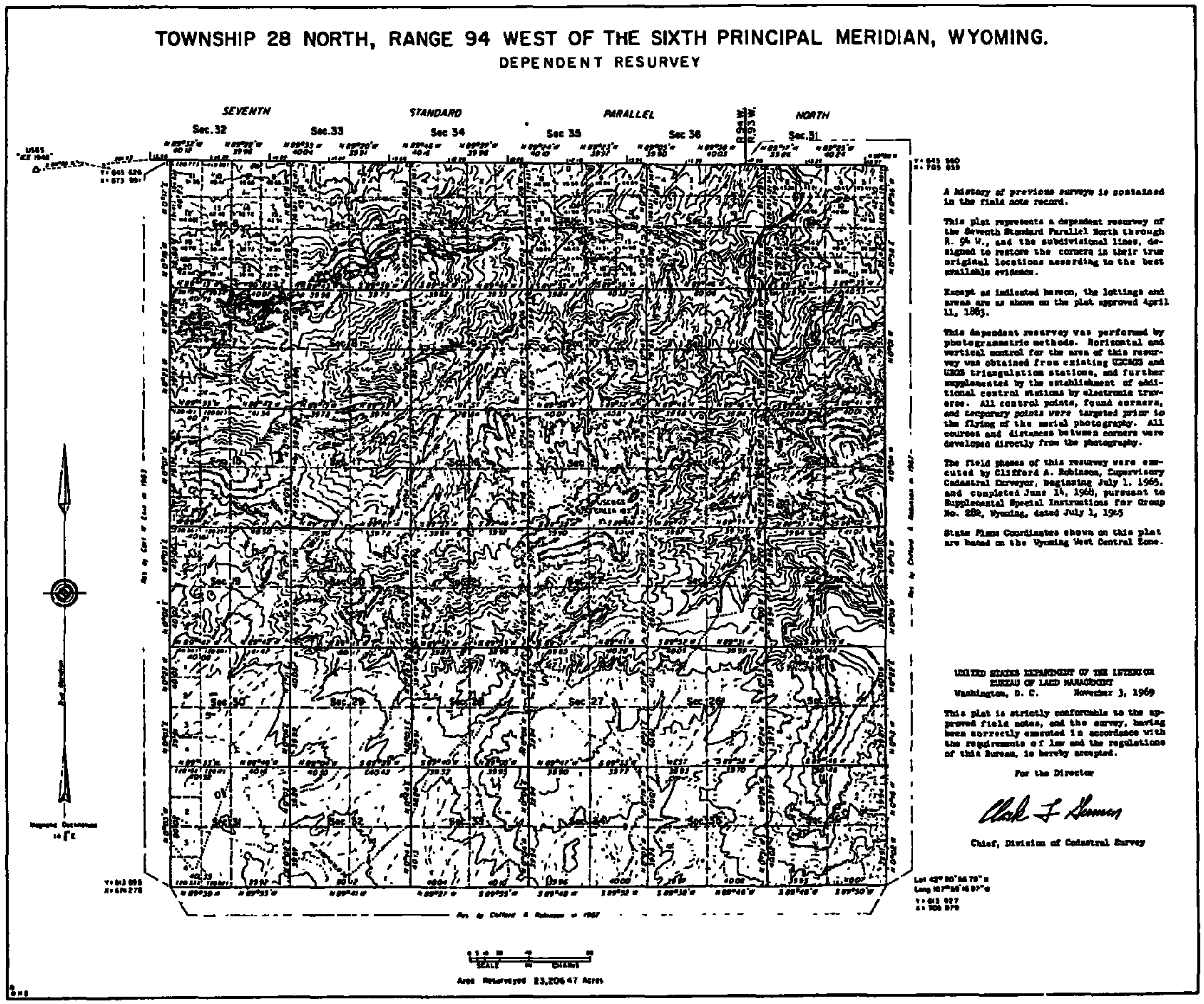


Figure 11-3. (cont.)--Sample field notes.

SPECIMEN

FIELD NOTES

MINERAL SURVEY NO. 20220 A AND B

COLORADO

FIELD NOTES

OF THE SURVEY OF THE MINING CLAIM OF

THE GOLD MINING COMPANY

KNOWN AS THE JIM DANDY, PRINCE, AND

PROTECTOR LODES AND DUMP MILLSITE

Cottonwood Mining District, Chaffee County

Pueblo Land District

Sections 7, 8, 17, and 18, Township 16 South, Range 80 West, of the Sixth Principal Meridian

Surveyed by H.B. SANDS, Mineral Surveyor, under order dated April 9, 1972

Survey commenced May 10, 1972; completed May 14, 1972.

Address of claimant's agent,
John Jones, 561 Foster Building, Denver, Colorado

Dates of amended locations: Protector lode, June 16, 1971; Prince lode, August 10, 1971.

Dates of locations: Jim Dandy lode, July 26, 1932; Dump Millsite, August 10, 1971.

Figure 11-3. (cont.)--Sample field notes.

Form 9180-22
(April 1965)
(formerly 4-691a)

Mineral Survey No. 20220 A and B

FEET

This survey was made with a transit No. , with horizontal limb 5.65 ins. diam., having two double opposite verniers, and full vertical circle 5 ins. diam., having one double vernier; the verniers read to one minute of arc; the eyepiece is equipped with a colored shade set in the dust shutter for making direct observations on the sun. The instrument was in good condition at the time of the survey, and all adjustments were in good order.

All azimuths in this record were determined by the method of deflection angles referred to the meridian determined by the following observation:

May 10, 1972, at Cor. No. 1 of the Jim Dandy lode, in latitude 38°45' N., and longitude 106°20' W., elevation 9,500 ft. above sea level, and temperature 50° F., make a series of six altitude observations on the sun for azimuth at approximately equal time intervals, three each with the telescope in direct and reversed positions, observing opposite limbs of the sun, and reading the horizontal angle from a reference point about 600 ft. southward SE. to the sun.

Mean time of observation, 105th meridian standard time	= 8^h15^m a.m.
Declination of sun at mean time of observation	= 17°45'27.4" N.
Mean observed vertical angle to sun's center	= 37°59'30"
Mean horizontal angle from reference point to sun's center	= 74°10' S-E.
True bearing to reference point	= S. 8°20' E.

The lines were measured with a steel tape 300 ft. in length, graduated every foot for 100 ft., and the remainder at intervals of 10 ft.; and a steel tape 10 ft. in length, graduated to feet, tenths, and hundredths; both tapes were compared with a standard tape at the time of beginning the survey, and found to be correct.

All lines and connections of this survey were run by direct methods where the lines are accessible; the inaccessible lines were run by traverse methods, as shown by the calculation sheets herewith submitted.

The magnetic declination observed at each corner of the survey gave a uniform value of 15°30' E.

Mineral Survey No. 20220 A

JIM DANDY LODE

At Cor. No. 1 of the Jim Dandy lode, identical with Cor. No. 1 of the Prince lode of this survey.

Set a granite stone, 26 x 10 x 8 ins., 14 ins. in the ground to bedrock, surrounded by a mound of stone to top, mkd. JD-1-PRI-1-20220A; from which

The cor. of secs. 7, 8, 17, and 18, T. 16 S., R. 80 W., 6th Prin. Mer., bears S. 55°40' W., 212.5 ft. dist.; monumented with an iron post, 2 ins. diam., 12 ins. above ground, firmly set, with brass cap properly mkd., and with a mound of stone, 3 ft. base, 2 ft. high, W of cor.

(This form bound at top)

Figure 11-3. (cont.)--Sample field notes.

Form 9180-22
(April 1963)
(formerly 4-693a)

Mineral Survey No. 20220 A

FEET	
234.60	Lode line; discovery point bears S. 50°23' W., 1,004.0 ft. dist.
241.90	Intersect line 2-3, M.S. No. 12071 Major lode, at a point from which Cor. No. 2 bears S. 79°00' W., 310.46 ft. dist.
404.50	Intersect line 1-2, M.S. No. 19910 Golden lode, claimant herein, at a point from which Cor. No. 1 bears S. 47°12' W., 620.0 ft. dist.
535.90	Cor. No. 4.
	This cor. falls on a rock slide where a permanent monument cannot be established; from this point Cor. No. 1, M.S. No. 19910 Golden lode, bears S. 59°26' W., 601.9 ft. dist.
	Thence S. 50°23' W.
99.66	A point on top of a granite boulder, 48 x 26 ins., 36 ins. above ground, for witness Cor. No. 4, mkd. X-WC-JD-4-20220A.
612.92	Intersect Cor. No. 3, M.S. No. 19142 I.X.L. lode, established on line 6-1, M.S. No. 19910 Golden lode, at a point from which Cor. No. 1 bears N. 28°33' W., 96.46 ft. dist.
1,500.00	Cor. No. 1, and place of beginning.
	PRINCE LODE
	Beginning at Cor. No. 1 of the Prince lode, identical with Cor. No. 1 of the Jim Dandy lode of this survey.
	Thence N. 28°50' W.
170.28	Intersect line 3-4, M.S. No. 19142 I.X.L. lode, at a point from which Cor. No. 4 bears S. 61°27' W., 628.57 ft. dist.
267.95	Lode line; discovery point bears S. 42°25' W., 849.0 ft. dist.
370.28	Intersect line 4-1, M.S. No. 19557 Alley lode, at a point from which Cor. No. 1 bears S. 44°30' W., 167.58 ft. dist.
456.67	Intersect line 4-1 Protector lode of this survey.
535.90	Cor. No. 2, identical with Cor. No. 2 of the Jim Dandy lode of this survey.
	Thence S. 41°58' W.
215.30	Intersect line 1-2, M.S. No. 19557 Alley lode, at a point from which Cor. No. 1 bears S. 45°30' E., 149.14 ft. dist.
356.	Center of road, 16 ft. wide, bears N. 15° W. and S. 15° E.
598.76	Intersect line 1-2, M.S. No. 4923 Idella lode, at a point from which Cor. No. 1 bears N. 24°48' E., 399.35 ft. dist.
756.32	Intersect line 4-1 Protector lode of this survey.
891.	Left bank of Chalk Creek, 18 ft. wide, course S. 42° E.
930.	Center of road, 16 ft. wide, bears N. 40° W. and S. 40° E.
1,504.00	Cor. No. 3.

(This form bound at top)

Figure 11-3. (cont.)--Sample *field notes.*

Form 9180-22
(April 1965)
(formerly 4-493a)

Mineral Survey No. 20220 A

	FEET	
		Cor. No. 1, M.S. No. 19557 Alley lode, bears N. 55°19' W., 360.0 ft. dist.
		Cor. No. 1, M.S. No. 19142 I.X.L. lode, claimant herein, bears S. 49°48' W., 642.7 ft. dist.
		Cor. No. 3, M.S. No. 18837 C.O.D. lode, bears N. 58°45' E., 208.47 ft. dist.
		A yellow pine, 14 ins. diam., bears N. 10°00' E., 38.3 ft. dist., mkd. JD-1-20220A BT.
		A distant peak, known as Barren Mt., bears N. 55°57' W.
		Thence N. 28°50' W.
	170.28	Intersect line 3-4, M.S. No. 19142 I.X.L. lode, at a point from which Cor. No. 3 bears N. 61°27' E., 871.43 ft. dist.
	301.30	Lode line; discovery point bears N. 50°23' E., 496.0 ft. dist.
	370.28	Intersect line 4-1, M.S. No. 19557 Alley lode, at a point from which Cor. No. 4 bears N. 44°30' E., 1,332.42 ft. dist.
	456.67	Intersect line 4-1 Protector lode of this survey.
	535.90	Cor. No. 2, identical with Cor. No. 2 of the Prince lode of this survey.
		Set an iron post, 3 ft. long, 2 ins. diam., 24 ins. in the ground, and in a mound of stone, 3 ft. base, to top, with brass cap mkd. JD-2-PRI-2-20220A; from which
		A granite rock in place, 46 x 34 ins., 26 ins. above ground, bears S. 24°00' E., 10.5 ft. dist., mkd. X-BO-JD-2-20220A.
		Thence N. 50°23' E.
	679.32	Intersect line 3-4 Protector lode of this survey.
	1,150.19	Intersect line 4-1, M.S. No. 20062 Copper lode, at a point from which Cor. No. 4 bears S. 59°25' E., 94.5 ft. dist.
	1,230.73	Intersect line 1-2, M.S. No. 12071 Major lode, at a point from which Cor. No. 2 bears S. 11°00' E., 101.3 ft. dist.
	1,291.67	Intersect line 3-4, M.S. No. 19557 Alley lode, at a point from which Cor. No. 4 bears S. 45°30' E., 26.31 ft. dist.
	1,500.00	Cor. No. 3.
		On line 3-4, M.S. No. 20062 Copper lode.
		On granite bedrock outcrop, even with the general surface, point for Cor. No. 3, mkd. X JD-3-20220A; from which
		Cor. No. 4, M.S. No. 20062 Copper lode, bears S. 34°45' W., 330.0 ft. dist.; identical with Cor. No. 2, M.S. No. 12071 Major lode.
		A silver spruce, 16 ins. diam., bears N. 40°00' E., 47.5 ft. dist., mkd. JD-3-20220A BT.
		Thence S. 28°50' E.

(This form bound at top)

Figure 11-3. (cont.)--Sample field notes.

The excerpts from the BLM manual clearly describe what supplemental plats are and why they are developed. Figures 11-4 through 11-7 clearly illustrate the nature of a supplemental plat.

A supplemental plat is prepared entirely from office records and is 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 prepared for acceptance by the Director.

Supplemental plats are required where the existing 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 subsequent to the plat of the existing survey or where the segregation of the claims was overlooked at the time of its approval.

All supplemental plats should show a proper reference to the former plat, the purpose of and the authority for the preparation, and all essential data, without unnecessary duplication of that carried by the former plat. The scale of the supplemental plat may be enlarged to 1 inch equals 10 or 20 chains, as appropriate.

The new lots are numbered as required in sections 3-82 and 3-111 (of the BLM manual), and proper areas returned. The areas of the lots are computed from the existing record. No revision of the total area within the section is required and generally there is no occasion for showing topography.

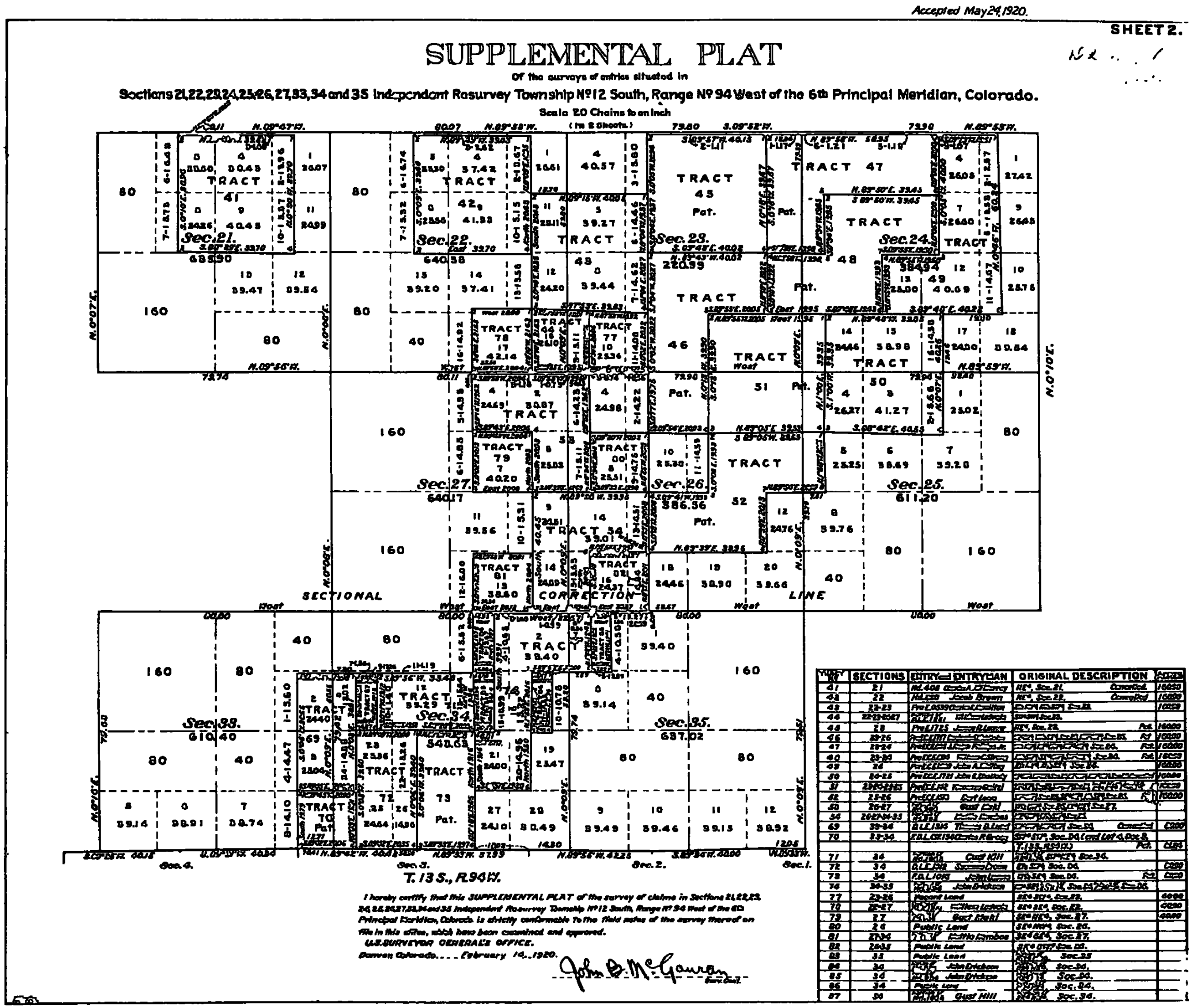


Figure 11-4.--Supplemental plat.

U. S. DEPARTMENT OF AGRICULTURE

FOREST SERVICE

FIELD NOTES

OF

HOMESTEAD ENTRY SURVEY NO. 158

SITUATED IN THE

BATTLEMENT NATIONAL FOREST

ADMINISTRATIVE DISTRICT NO. 2

in

Section 11, unsurveyed, Township 11 S., Range 91 W.,

Section 13, unsurveyed, Township 11 S., Range 91 W.,

Section 14, unsurveyed, Township 11 S., Range 91 W.

of the

Sixth Principal Meridian.

State of

Colorado

Survey executed by H. C. Langston, Surveyor-Forest Service.

Under special instructions dated July 10, 1915

Survey commenced July 17, 1915

Survey completed July 20, 1915

Under Acts of June 11, 1906 and March 4, 1915.

Applicant for listing Arthur Curtis
Applicant for listing J. Frank Cline
Applicant for listing James W. Cline,

Residence Paonia, Colorado.
Application No. 13, dated September 7, 1906
Application No. 36, dated May 13, 1907
Application No. 31, dated May 14, 1907
Portion of List No. 49, dated April 4, 1907
Portion of List No. 609, dated October 23, 1907
Portion of List No. 2-1526, dated April 4, 1912
Applicant for survey James W. Cline,

Residence Paonia, Colorado.

H. E. No. 07036, dated March 27, 1913.
As amended on April 8, 1915.
Land district Glenwood Springs.

Figure 11-5.--Homestead entry survey field notes.

HOMESTEAD ENTRY SURVEY NO. 158

BATTLEMENT NATIONAL FOREST

STATE OF COLORADO

Chains

A spruce, 15 ins. dia., bears S 55°20' E., 90 lks. dist., blazed and scribed with a cross and 1-HES 158 BT.

A spruce, 15 ins. dia., bears N 76°00'W., 1.25 chs. dist., blazed and scribed with a cross and 1-HES 158 BT.

U.S.L.M., H.E.S. No. 64, bears N 41°57' W., 22.86 chs. dist., which is a lava boulder in place, 30x18 ins., showing 24 ins. above ground, mkd. U.S.L.M. HES 64 on S. face and witnessed by a mound of stone and 2 BTs.

Cor. No. 1 H.E.SS No. 64 unapproved, Edmund Quackenbush claimant, bears S 55°32'E., 3.80 chs. dist., which is a lava stone, 20x12 ins., showing 10 ins. above ground, firmly set, mkd. and witnessed as described by the Surveyor General.

Mag. decl. at 8h 00m a.m., l.m.t., 15°30'E.
Mean mag. decl., 15°24.3'E.

Thence I run
N 20°27' W., bet. H.E.S. No. 158 and public land, along W. bdy. of List No. 2-1526.
Desc. gradually
2.90 Cow Creek, 1 ft. deep, 20 lks. wide, course SE.; asc.
6.30 Enter dense aspens and undergrowth; thence along E.slope.
27.50 Leave aspens and desc. gradual N. slope
29.40 Irrigation ditch, dry, drains SE.
32.00 Dry gulch, drains SE.; asc.
42.00 Wagon road bears W. and E.to SE.
43.00 Enter scattering aspens
44.20 Intersect cor. No. 2 of List No. 2-1526, which is an aspen post 4 ins. square, showing 4 ft. above ground, firmly set, mkd. and witnessed as described in the field notes of the listing survey, whence cor. No. 2 of List No. 609, J. Frank Cline applicant, bears N. 73° 51' W., 2.16 chs. dist., which is an aspen tree, 15 ins. dia., mkd. and witnessed as described in the field notes of the listing survey. I efface the markings on this tree and its accessories and return to cor. No. 2 of List No. 2-1526, which cor. and its accessories I destroy
Depart from List No. 2-1526; enter List No. 609.
51.44 To cor. No. 2 of this survey at intersection with line 4-1 of H.E.S.No. 159, unapproved, J. Frank Cline, claimant.

Set a basalt stone, 30x18x10 ins., 20 ins. in the ground, over a stone mkd. with a cross for cor. No. 2 of this survey, mkd. 2-HES 158 on side facing the claim; no bearings; therefore dig pits, 24x24x12 ins. crosswise on this and the succeeding course, 7 ft. dist., and raise a mound of earth 4 ft. base, 2 ft high, 3½ ft. dist., within the claim.

Cor. No. 1 of H.E.S. No. 159 bears S 60°38'W., 2.18 chs. dist., which is a basalt stone, 14x6 ins., showing 10 ins. above ground, firmly set, mkd. 1-HES 159 on NE face and witnessed by pits, a mound of earth and 2 BTs.

Thence I run
N 60°38' E., bet. H.E.Surveys Nos 158 and 159 through List No. 609.
Over rolling land.

Figure 11-5. (cont.)--Homestead entry survey field notes.

Form 85.
Sheet No. 2.

HOMESTEAD ENTRY SURVEY NO.158

BATTLEMENT NATIONAL FOREST

STATE OF COLORADO

Chains	
16.00	Desc. gradual E. slope
25.10	Wagon road bears N. and S.
26.47	To cor. No. 3 of this survey, identical with cor. No. 4 of H.E.S. No. 159, which is a basalt stone, 16x10 ins. showing 10 ins. above ground, firmly set, mkd. 4-HES 159 on NW. face and witnessed by a mound of stone.
	I mark this cor. 3-HES 158 on S. side facing the claim for cor. No. 3 of this survey; no bearings; therefore dig pits, 24x24x12 ins. crosswise on this and the succeeding course, 8 ft. dist., and raise a mound of earth 4 ft. base, 2 ft. high, 3½ ft. dist., within the claim.
	Cor. No. 2, H.E.S. No. 157, unapproved, James G. Alexander claimant, bears N 23°48'E., 4.05 chs. dist., Which is a basalt stone, 12x4 ins., showing 10 ins. above ground, firmly set, mkd. 2-HES 157 on E. face, and witnessed by pits, a mound of earth and 2 BTs.
	July 19, 1915.
	July 20, 1915.
	I begin at cor. No.-3 of this survey, previously described.
	Thence I run
	S 29°58'E., bet. H.E.S. No. 158 and public land
	Asc. gradually along E. slope.
5.20	Depart from List. No. 609; enter List No. 49.
8.00	Enter dense aspens and undergrowth and asc. gradually along steep E. slope..
29.00	Leave aspens and undergrowth and asc. gradually over SW. slope.
29.10	Wagon road bears NW and SE.
30.00	Wire fence bears NW and SE.
33.00	Wire fence bears N. and S.
33.20	Wagon road bears N. and S.
53.00	To cor. No. 4 of this survey
	Set a granite stone, 24x12x8 ins., 14 ins. in the ground over a stone mkd. with a cross for cor. No. 4 of this survey, mkd. 4-HES 158 on side facing the claim, and raise a mound of stone, 3 ft. base, 2 ft. high, 3½ ft. dist., within the claim.
	No bearings available; pits impracticable.
	Thence I run
	S 64°15'W., along the S. bdy. of H.E.S. No. 158,
	Depart from List No. 49, Enter List No. 2-1526.
	Asc. gradually over mesa land.
0.50	Wagon road bears NW and SE.
3.50	Small creek, 3 ins. deep, 2 lks. wide, course SE.
7.50	Cross bend in wagon road bearing N. and S.
13.25	Wagon road bears E. and W.
34.00	Cow Creek, 1 ft. deep, 20 lks. wide, course SE. asc.
35.05	To cor. No. 1 and place of beginning.
	Total area of H.E.S. No. 158, 159.95 acres.

Figure 11-5. (cont.)--Homestead entry survey field notes.

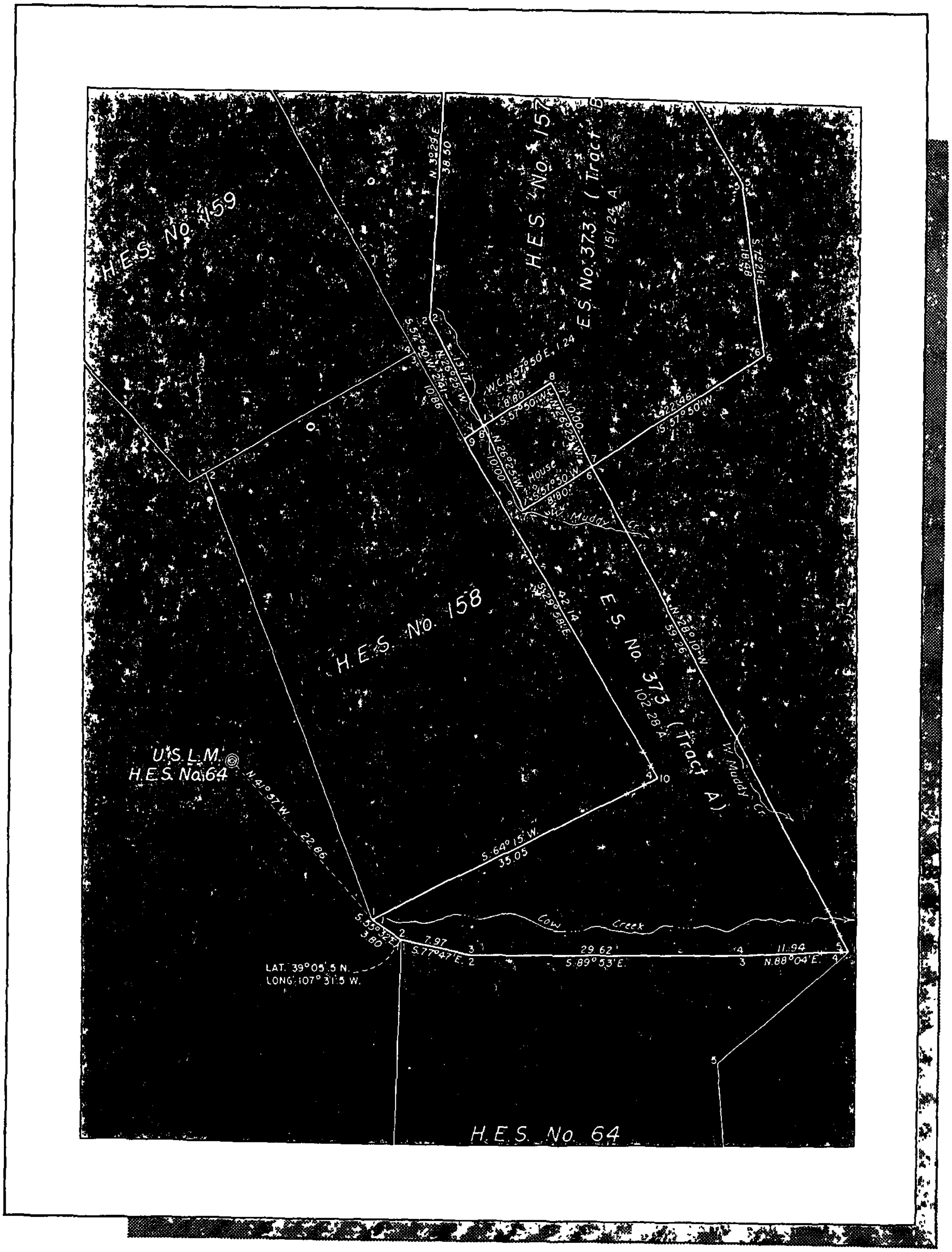


Figure 11-6.--Example of both a homestead entry survey and an exchange survey plat (E. S. No. *373).*

Form 9180-6
(April 1965)
(formerly 4-679)

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

ORIGINAL

0103

FIELD NOTES

OF THE

REMONUMENTATION

OF

CERTAIN

ORIGINAL CORNERS

IN

TOWNSHIP 15 SOUTH, RANGE 101 WEST

Of the SIXTH PRINCIPAL Meridian.

In the State of COLORADO.

EXECUTED BY

VERN A. COLARD CADASTRAL SURVEYOR

Under special instructions dated MAY 11, 19 59, which provided for the surveys included under Group Number 449, approved MAY 11, 1959, and assignment instructions dated JUNE 20, 19 66.

Survey commenced JULY 24, 19 68

Survey completed SEPTEMBER 19, 19 71

Figure 11-7.--Field notes of original corner remonumentation.

CHAINS

The following field notes describe the remonumentation of certain original corner points, Township 15 South, Range 101 West, of the Sixth Principal Meridian, Colorado, as provided for in the General Special Instructions, Group No. 449, dated May 11, 1959, "Investigation of Collateral or Physical Evidence of Corner Positions and Accessories Followed by Remonumentation of Corner Points, with New Accessories when needed."

The remonumentation of original corner points was made at the request of the United States Forest Service, in conjunction with their Land Line Location Program. The mean magnetic declination was determined to be 13½° E.

The following field notes are those of remonumentation of certain corners of the survey executed by C. A. Trease, in 1883, and retraced by Benjamin Clark, in 1902, on the Third Standard Parallel South, identical with the South Boundary, Uncompahgre National Forest, Township 15 South, Range 101 West, Sixth Principal Meridian, Colorado

---

The standard cor. of secs. 33 and 34, on the S. bdy. of the Tp., monumented by the original sandstone, 18x10x6 ins., mkd. with 3 notches on the E. and 3 notches on the W. edges and SC on the N. face, firmly set in the ground, with a mound of stone N., from which the original bearing tree

A stump hole, bears N. 12° E., 23 lks. dist., with a fallen pine, 14 ins. diam., no visible marks.

A pine, 18 ins. diam., bears N. 5° W., 61 lks. dist., mkd. T15S R101W S33 BT.

At the corner point

Set an iron post, 30 ins. long, 2½ ins. diam., 10 ins. in the ground, to underlying rock and in a supporting mound of stone, 4 ft. base, to top, with brass cap mkd.

S C
T15S R101W
S33|S34

1968

from which a new bearing tree

A pine, 14 ins. diam., bears N. 16° E., 72 lks. dist., mkd. T15S R101W S34 SC BT.

Bury the mkd. stone alongside the iron post.

The corner is situated on near level terrain in scattered aspen and pine timber, 152 lks. E. of Devide Road, bears SE. and NW.

The standard cor. of secs. 32 and 33, on the S. bdy. of the Tp., monumented by the original sandstone, 20x18x4 ins., mkd. with 4 notches on the E. and 2 notches on the W. edges, and SC on the N. face, firmly set 8 ins. in

Figure 11-7. (cont.)--Field notes or original corner remonumentation.

Unit 12
MAPS & Diagrams

Various maps and diagrams have been used for the Forest Service corner and landline atlas. These have not been standardized throughout the Forest Service. However, a comprehensive program is underway to revise and adopt the Primary Base Series maps as the principle maps for most Forest Service project work. The basis for such Forest Service modified maps is the U.S. Geological Survey quadrangle maps. Private land parcels within and adjacent to the Forests are shown. The maps, when completed for all Forests, can serve as a basis for the landline and corner atlas. Since these maps are available with topography and vegetation coverage, they are most valuable as field maps.

It may be some time, however, before all Forests receive primary base maps. In the meantime, Forest personnel may do well to use the USGS quadrangle maps as the landline atlas as they are at the same scale as the primary base maps. The Forest planimetric maps show private land, and this is most helpful. Private land parcels can be transferred to the USGS quadrangle maps if desired. An overhead projector or vertical sketchmaster will simplify this process.

If the maps are kept current, they are an excellent aid to the corner searcher. Mylar copies are superior for corrections. Both the Forest Supervisor’s office and districts can maintain copies of the landline and corner atlas. Standardized symbols may be adopted to show recovered and/or monumented GLO/BLM corners (rock or metal posts), Forest Service monuments, private surveyor’s monuments, corners searched for and not found, as well as posted and marked Forest Service boundaries.

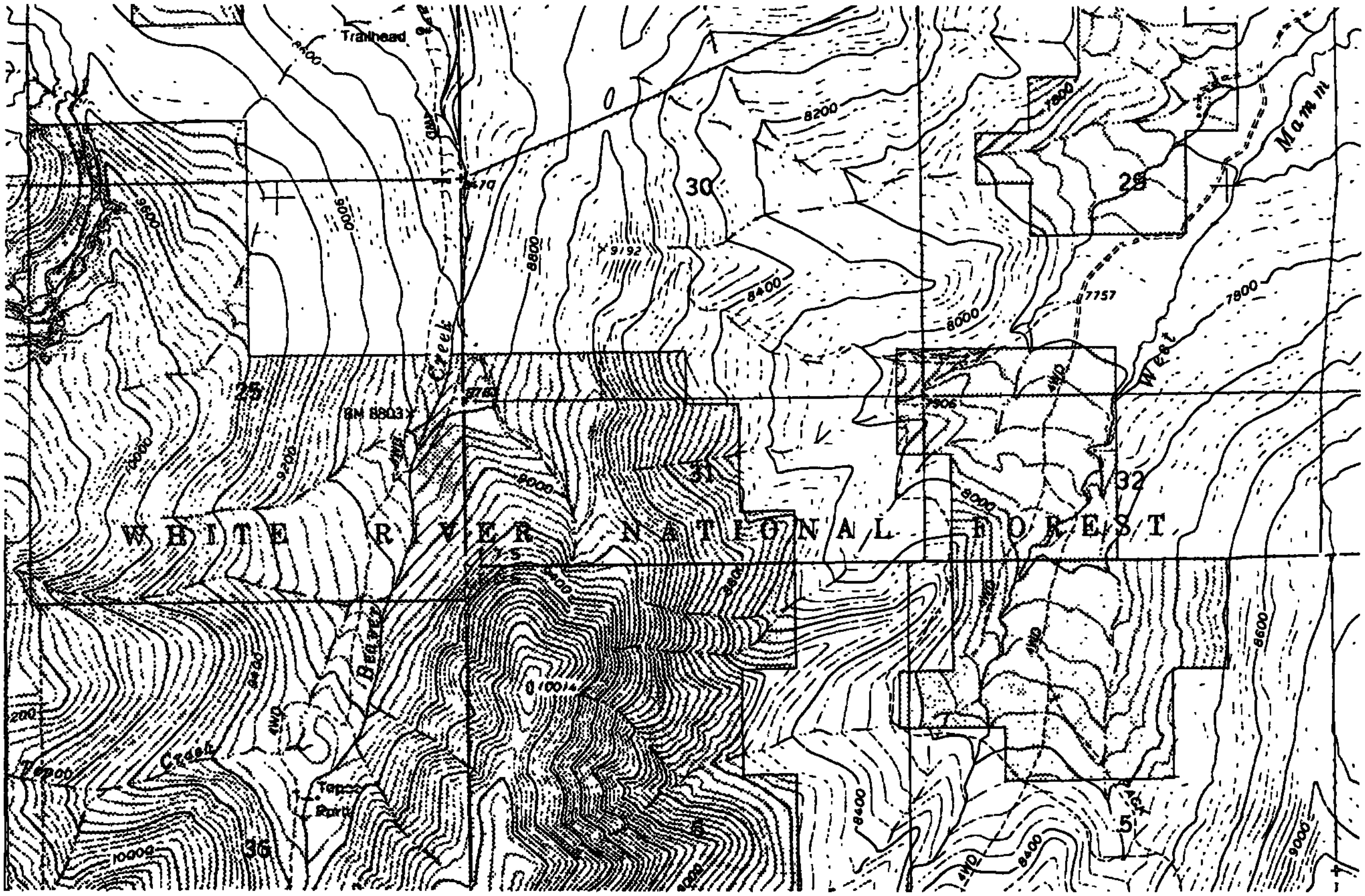


Figure 12-1.--The Forest Service primary series maps are excellent maps for the corner and landline atlas. They are available with or without topography. The USGS quadrangle maps serve as a basis for these. Found corner monuments are indicated by the (#) symbol. Dashed lines may not represent unsurveyed section lines; their positions may be questionable.

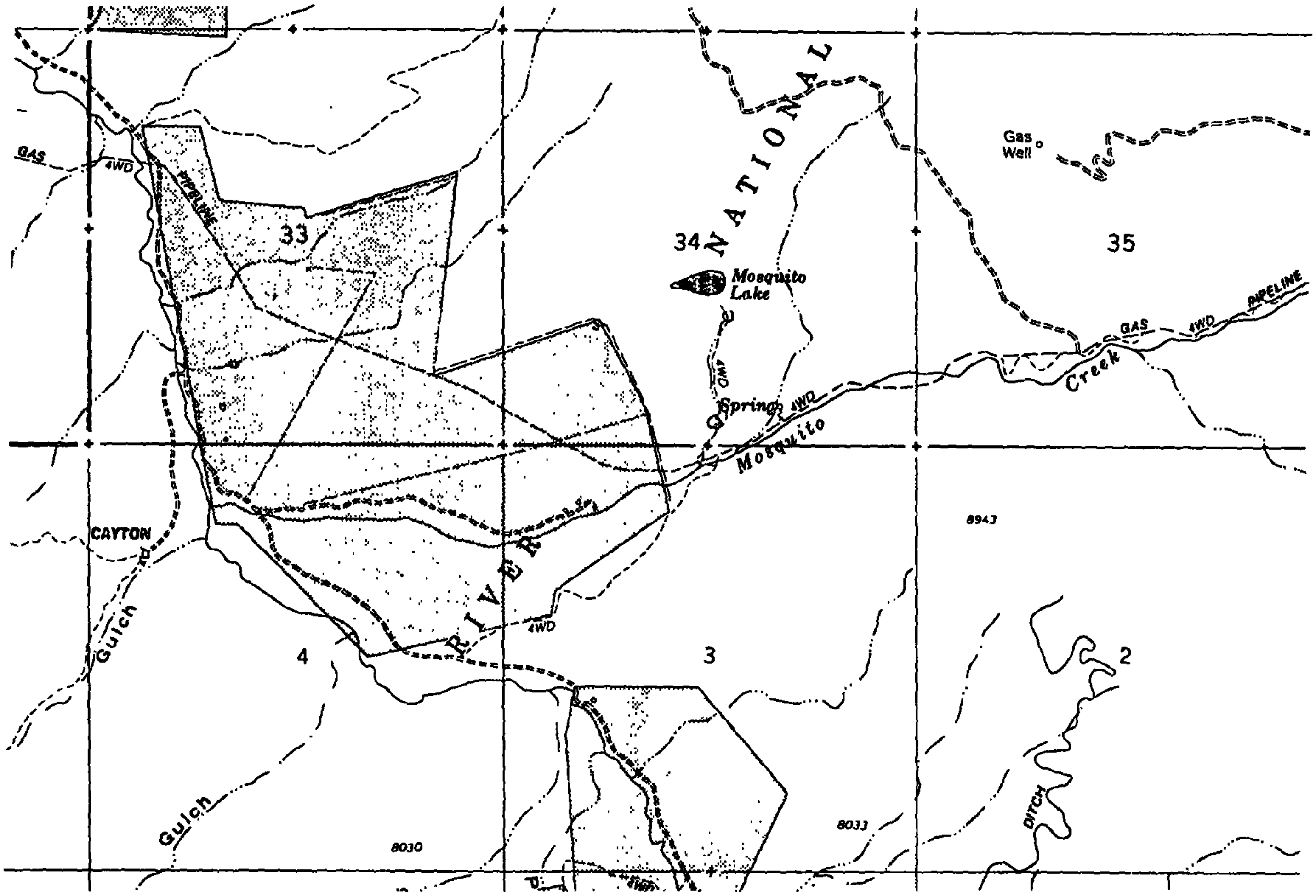


Figure 12-2.--A portion of the Forest Service primary series (1:24,000) map. These maps are available with or without topography. This particular example is planimetric (without topography). Note the private land parcels. The planimetric version may be useful for planning purposes. The topographic type is useful to the land surveyor and corner searcher. Vegetation patterns are also available for these maps.

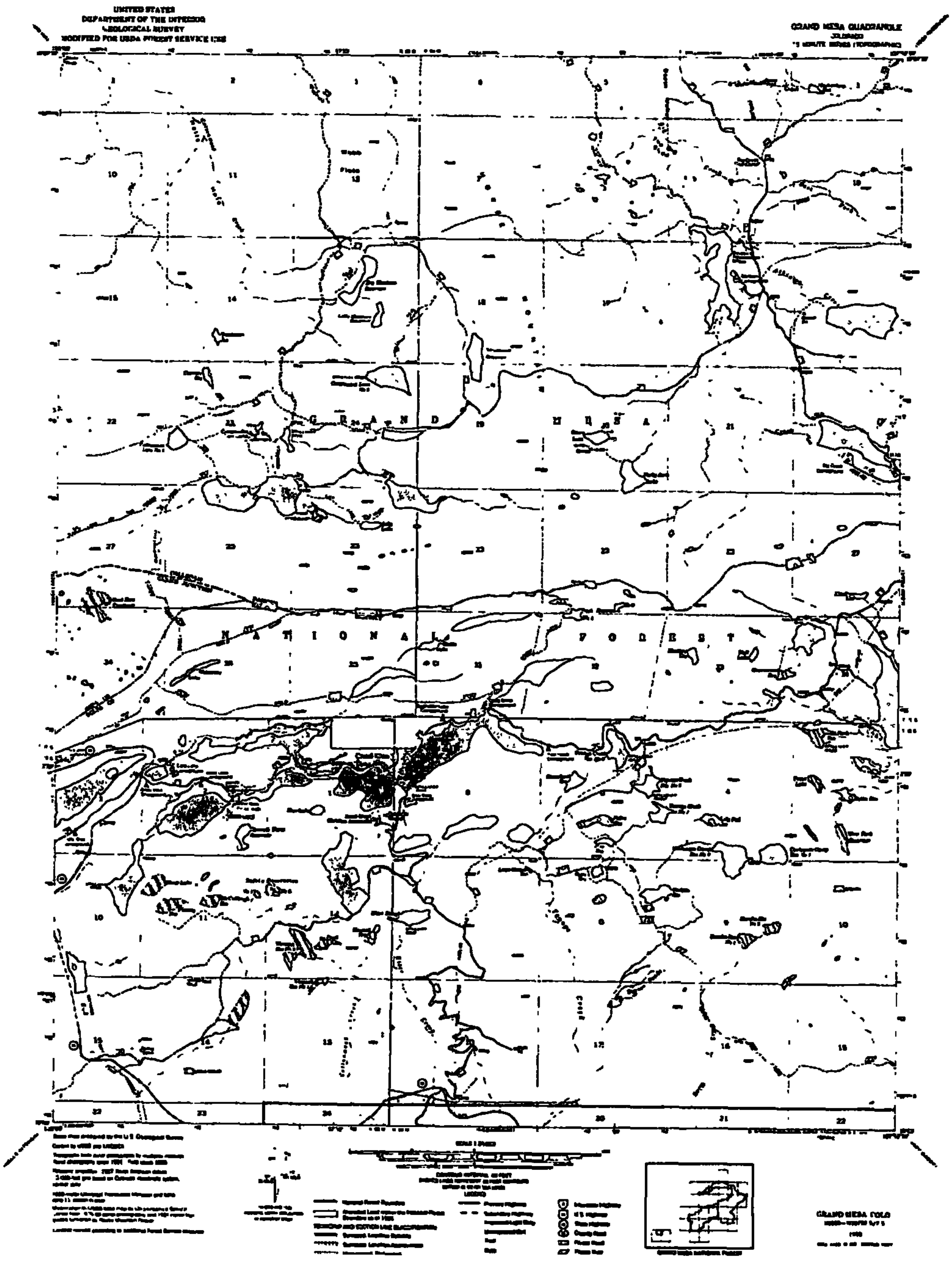


Figure 12-3.--Reductions of the primary base maps are *available and are convenient for weekly reports. Film positives can be ordered for these maps and additional copies photocopied or blue-lined. They may also serve as a field base map.*

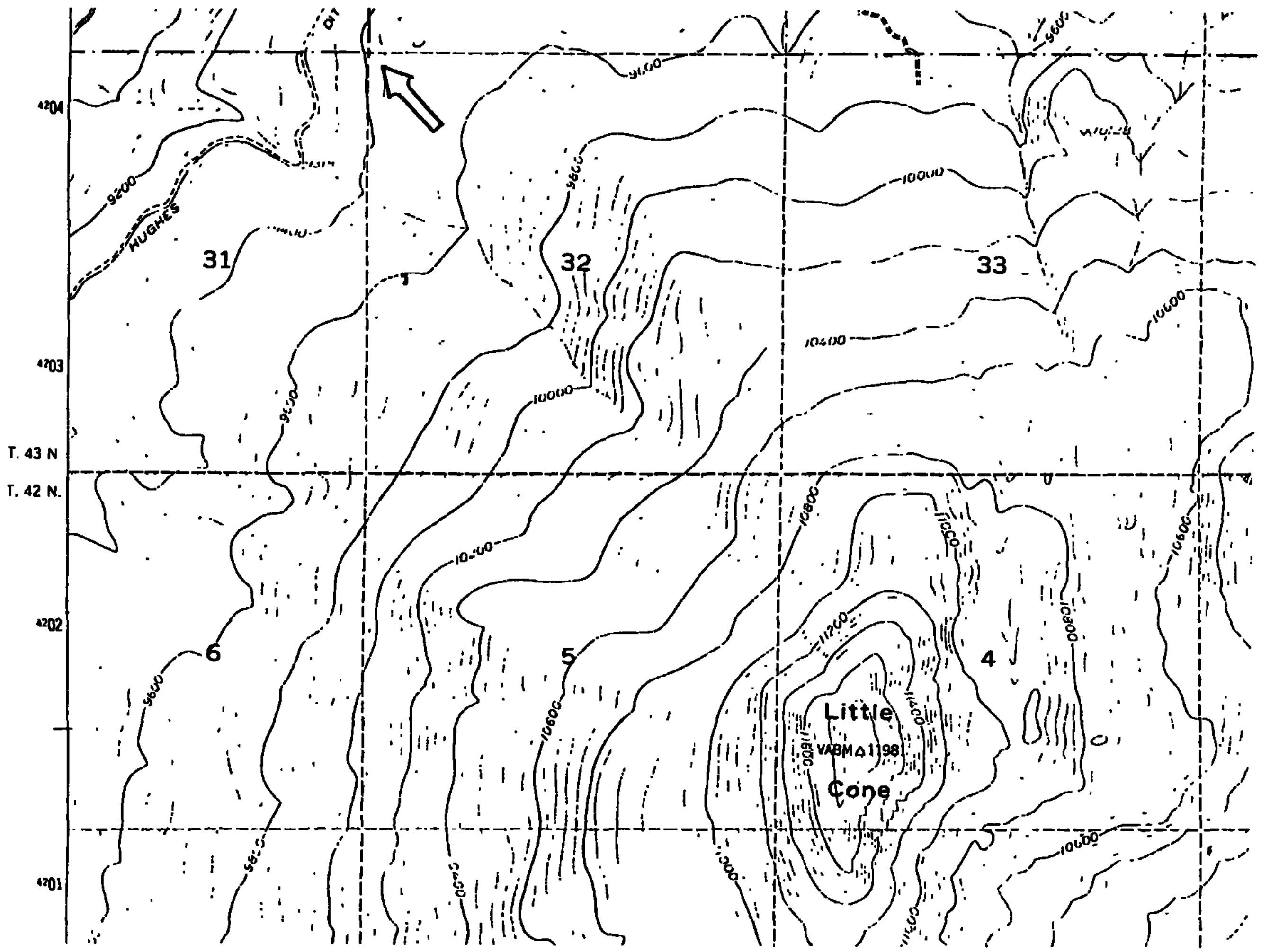


Figure 12-4.--U.S. Geological Survey quadrangle maps are excellent for corner search work. Several symbols should be understood, however. For example, the *dashed lines do not necessarily represent unsurveyed townships. These may simply mean the field edit personnel did not recover corners in this area. Note the corner symbol (+).*

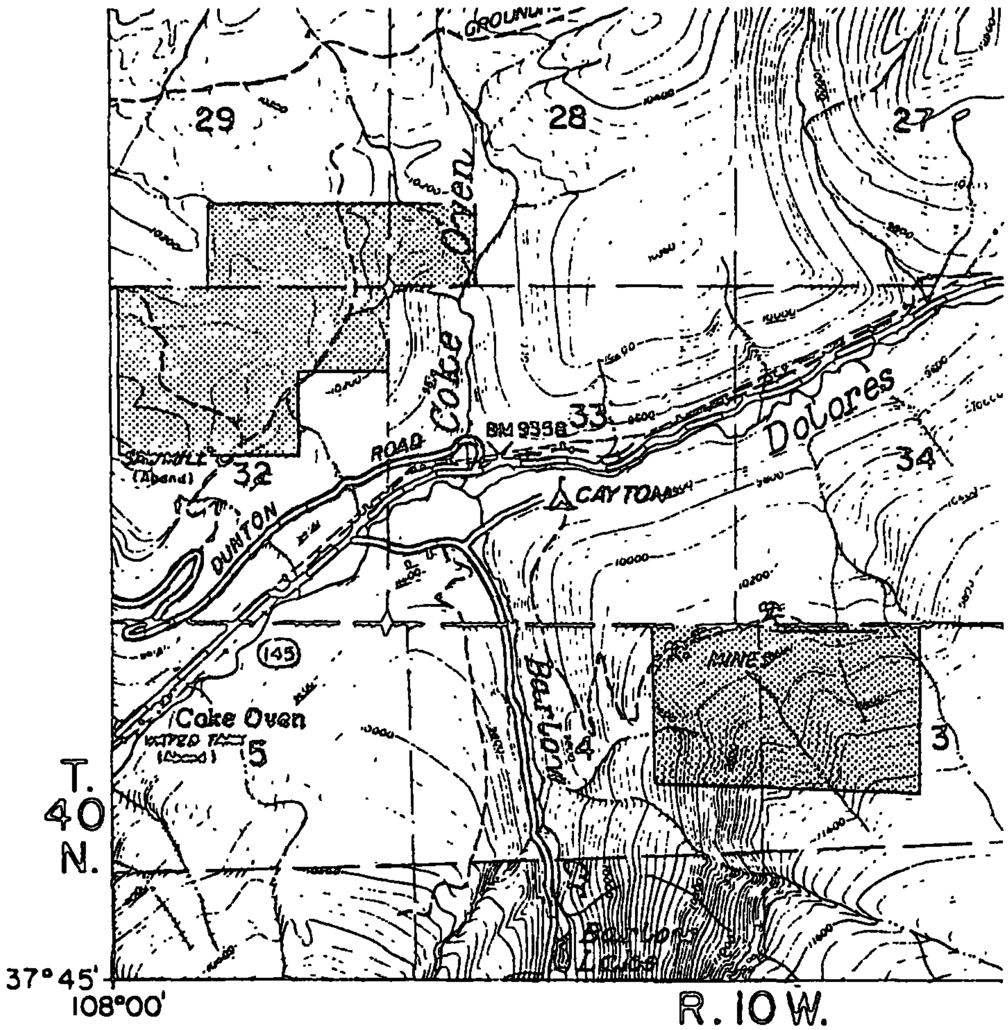


Figure 12-5.--Forest Service planimetric map (2 inches to the mile scale). This map presents the horizontal positions only for the features represented; distinguished from a topographic map by the omission of relief in measurable form. The natural features usually shown on a planimetric map include rivers, lakes, and seas; mountains, valleys, and plains; and forests, prairies, marshes, and deserts. The cultural features may include cities, farms, transportation routes, public utility facilities, and political and private boundary lines. Note: These are no longer being updated, but can be useful nonetheless.

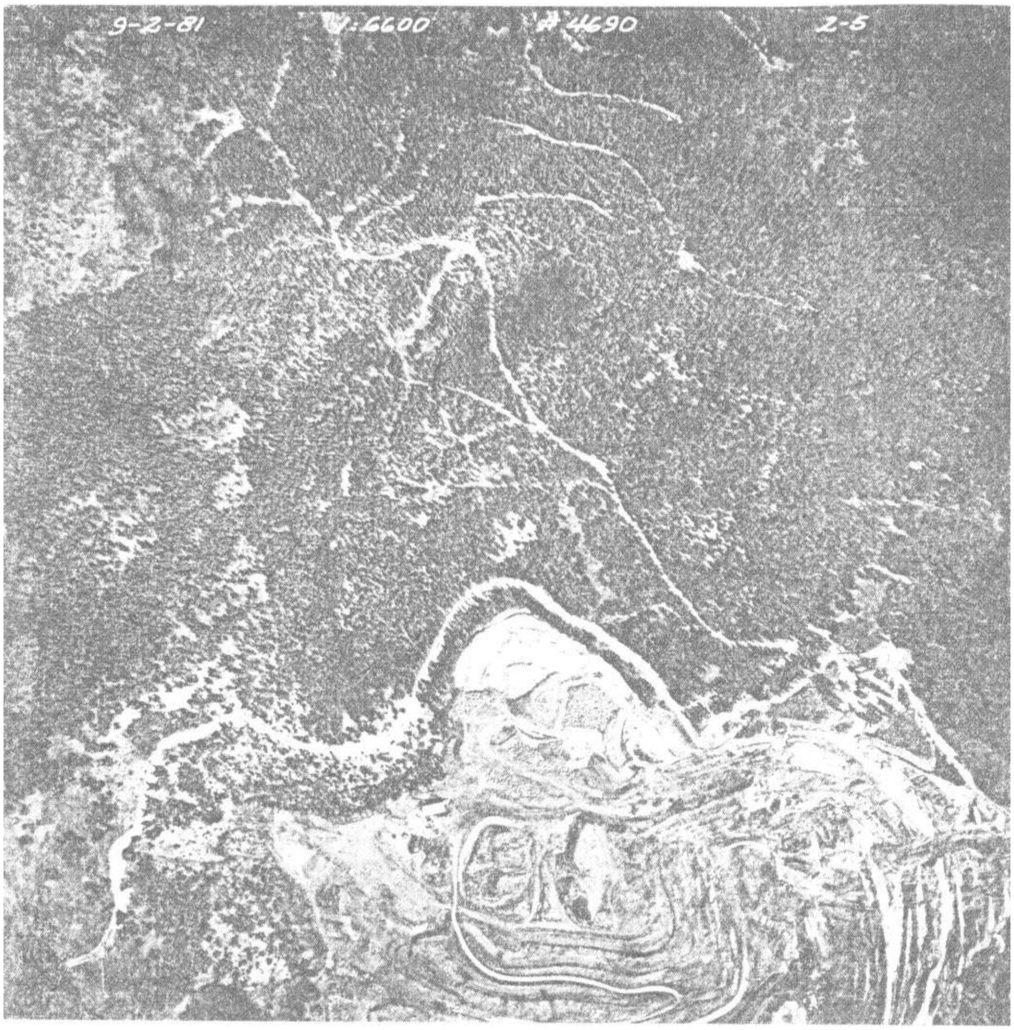


Figure 12-6.--Example of an aerial photograph. This photo reflects usefulness as an up-to-date map. The extensive uranium mining activity in the southern portion was not shown on the USGS quadrangle map. Aerial photographs may also be viewed in stereo with proper stereo viewers. This permits three-dimensional viewing. A number of photographs may be placed together to form a mosaic; this provides a broad coverage.

Figure l2-7.--Orthophotoquads are available for some areas. These may include landnets and topography. The primary advantage of orthophotos over standard aerial photos is the scale variation has been removed. There is an additional charge for the extras" and readability is somewhat reduced with the contours.

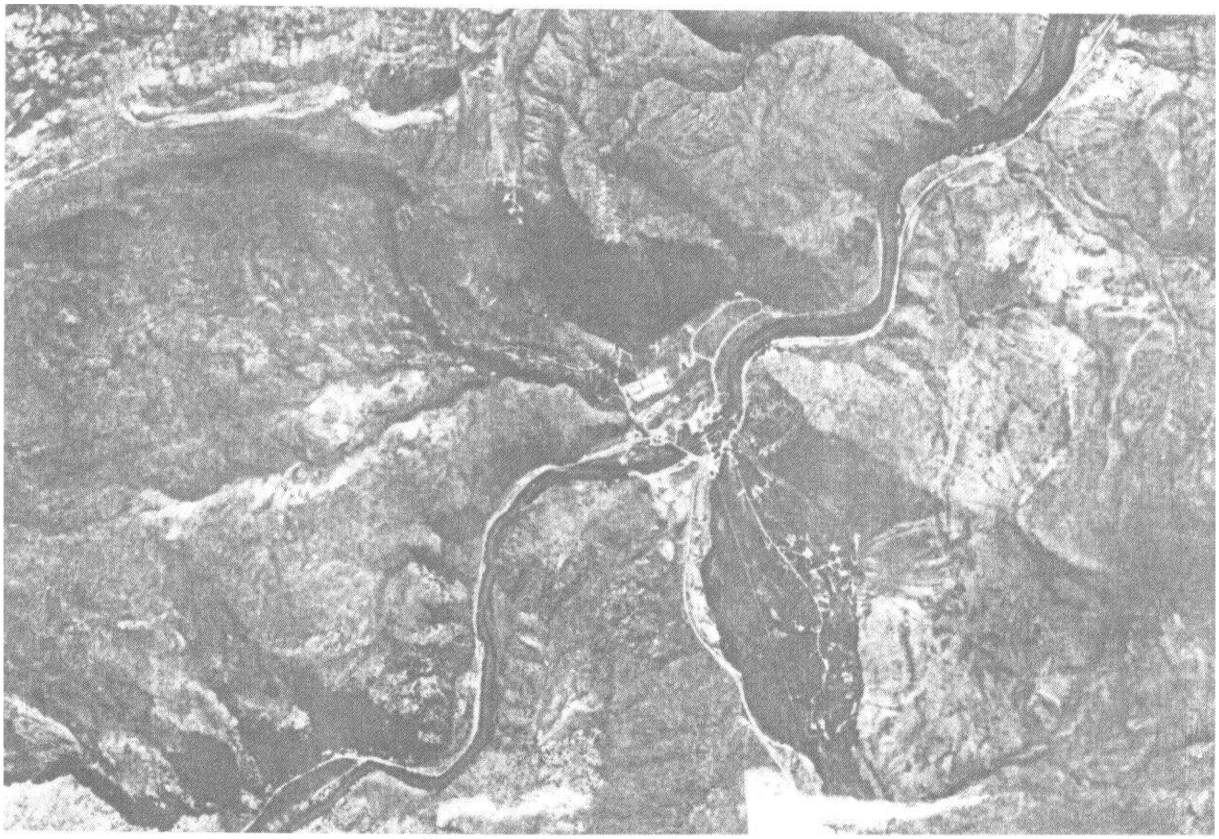


Figure 12-8.--Photoquads are useful when a true-to-scale orthophoto is not needed. They provide nearly the same coverage as a 1:24,000-scale USGS quadrangle and are quite convenient for access determinations. For those areas not covered by orthophotos, the photoquad often will suffice.

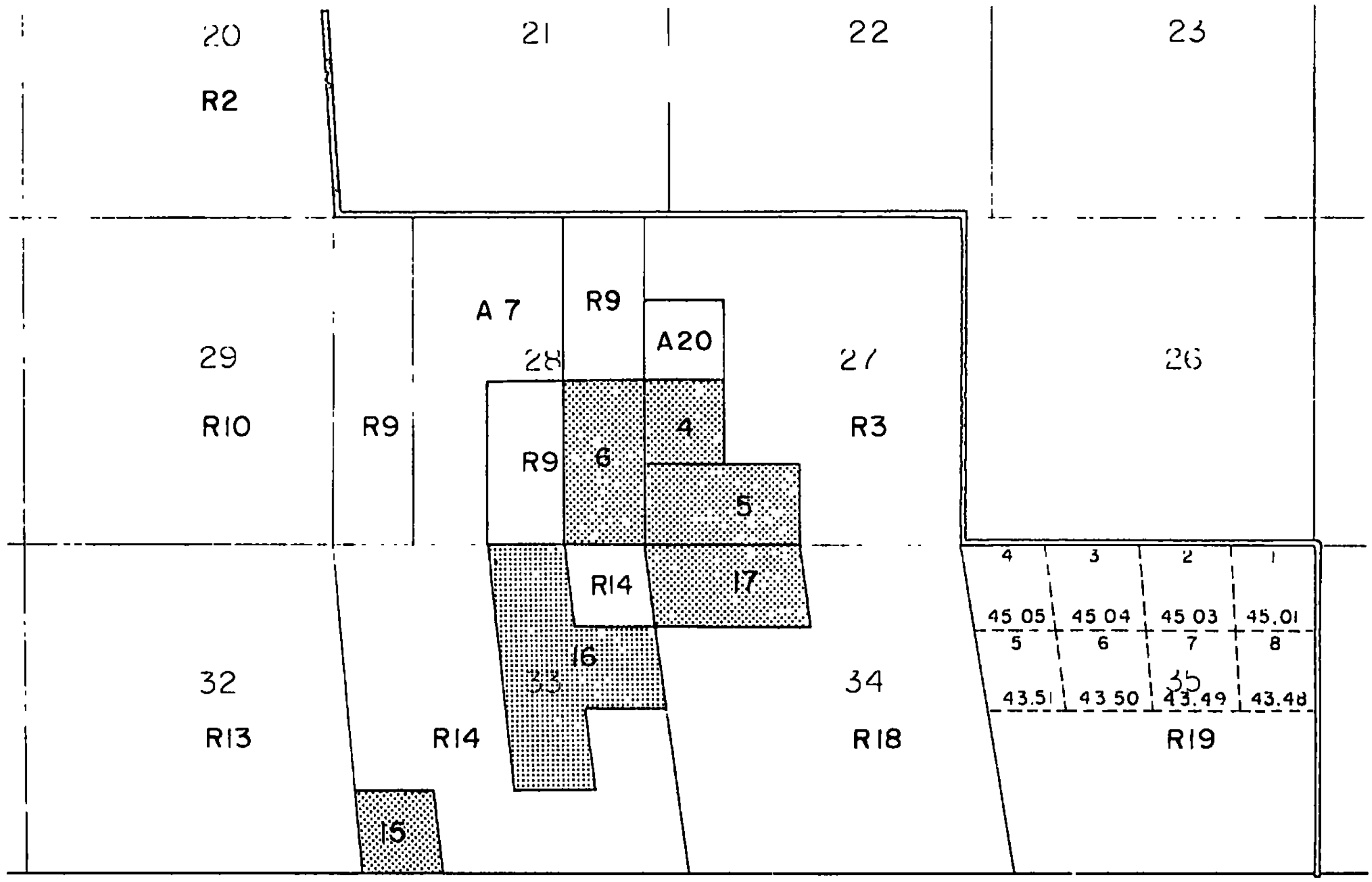


Figure l2-9.--Forest Service status plats show land ownership. These plats, used in conjunction with the narrative, can be most useful in determining ownership patterns.

FOREST UNCOMPAHGRE		RANGER DIST. OURAY			STATE COLORADO				COUNTY OURAY	COMPILED BY

BASE MAP TABULAR RECORD

Line No.	Land Description	Action or Entry	Date of	Authority	Acres	Encumbrances: Interest Vested in Govt.	Pvt.	Expr. Date	Remarks	Line No.
1	Sec. 19	Res.P.D.	6-14-05	Proc.	760.09				All.	
2	" 20	"	6-14-05	"	640.00					
3	" 21	"	6-14-05	"	480.00				E½, E½ NW¼, NW¼ NW¼, NE¼ SW¼.	
4	" [illegible]	Pat.	9-9-90	C.E.	40.00				NW¼ SW¼.	
5	" 27	Pat.	1-27-88	C.E.	80.00				S½ SW¼.	
6	" 28	Pat.	9-9-90	C.E.	80.00				E½ SE¼.	
7	" [illegible]	Exch.	8-6-73	Act 3-20-22	240.00				W½ NE¼, E½ W½. C-4228, C. Tad Paxton, et al.	
9	" [illegible]	Res.P.D.	6-14-05	Proc.	320.00				E½ NE¼, W½ SE¼, W½ W½.	
10	" 29	"	6-14-05	"	640.00					
11	" 30	"	6-14-05	"	757.77				All.	
12	" 31	"	6-14-05	"	754.88				All.	
13	" 32	"	6-14-05	"	640.00					
14	" 33	"	6-14-05	"	440.00				NE¼ NE¼, NW¼, N½ SW¼, SE¼ SW¼, NE¼ SE¼, S½ SE¼.	
15	" 33	Pat.	6-12-90	C.E.	40.00				SW¼ SW¼.	
16	" 33	Pat.	10-27-90	C.E.	160.00				W½ NE¼, SE¼ NE¼, NW¼ SE¼.	
17	" 34	Pat.	1-27-88	C.E.	80.00				N½ NW¼.	
18	" 34	Res.P.D.	6-14-05	Proc.	560.00				N½ NE¼, S½ N½, S½.	
19	" 35	"	6-14-05		674.11				All.	

Figure 12-10.--The narrative portion of the land status record shows various important parameters affecting land parcels, including patent dates, acreages, and legal descriptions.

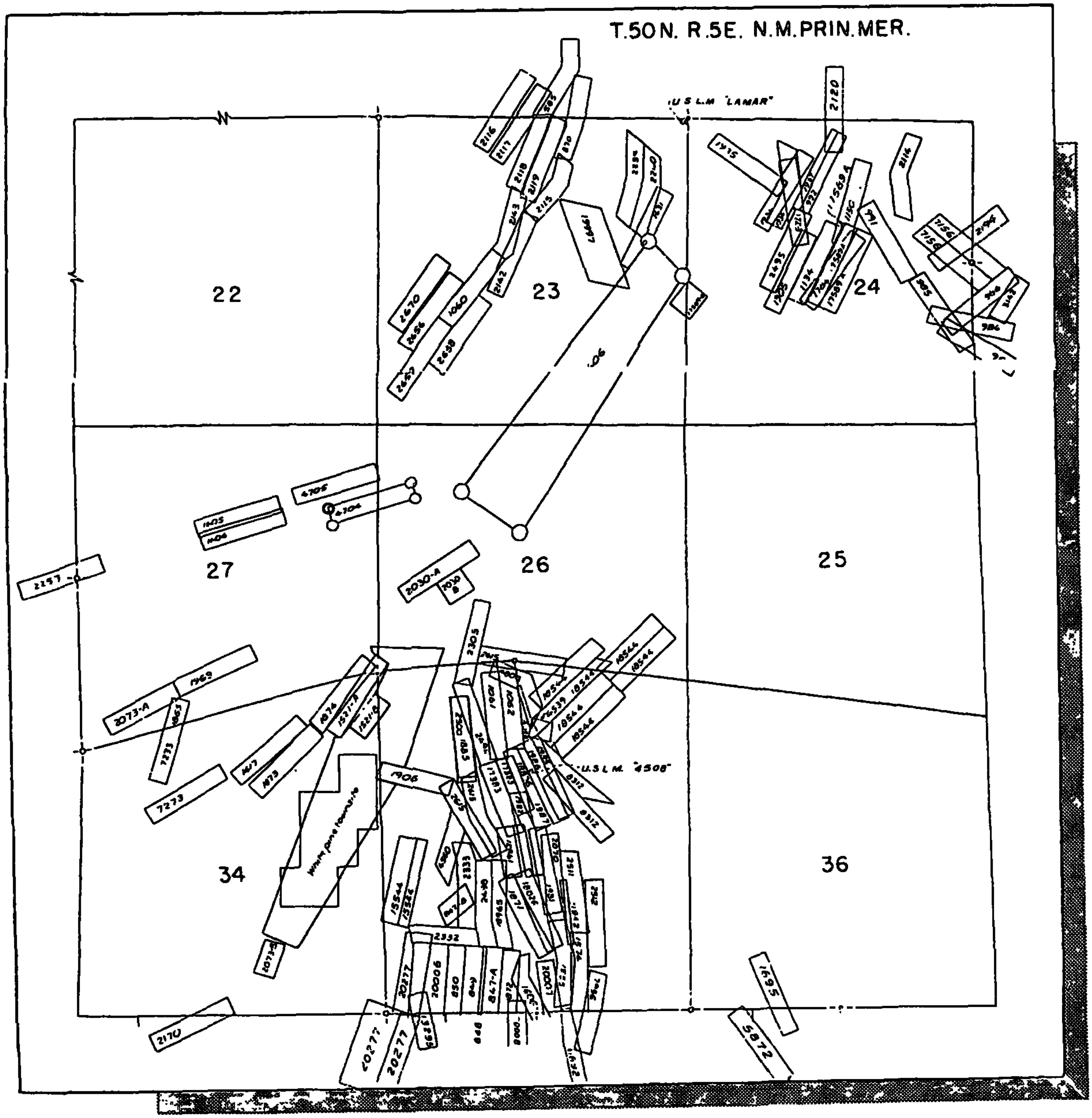


Figure 12-11.--Example of a mineral status sheet. This is convenient for showing the status of the corners, whether lost or recovered.

BUREAU OF LAND MANAGEMENT
LAND STATUS RECORDS

The Records in the Bureau of Land Management Offices consist of several elements. Each township has an ownership or Master Title Plat and a Historical Index. Some townships may also include Leasable Resource Plats which show issued mineral leases and permits.

One additional new record is the Miscellaneous Document Index which lists documents involving unidentified lands or orders of a general nature. These documents are an integral part of the records and this index should be examined in conjunction with the records for each township to determine the complete status of public lands. Microfilm copies of all records may be inspected by the public or paper copies may be purchased from the respective B.L.M. District Offices throughout the various states.

Master Title Plat

The Master Title Plat shows the land which has been patented to private ownership, the patent numbers, and the reservations to the United States as stated in the patent. The absence of such information would indicate the land is still Federal land - often referred to as public domain. Withdrawals, rights-of-way, national forests, Indian Reservations, wildlife refuges, classifications, and other reservations and actions are also shown. Lands which have been patented and then reacquired by the United States by donation, purchase, or condemnation are shown when such information is available and are referred to as acquired lands. Grazing permits or leases and timber sales are not a part of the new records and information concerning them must be obtained from the District Offices.

The first step in building the Master Title Plat was the making of a basic township plat. It is a copy of the official township survey plat and is as nearly identical as possible. If more than one survey has been made for a township, the basic plat is a composite of all the surveys, with the composite survey picture appearing on one page. Although it is a copy or a composite of the surveys, the Master Title Plat must not be construed as an official survey plat.

The Master Title Plat illustrates title information by the use of various weights and types of lines to show the area affected. Each weight or kind of line indicates a separate and distinct type of action. Each such action is shown by an abbreviated notation which identifies the action or authority for it. The legend of abbreviations and symbols on the back of this explanation sheet shows the different lines used and interprets the abbreviations.

Procedure for Using Master Title Plat

As mentioned before, the new records are designed to portray the title story by the use of lines and abbreviated notations. The guides listed below, if followed in each case, should help in making the records quite easy to read:

1. Always follow a particular line around until you come back to the point of beginning. The area within the bounds of the line is the land affected.

2. To find the notation for a particular line, know what the line stands for. Refer to the legend of abbreviations and symbols which explains the information portrayed by the different lines.

3. The identification for the area circumscribed by a line usually appears at the lower edge of the area involved. In some instances where space is limited, the identification may be "arrowed" in. The legend of abbreviations gives the full wording.

4. Whenever the plat is too small to adequately tell the story, a supplemental plat is prepared on a larger scale. Usually not more than four sections appear on a supplemental plat. If a supplemental plat has been made, the Master Title Plat will indicate it. The title information for those sections will be shown only on the supplemental plat.

The same township plat included with this explanation sheet has been prepared to show most of the types of lines used and the information conveyed by each. The following explanation will further assist the reader in using and understanding the sample plat.

The light-weight line surrounding Section I is the weight of the survey lines which appear on the basic plat. Sections 3 and 8 show how lots appear. Note that the subdivision lines separating lots are not full length, only partial; they are called tick marks. These partial subdivision lines are the only survey lines shown within a section. Survey lines for a full 40-acre subdivision are not shown. Section 4 shows a boundary line between surveyed and unsurveyed lands.

In Sections 5 and 6 there is shown a line which is used to outline Federal withdrawals or classifications affecting a part of the township. These are further identified as to type of order and purpose by notations at the lower edge of the area outlined. The date shown is the date of the last order affecting that area. If the entire township is affected, it is not outlined. Instead, a notation on the right-hand side of the plat will state that the entire township is in the withdrawal or classification. A good rule to follow is always first check the right-hand side of the plat for notations.

Figure 12-12.--BLM land status records.

Surveyed Mines are shown in Section 7 of the sample M.T. Plat. The claimants of all unpatented mining claims after October 21, 1979, have 90 days in which to register the claims with the B.L.M. Office. This includes the mineral locations.

The B.L.M. Office has a record of mining claims which have been patented and those which have been included in approved mineral surveys. If an official mineral survey has been made of the mining claim it is outlined with a survey weight line and is identified by the Mineral Survey Number, such as MS 1550. If a claim has been patented, a patent line is drawn around the claim and the patent number, such as 25389 in Section 7, is inserted in the affected area. The Mineral Survey number will also be shown in the patented area.

The law requires that the B.L.M. Office must be advised of mining locations on withdrawn Power Site land. An index to mineral locations and contests has been prepared for each township where these have been filed.

The illustration in Section 9 is for Public Law 167, the Act of July 23, 1955. This law pertains to the right of the United States to manage surface resources on unpatented mining claims. Although it does not affect title, where a final determination has been made, it is noted on the right-hand side of the plat.

Sections 13, 14, 15, 23 and 24 illustrate examples of patents. A patent line is drawn around the lands described in the patent. When two patented areas adjoin there is a double-weight line. The single and double-weight patent lines are shown in Section 14. The patent number usually appears in the lower extremity of the area patented. Land which is still in Federal ownership will not have a patent number. Note the SW¼NE¼, SE¼NW¼, NW¼SW¼ NW¼SE¼ in the middle of Section 14.

Whenever there are any reservations to the United States, a notation will appear below the patent number. If there is nothing below the patent number, the United States reserved nothing. The patent numbers and reservations for the patented areas outlined in Sections 13, 23, and 24 are examples of the various types which can occur.

Section 16 and 36 illustrate grant of land made to the State of California. Sections 17, 20 and 21 show an example of a lease or permit line. As mentioned before, grazing leases or permits are not shown. Section 18 illustrates a pending application and an approved or allowed application. The notation identifies the serial number and type of application. Section 19 illustrates land classifications by BLM.

The United States occasionally reacquires lands which had been previously patented. Such land is referred to as acquired land if obtained by donation, purchase or condemnation. Where the BLM Office has the acquisition information, such acquired lands are shaded as shown in Sections 27 through 30. The fact that an area is shaded indicates that the United States has an acquired surface interest or an acquired mineral interest, or both. Exactly what was acquired by the United States is shown by the notations.

Section 27 illustrates that the United States does not own the surface but has an acquired mineral interest; hence the shading. Sections 28 and 29 both show the surface and the minerals are owned by the United States, but those originally retained, as in Section 28, are subject to disposition under one law and those acquired, as in Section 29, are subject to disposition under a different law. Therefore the new records will show whether the Government owns the surface or minerals or both.

Records of lands acquired by Federal agencies other than BLM may not always be available in the office. However, ownership status can usually be obtained from the records of the county where the lands are located.

The right-of-way symbols are shown in Sections 31 and 32 with its width from the centerline of the R/W and the act under which the R/W was granted. It should be emphasized that rights-of-way are only shown in their approximate location.

Section 25 is an example of a jurisdiction boundary line between California District Offices. Section 33 shows an example of a county boundary line. Various types of range improvements are shown in Section 34. Section 35 shows a notation referring to supplemental plat.

Historical Index

The Historical Index is a chronological narrative of all past and present actions which affect the use of or title to public lands and resources. It can be used to check title, but it was not designed for that purpose nor is it necessary for use in making title determinations. The primary value is its adaptability for abstract work.

Source Documents

The title information on the Master Title Plat was taken from microfilm copies of documents such as patents, withdrawal orders, state selection lists, etc. These microfilm copies are filed in the BLM Office and paper copies can be made and purchased from that office.

Figure 12-12. (cont.)--BLM land status records.

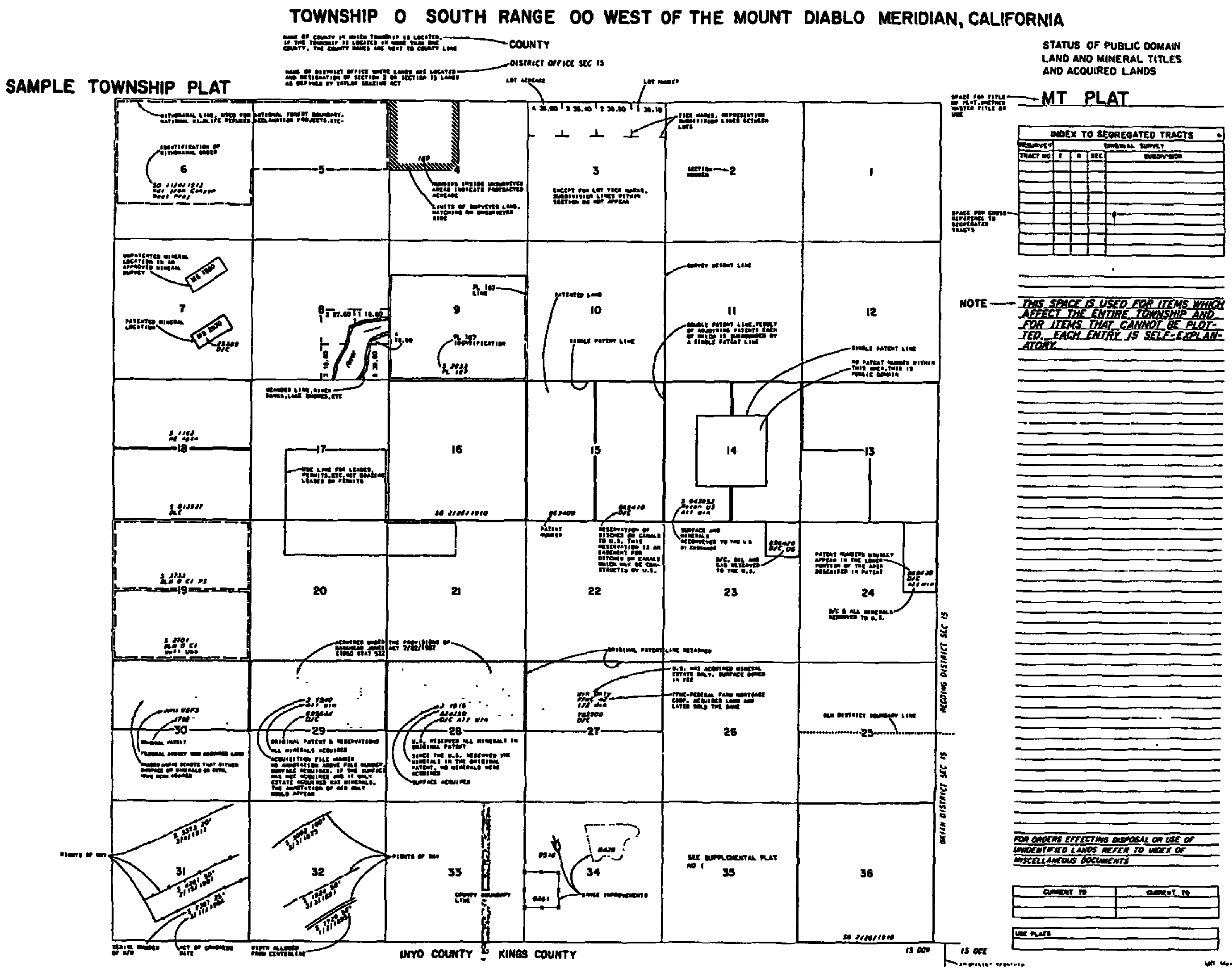


Figure 12-13.--Sample township plat.

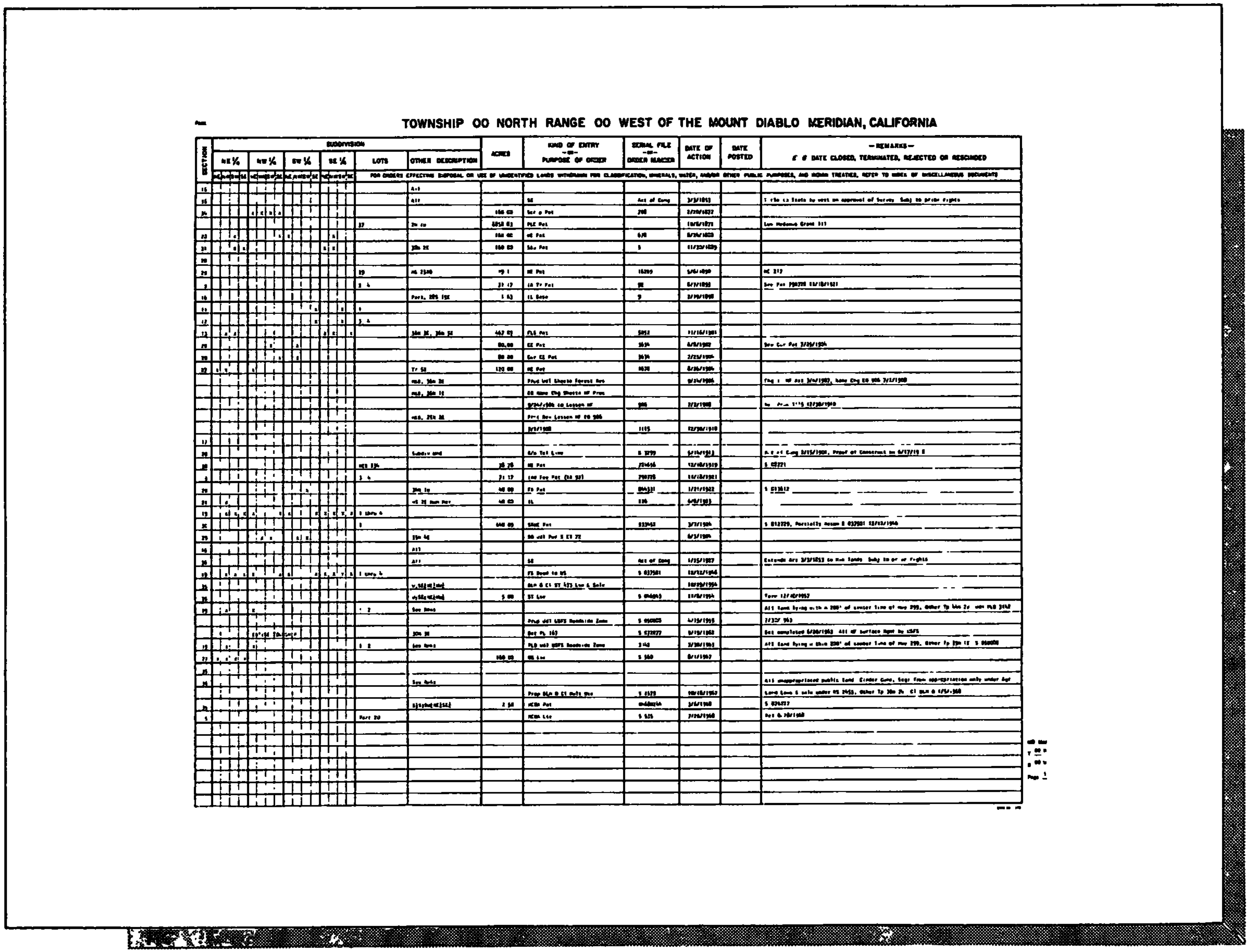


Figure 12-14.--Sample historical index.

Acq	Acquired
A	Acre, Acres
Adm S	Administrative Site
Allot	Allotment
Amdt	Amendment, Amended
Apln	Application
Appvd	Approved
Asgn	Assignment
Bdy; Bdrs	Boundary, Boundaries
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BLM O	Bureau of Land Management Order
BR	Bureau of Reclamation
BSF&W	Bureau of Sport Fisheries & Wildlife
Cad	Cadastral
Calif	California
Canc	Cancellation, Cancelled
CE	Cash Entry
Cl	Classification
Comm S	Communication Site
CDI	Control Document Index
C of E	Corps of Engineers
Cur	Curative
Dept	Department
DLE	Desert Land Entry
Des	Designated or Designation
Det	Determination
D/C	Ditches /or Canals
Esmt	Easement
E	East
Eff	Effective
X	Exchange
EO	Executive Order
Fm U	Farm Unit
FAA	Federal Aviation Administration
FFMC	Federal Farm Mortgage Corporation
FPA	Federal Power Act
FR	Federal Register
FPC O	Federal Power Commission Order
FX	Forest Exchange
FLS	Forest Lieu Selection
Frac	Fractional
GLO O	General Land Office Order
Geo	Geothermal
Hum Mer	Humboldt Meridian
½	Half
Hwy	Highway
HE	Homestead Entry
IL	Indemnity List
IA	Indian Allotment
Ind Res	Indian Reservation
Ind Tr	Indian Trust
Int	Interior
Intpr	Interpretation
KGRA	Known Geothermal Resource Area
KGS	Known Geologic Structure
Lse	Lease
Lsbl	Leasable
Lic	License
LS	Lieu Selection
Mgmt	Management
MTP	Master Title Plat
Mer	Meridian
M&B	Metes & Bounds
Mil Res	Military Reservation
Min	Mineral
MC	Mineral Certificate
ME	Mineral Entry
ML	Mineral Location
MS	Mineral Survey
MCOA	Mining Claim Occupancy Act
Misc	Miscellaneous
Missing Doc	Missing Document
Mod	Modification
MD Mer	Mount Diablo Meridian
Mult Use	Multiple Use
NF	National Forest
N Mon	National Monument
NP	National Park
NWR	National Wildlife Refuge
N	North
NE	Northeast
NW	Northwest
OG	Oil and Gas
Oper	Operation
O	Order
Pat	Patent
Per	Permit
Pet Res	Petroleum Reserve
Pho	Phosphate
Pot	Potash
Pwr Proj	Power Project
Pwr S	Power Site
PX	Private Exchange
Proc	Proclamation
Proj	Project
Prop	Proposed
PLC	Private Land Claim
PD	Public Domain
PLO	Public Land Order
PL	Public Law
PLS	Public Land Sale
PS	Public Sale
PW Res	Public Water Reserve
QCD	Quitclaim Deed
RR	Railroad
RRG	Railroad Grant
RRIS	Railroad Indemnity Selection
RRLS	Railroad Lieu Selection
Ry	Railway
R	Range
Recpl	Reciprocal
Rd	Road
RHE	Reclamation Homestead Entry
Recl Wdl	Reclamation Withdrawal
Recon	Reconveyed
Rec Lse	Recreation Lease
R & PP	Recreation & Public Purposes
Rmks	Remarks
Res	Reserve, Reservation
Resvr	Reservoir
Rest	Restoration, Restored
Rstd	Restricted
Rev	Revocation, Revoked
R/W	Right-of-Way
SB Mer	San Bernardino Meridian
Sec	Section
SO	Secretary's Order
Segr	Segregate
Sel	Selection, Selected
Sim	Simultaneous
ST	Small Tract
Sod	Sodium
S	South
SE	Southeast
SW	Southwest
SX	State Exchange
SG	State Grant
SS	State Selection
SD Wdl	Stock Driveway Withdrawal
SRHE	Stockraising Homestead Entry
Suppl	Supplemental
Sur	Surveyed or Survey
Sus	Suspended
Temp	Temporary
Term	Terminate, Termination
Tp	Township
Tns	Townsite
Tr	Tract
Trf Juris	Transfer of Jurisdiction
Trans	Transmission
UNDGD	Underground
Undet	Undetermined
Unsur	Unsurveyed
US	United States
USAF	United States Air Force
USFS	United States Forest Service
USGS	United States Geological Survey
WD	Warranty Deed
WP	Water Power
W	West
Wdl	Withdrawal
Wdn	Withdrawn

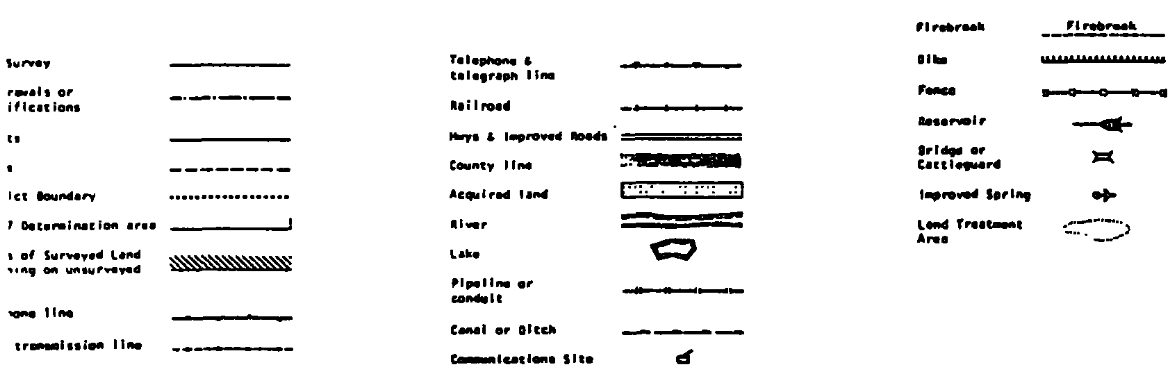


Figure 12-15.--Legend of abbreviations and symbols on new records.

Unit 13
Forest Service Signs & Posters

BEARING TREE TAGS

All properly trained field personnel are authorized to attach the bearing tree sign 54-3 to positively identified bearing trees. The sign, if properly applied, perpetuates the corner and corner accessories. It must be emphasized that the bearing trees become a monument in themselves in the event the corner monument is destroyed or lost. Any corner may be reestablished (by an authorized land surveyor) from positively identified bearing trees. The perpetuation of corner monuments, through the proper application of bearing tree tags (sign 54-3), is paramount to the land line location program.

The tags are to be attached to live or dead, standing or fallen bearing trees and may serve as additional hard (prima fade) evidence of the accessory at a future date. Bearing tree scribing and blazes often become concealed by overgrowth or deteriorated, thereby making positive identification difficult, if not impossible. The bearing tree tags usually eliminate the need for opening (cutting into) a suspected tree.

If properly used, the bearing tree tags are a most valuable sign. Considering the few minutes required to attach the tags, all field personnel can assist with perpetuation of land corner monuments. These tags may be attached to the trees with two 14- or 16-penny galvanized nails at the top and bottom center. Nails should project 1/2-inch for living trees.

LOCATION POSTERS

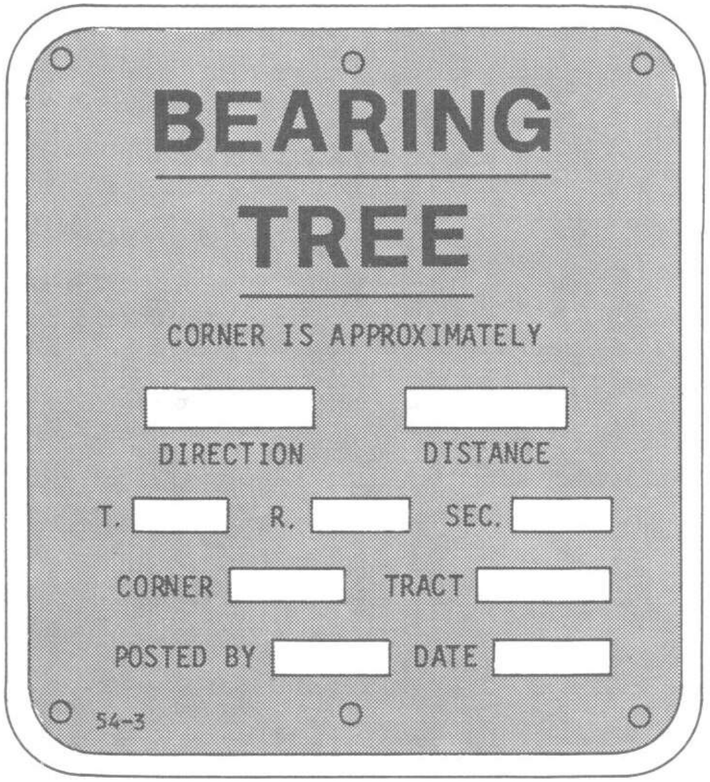
Location posters (signs 54-6, and 54-9) are among the most valuable of all the land line location signs. All field-going personnel should be familiar with these posters and their application so that they may assist with the overall recovery and perpetuation of land corner monuments.

The primary advantage of the location poster is that it requires only a few minutes to attach once the corner monument is recovered. This time spent will undoubtedly result in a tremendous savings in time and effort on the part of subsequent searchers and surveyors.

A location poster should be attached in the most visible location. Examples of desirable poster placements are at stream, road, and trail intersections; fence lines; along a boundary line; and other points visible to a passerby traveling the road or trail. Location posters also may be attached to a tree on the margin of a clearing or meadow if the corner is in heavy timber.

This sign serves as a guide to the corner monument. It may be located at any reasonable distance from the corner (1 foot to 2 miles). The 2-mile distance may seem unrealistic, but it does provide a starting point and lets the searcher know the corner has been recovered. Other information on the corner card may be more specific and will guide the searcher more precisely to the corner once he or she is in the area. Location of the "K" tag should be described on the corner card.

There are spaces available on the poster for recording bearing and distance to the corner monument. These may be neatly scratched, etched, or stamped on the poster. The bearings should be true as opposed to magnetic. These should be actual field measurements or best estimates. When they are estimates, one should indicate by showing plus or minus or approximate on the sign. Even paces may be shown and indicated as such. Although paces vary, the indications are helpful. More precise measurements may be required for corners recovered in dense oak brush or timber as such corners may be most difficult to recover.



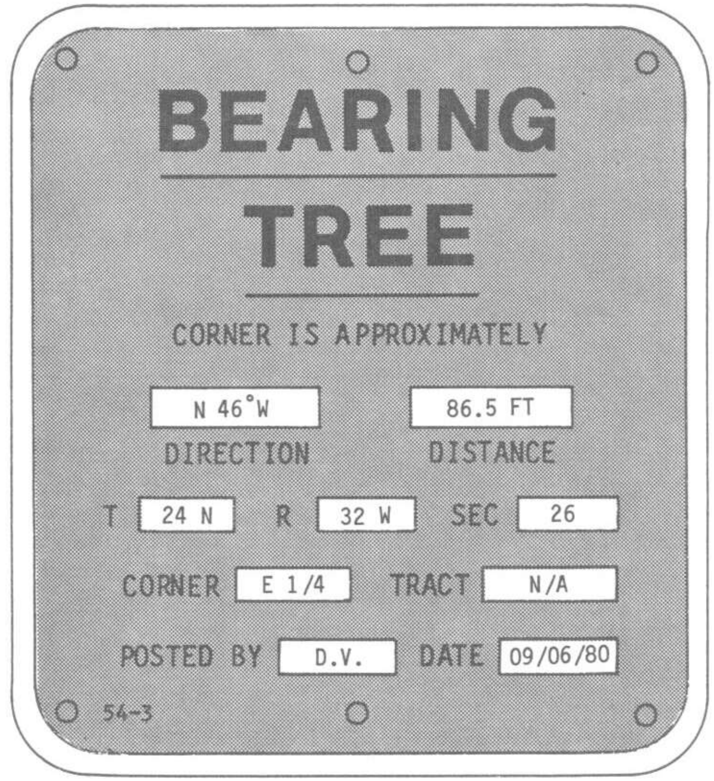


Figure 13-1.--Bearing tree signs. The bearing tree sign 54-3 on the left has not been completed. The sign on the right has been filled in for an east quarter corner. If this were a tract corner, the number of the tract and the corner number would be included. The direction given is from the tree to the corner and is a true bearing. The distance normally is given in feet and tenths; however, the BLM reports these in chains and links.

Figures 13-2 through 13-5 contain a few examples of posters that illustrate the proper application and completion of location posters. Proper use of the location posters is highly recommended and vital to the land line program. Hunters and vandals often destroy or deface these posters; therefore, it may prove worthwhile to attach an additional poster on the opposite side of the tree. An extra poster on a less visible tree also may be advisable. It nay not be seen by the vandals.

Caution: Location posters are to be used when sound evidence of the corner is found. These signs are not to be placed indiscriminately.

APPLICATION of CORNER ACCESSORIES & RECORD MEASUREMENTS

Fence corners frequently are assumed to represent the true corner point. Refer to official GLO field notes for record measurements. Original accessories may be recovered and may provide sound basis for reestablishment of the true corner. An improperly posted corner post or fence may lead to litigation since it nay convey to the landowner and others that the Forest Service accepts the post as representing the true corner position.

LAND SURVEY MONUMENT TAGS

This sign (form 54-2) is most valuable for perpetuating a monument. It is the official regulation sign to be used to perpetuate survey monuments. When riveted (with wide-based pop rivets) to a steel post and placed adjacent to a monument, it becomes a prime reference for the monument. A stick-on decal also is available and can be applied to other post types. When this sign is placed adjacent to a monument, it should be recorded on a corner card 7100-52. The bearing (true) and distance also should be recorded. Cardinal directions (north, south, east, west) can be used for convenience. The post should be placed a short distance (2 to 3 feet) away from the monument so as not to interfere with subsequent surveyors.

The land survey monument sign is especially effective for protecting the corner from destruction by heavy equipment operators who would otherwise fail to notice the monument.

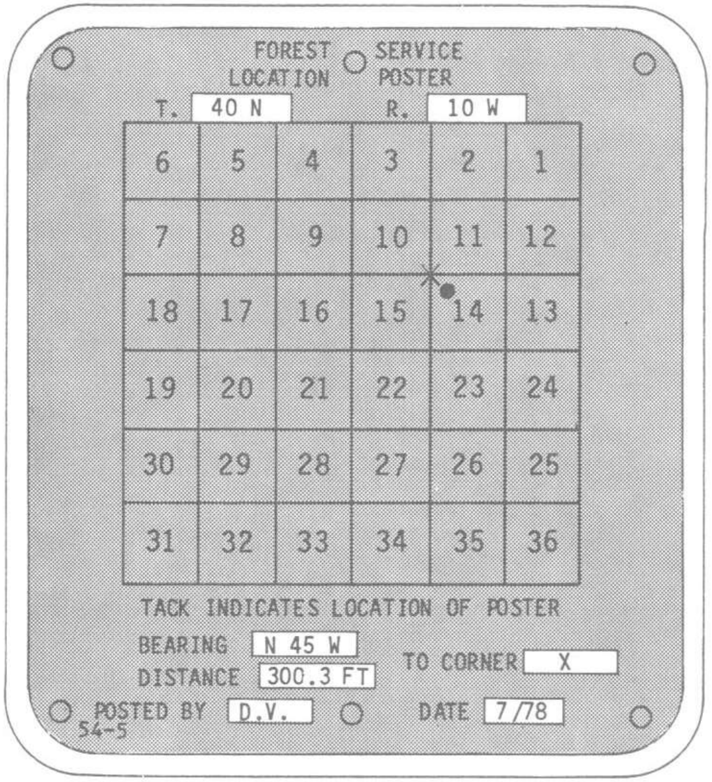
Please note that sign 54-4, attention sign, no longer is the official regulation sign to be used for perpetuation of land survey monuments. The land survey monument sign will be used once the supply of the sign 54-4 is depleted. The sign 54-9, land survey monument sign, is by far the most suited for this purpose.

PROPERTY BOUNDARY SIGNS

The authorized cadastral surveyor normally is responsible for the attachment of the property boundary signs (form 54-2). Location by survey of the true boundary usually is required. The signs are attached to steel (aluminum or fiberglass) posts by rivets or nailed to trees that fall on or very near the true line. Steel posts, though heavy, are sturdy and do not fracture when driven in rocky areas. The nails should be left protruding 1/2 to 3/4 inch to allow for growth. The decal-type sign may be attached to fiberglass or other types of posts. The sign must face the private land. Decals may be attached to the back of the sign to allow recognition of the sign from National Forest lands. Cattle are destructive to posts and signs; therefore, their presence mandates strong posts as well as additional rivets.

The property boundary sign normally is not attached to fences since fence poles may be subject to removal and/or may not be on the boundary line.

Old signs should be replaced if they are in fact on the property line. Many signs in the past were placed by compass and there was often doubt as to the location of the true line. Recent BLM resurveys often verify this fact. This is a primary reason why the posting of boundary lines is the responsibility of the Forest Land surveyor.



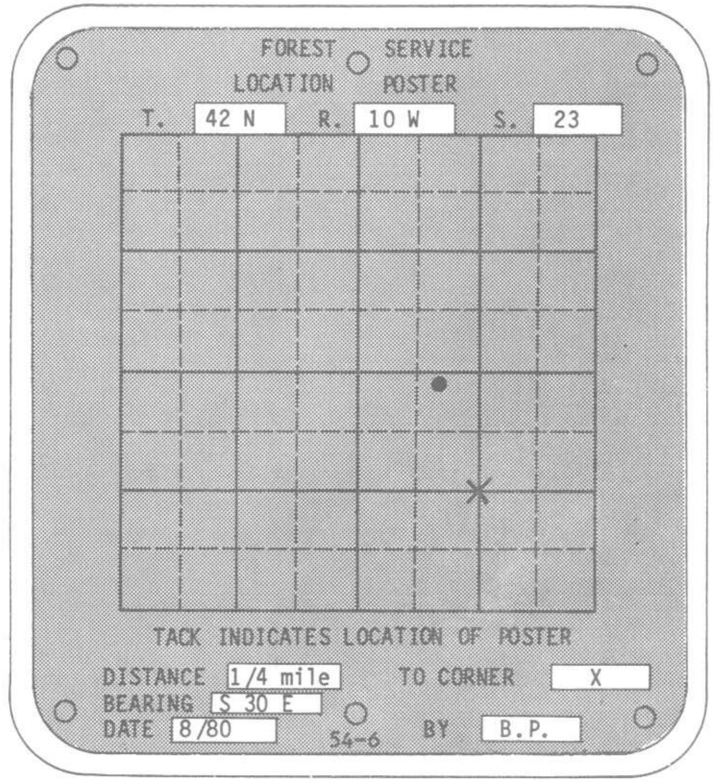


Figure 13-2.--Examples of completed location posters. The poster 54-5 on the left is for *primary rectangular corners. The poster on the right is to be used for section subdivision corners. Note that* the *posters call for a tack and that bearings are from poster to the corner. The corner is represented by a scribed "X." There are variations in the marking of these posters. Many place a tack at the corner, but the sign then becomes ambiguous. The distance the tack is placed from the corner can be greatly exaggerated. Great care must be exercised when recording bearing quadrants.*

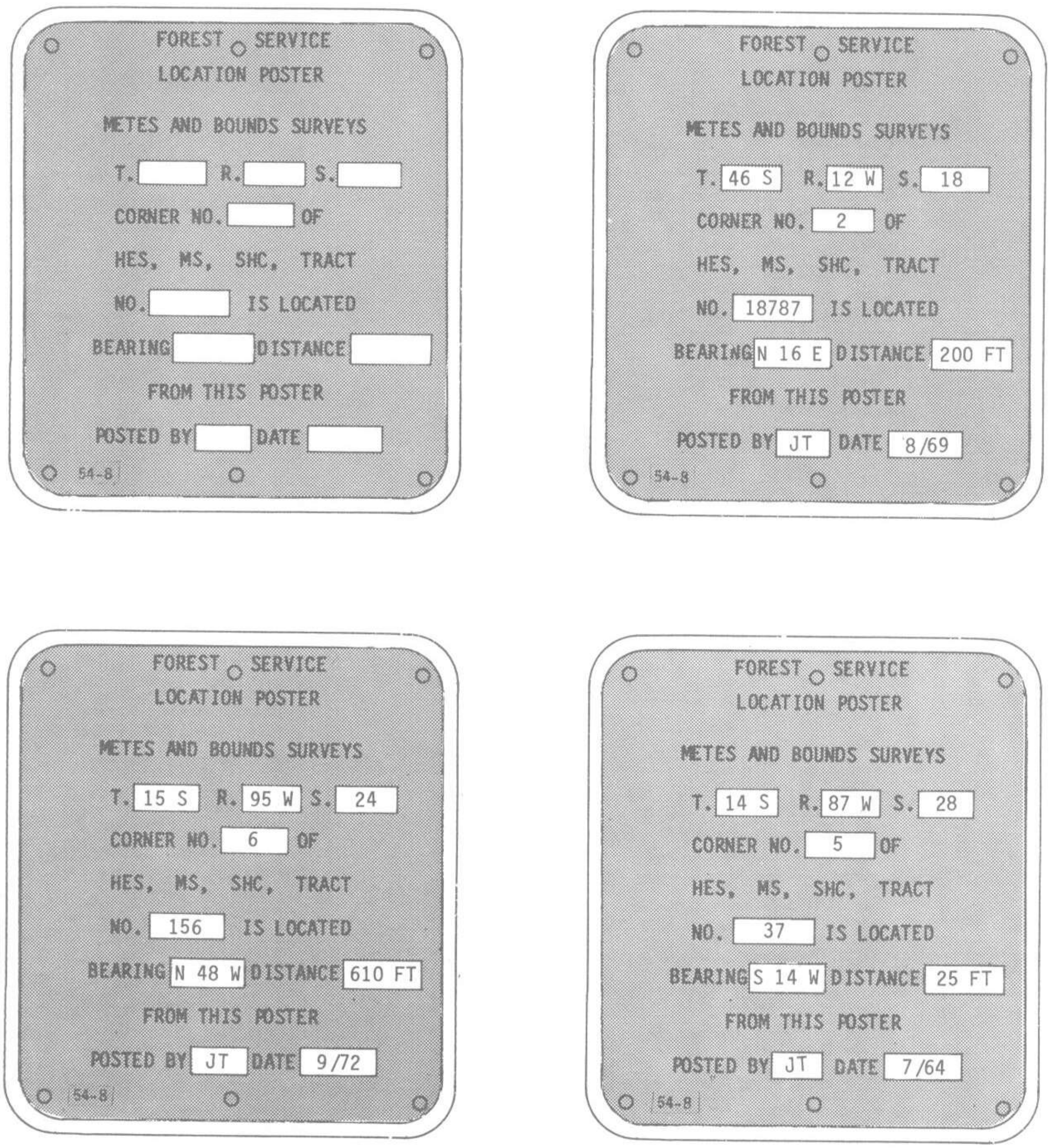


Figure 13-3.--Examples of location posters for mineral surveys, homestead entry surveys, school sections, and tract corners. Distances recorded are in feet and can be precise or estimated. This should be indicated in some manner (+). It is of great importance that the proper bearing be recorded, as this can result in wasted hours if the wrong quadrant or the *wrong* degrees are recorded. These are *most valuable* posters *as they can save surveyors and corner searchers many hours of time and frustration.*

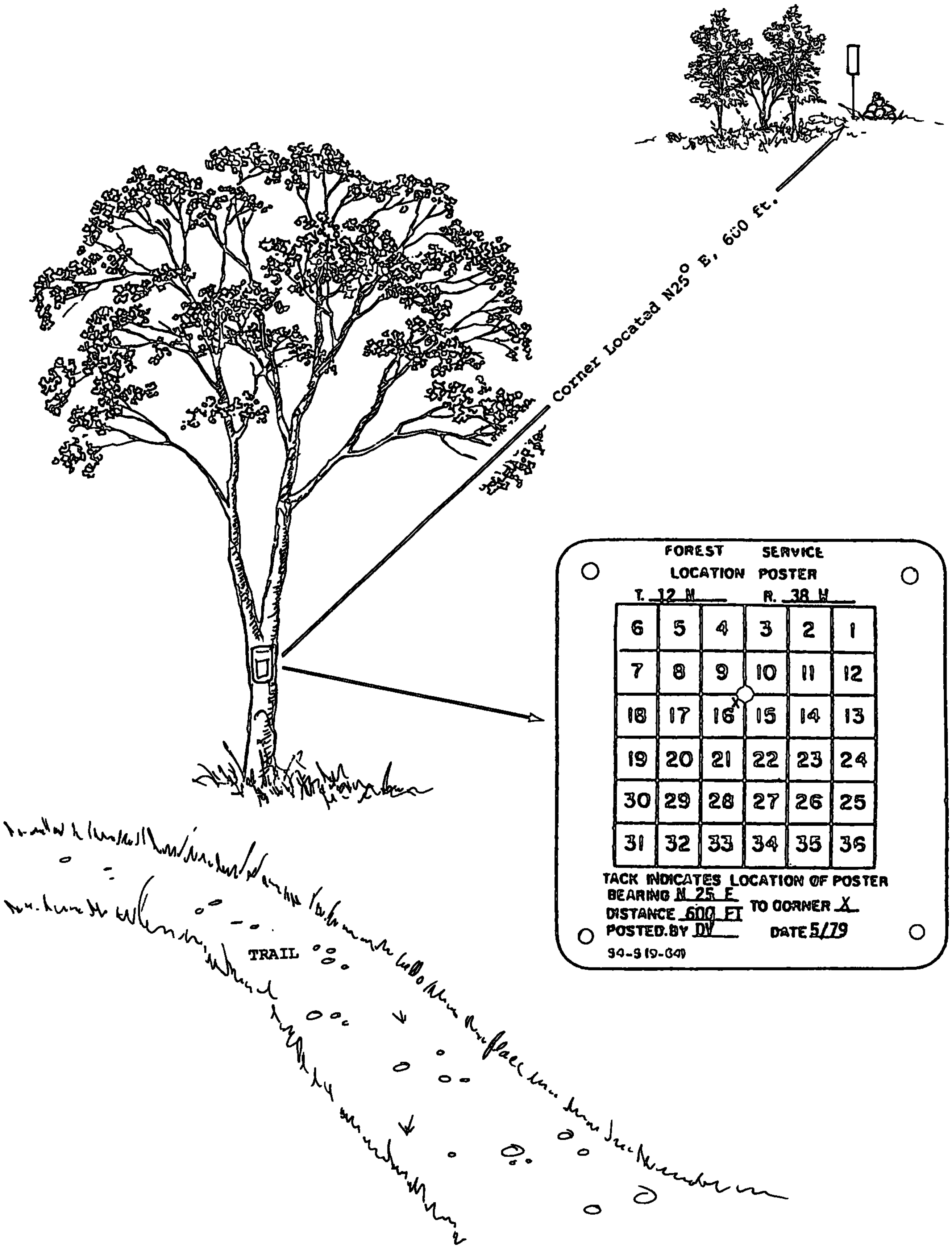


Figure 13-4.--Example of a typical placement of sign 54-6, location poster. The poster is located so as to be readily visible to a passerby proceeding along the trail.

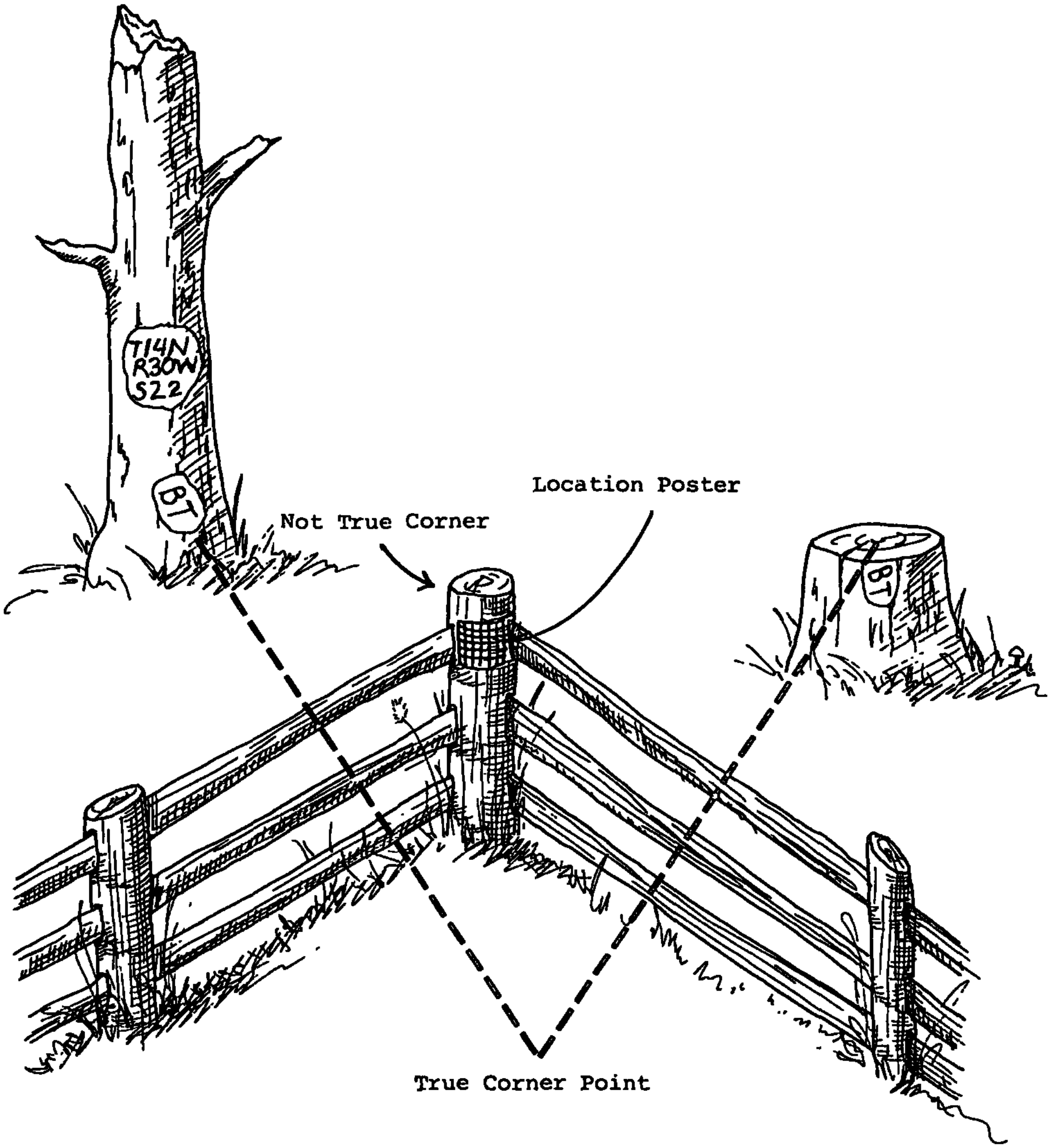
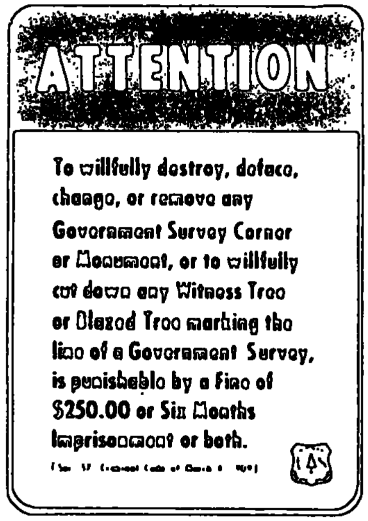


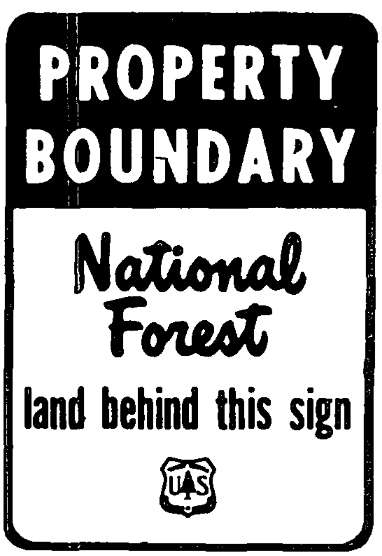
Figure 13-5.--Improper use of Forest Service location poster. Location poster or tag for this particular example erroneously implies fence corner is the true corner.

54-9 7" x 10"
Black on yellow
FSN 9905-00-436-9664



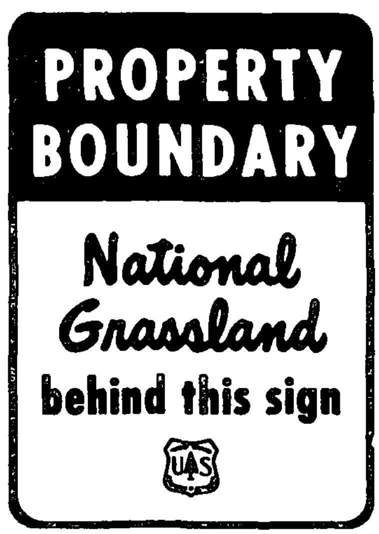
54-4 7" x 10"
Black on yellow
FSN 9905-00-890-4868

Figure 13-6.--The "Attention" sign above has been used over the years to post land survey monuments to mark them more permanently. The "Land Survey Monument" sign has now become the *official sign for posting the survey monuments. These signs should be used when supplies of the older "Attention" sign have been depleted. The land survey monument sign may also be placed at reference monuments to ensure their perpetuation. The signs are most permanently attached by pop rivets.*



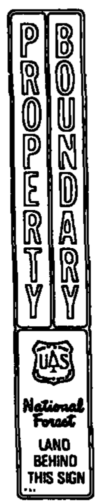
54-2 7" x 10"
Black on yellow and reverse
FSN 9905-00-890-4866

54-2a 2½" x 15"
Same as 54-2, except words "PROPERTY" and "BOUNDARY" are vertical
FSN 9905-01-150-0340

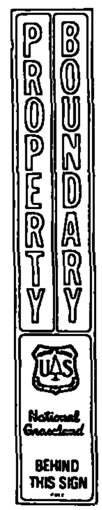


54-7 7" x 10"
Black on yellow
FSN 9905-00-890-4869

Figure 13-7.--The "Property Boundary" signs are available in both vertically or horizontally elongated versions. Care should be *exercised to place the signs on the true boundary line. These signs may be placed both on trees and posts designated for this purpose. When placed on trees, 14p to 16p galvanized nails should be used and the nails should be left projecting 1/2 to 3/4 inch. Two nails placed at center top and bottom of sign may suffice and can eliminate "popping" of the signs with tree growth. Old signs may be replaced with these new signs. A convenient method for attaching signs to posts is with pop rivets, which prevent removal of the signs. Where cattle are present in an area, new holes can be drilled farther in from the edge to prevent signs from tearing off.*

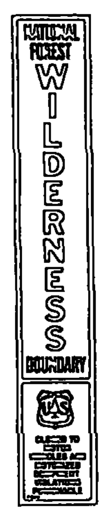


P54-1 **2½" × 15"**
Black on yellow (decal). For use on standard line post.



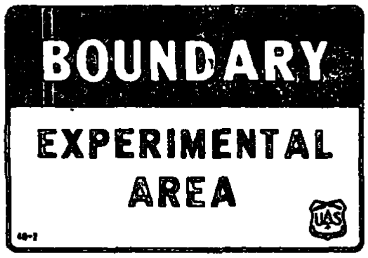
P54-2 **2½" × 15"**
Black on yellow (decal). For use on standard line post.

P71-10 **2½" × 15"**
Black on yellow (adhesive-backed)

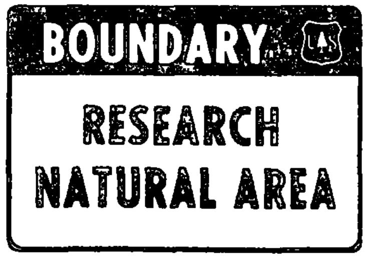


P54-3 **2½" × 15"**
Black on gray (decal). For use on standard line post.

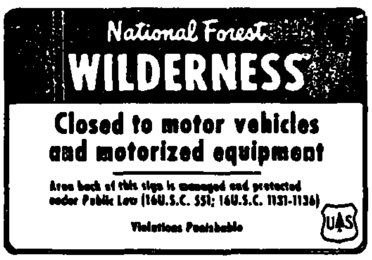
Figure l3-8.--The decal-type sign is easy *to* use and can be *quite permanent when used with posts designed for the decals. Fiberglass posts are especially suited for* *decal-type signs. Such posts* are *expensive, however, and may shatter when driven in rocky ground. Note that the above signs may be used for posting both standard and wilderness boundaries.*



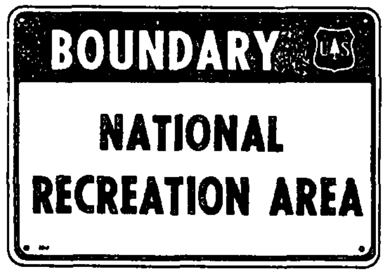
40-2 10" x 7"
Black on yellow and reverse
FSN 9905-00-887-8136



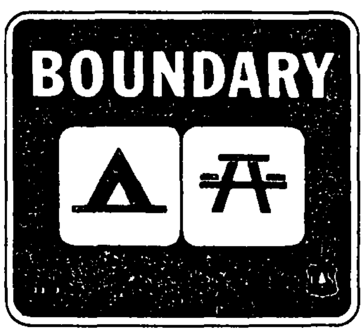
40-4 10" x 7"
Black on yellow and reverse
FSN 9905-00-436-9661



27-6A 10" x 7"
Black on gray and reverse
FSN 9905-00-887-8020



23-7 10"x7"
Black on yellow and reverse



23-3 5" x 4 1/2"
Dark green on light green and reverse
FSN 9905-00-258-1518

Figure 13-9.--Additional signs used for specific needs. Note that the wilderness sign is in black and gray.

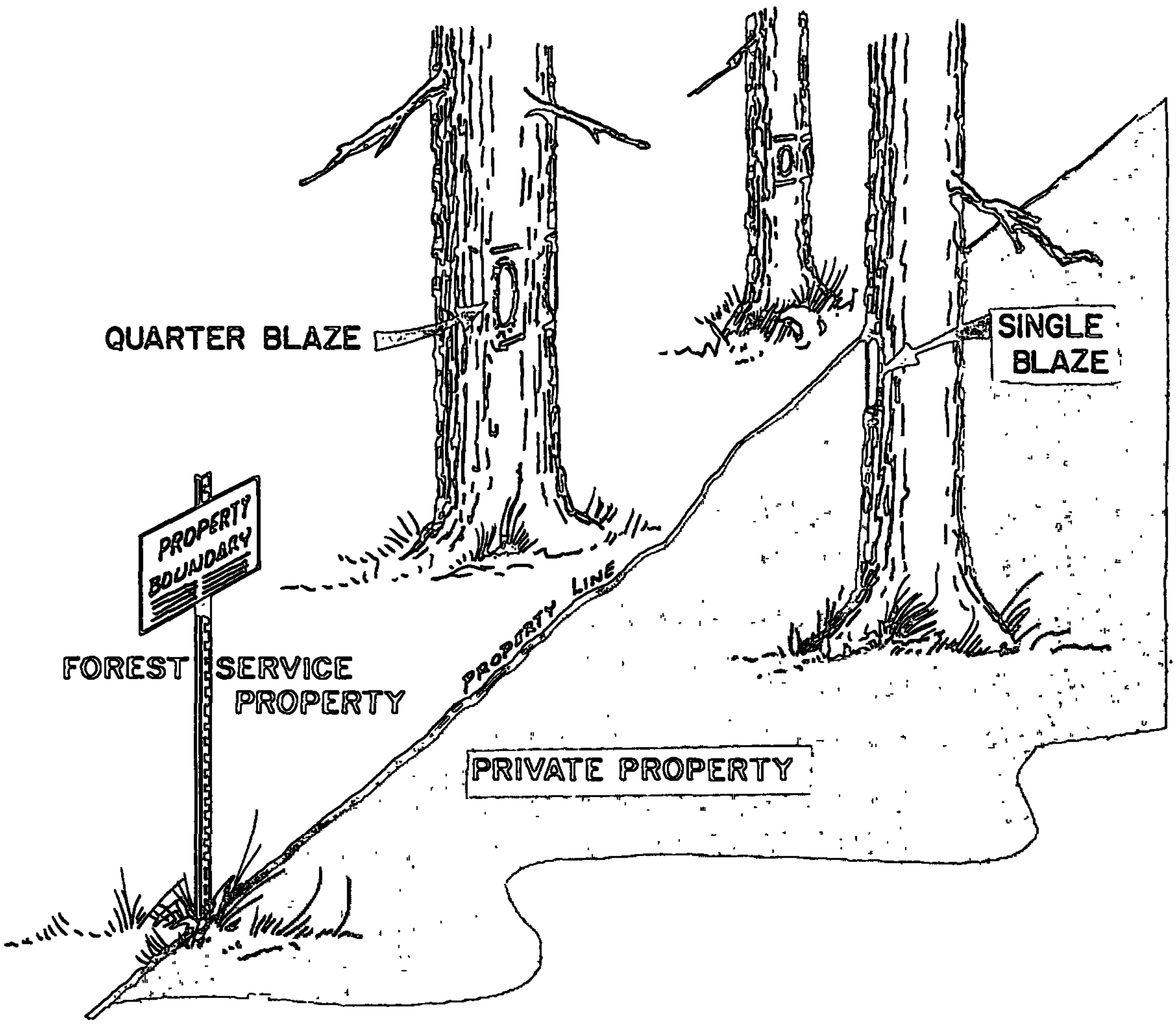


Figure 13-10.--Sketch showing a National Forest property line marked and posted to Forest Service standards. A corner searcher should be alert to such markings, as even though they may be partially overgrown, they often simplify the *corner recovery. The single blaze is technically termed “face blaze.” Some type of backing may be* used *to prevent signs from being bent by cattle or vandals. Vertically elongated signs also may limit bending. The decal-type sign also may be used with special posts.*

Unit 14
Corner Records

PHYSICAL CRITERIA for CORNER CARDS

Corner card descriptions frequently are deficient in physical references. Field personnel are not always aware of the precise type of data needed or available for use on the corner cards. The following are examples of such criteria. A quick review of this list will acquaint the field person with possible features and objects to record.

(1) A prominent or lone tree.

(2) A group of trees (for example, spruce in aspen).

(3) Manmade improvements, including water tanks, cattle guards, cabins, culverts, power poles, roads and road intersections, sign posts, concrete objects, parking areas, irrigation ditches, pipelines, fences, and fire hydrants.

(4) Open park-like areas, eroded areas, large boulders.

(5) Trails.

(6) Streams and springs.

Reference monuments may be established in more permanent areas. Of course there are occasions where it is difficult to determine whether an area is permanent or not. If there is a question here, it may prove worthwhile to select or establish reference points at greater distances (for example, 600 feet) to avoid total destruction of all points recorded. This is acceptable, especially in light of the modern electronic distance meters available today. In remote areas not subject to change, reference objects or monuments should be set closer (100 feet or less) for convenience and ease of recovery or reestablishment of the corner.

Monuments or other items may be used to reference stations. PK nails (hardened) or nails and washers may be suitable. A nail and washer can be driven and tied to a power pole. Forest Service location posters, placed in conspicuous places, can prove most valuable. Red posts are in standard use with the Forest Service, and when used in conjunction with signs and posters, these serve as fine reference objects. Red-orange (poppy-red) posts are more visible in heavy timber, however. Reference marks also can be set flush or a few inches below the pavement surface or ground surface. These must be recorded or subsequent searchers may never recover these. Any reference monument marked with a cap or disk should be carefully read to avoid confusion as to which is the true corner monument, if one has been set.

A sketch or map should be drawn on the recovery card or, at a minimum, an adequate description for accessing the corner should be included. It is quite common for the searcher to describe in detail the corner itself and totally omit this type of information. This information is somewhat similar to a vicinity map or a survey plat. It serves to provide location and direction from a certain geographical location to the corner. A final check for obvious features should be made prior to leaving the corner area.

A rubbing is a reproduction of the metal monument cap stampings (see figure 14-3). It is obtained by overlaying a piece of paper on the cap and executing a series of closely spaced back and forth motions of a pencil (3 to 5H) over the surface.

USDA-FOREST SERVICE GPO 940-117

CORNER RECORD (SEARCH) (Ref. FSM 7151.4)

Index File No. N - 13 | Tract or Survey No. ____ | Cor. No. ____

T 50 N R. 13 W | R.D. Miguel | County Montrose

Merid. NMPM | N.F. Uncompahgre | State Colorado

CORNER DIAGRAM

N

T50N R13W

16 | 15

21 | 22

1908

DESCRIBE CORNER MONUMENT FOUND

Sandstone 8"x4"x14" above ground. Stone scribed ≡ on east face, = on south face. Location fits topo calls and map location.

DESCRIBE BEARING TREES OR OTHER OFFICIAL ACCESSORIES FOUND

1) 14" dia pinon (dead-standing) BT bears SW, 11 feet
2) 18" dia pinon BT bears S30°E, 19 feet
3) 17" dia pinon (dead-leaning) BT bears N70°E, 68 feet
4) 16" dia pinon (dead & out-of-ground) - hole bears S30°W 35 feet

Partial mound of stone 3 feet east of corner.

PHOTO IDENTIFICATION DATA

Photo No. ENZ5-77

Filed At. RO

Object Ident. Lone Juniper

Ident. By John Turner (Signature)

PLANE COORDINATE POSITION DATA

State ____ Zone ____

X ____

Y ____

Estab. By ____ (Agency)

DESCRIBE CORNER LOCATION RELATIVE TO NEAR-BY FEATURES, ALSO HOW TO REACH CORNER

Corner is on a NW facing slope in heavy juniper and pinon timber; hill steep; there is a small clearing with a single juniper in center bearing N40°W, 103 feet; this tree is photo identified and has FS location poster on same; FS poster placed on 18" dia juniper on south edge of heavy timber; corner is approx. north, 170 paces.

Signature	Title	Division	Headquarters	Date
John Turner	Survey Tech	S & M	Denver	9/21/67

7100-52 (3 68)

Figure 14-1.--Corner search record. Directions for accessing a corner and/or location posters can be quite helpful.

CORNER RECORD (PERPETUATION)

MONUMENT. DESCRIBE NEW MONUMENT SET, OR WORK DONE TO PRESERVE EXISTING MONUMENT

New mound of stones built 2'x3'x4', 3 feet east of corner. Five foot red, steel post set 2 feet north of monument with land survey monument sign attached. BT tags attached to BT's. Brush cleared around corner and flagging tied to junipers. Rock collar built around monument.

ACCESSORIES. DESCRIBE NEW BT's WITNESS OBJECTS ETC. ESTABLISHED, OR WORK DONE TO PRESERVE EXISTING EVIDENCE

Corner is approx. 200 feet north of game trail and 50 feet west of large boulder.

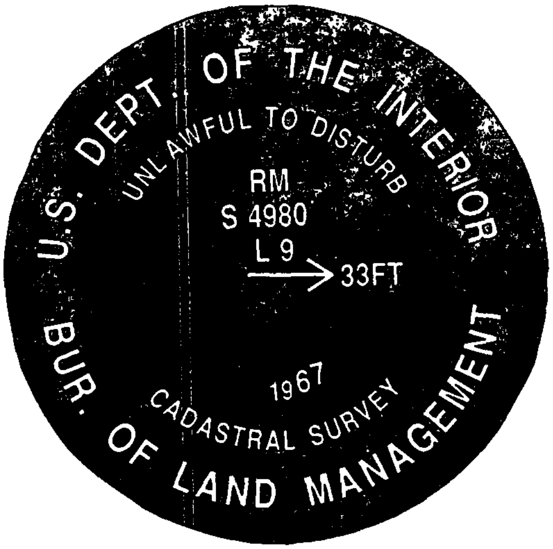
Work Done By John Turner Title Survey Tech Date 9/21/67 State Registration No. or Agency ____

Certified Cor. Record Prepared? Yes No X Filed At: ____ Date ____

REMARKS

Index File No. N -13 T. 50 N R. 13 W M. N.M. Tract or Surv. No. ____ Cor. ____

Figure l4-2.--Corner perpetuation record. The “Remarks" section can be used for a map or sketch.



Explanation of Stampings:

RM = Reference Mark

S4980 = U.S. Survey No. 4980

L9 = Lot No. 9

33 FT = Direction & Distance to Actual Monument

1967 = Date

NOTE: The lot corner no. was omitted. Words on outer portion of cap are pre-stamped.

Figure 14-3.--Example of rubbing.

The rubbing is useful in that it is an exact replica and not a copy of the stampings. If any questions arise concerning the cap markings, the rubbing (if properly executed) may very likely resolve them. The rubbing is especially useful when the corner searcher is inexperienced, but even experienced surveyors should resort to using these. Rubbings also are invaluable when a survey crew has established a new corner monument. There is always the chance that the cap was improperly stamped. The rubbing may become a part of the permanent record.

ITEMS TO BE RECORDED

(1) Every corner encountered during a corner search must be completely described.

(2) At found original corners, there must be a complete description of what was found, including monumentation and accessories.

(3) When the corner is a stone monument, it must be fully described as to size, kind, how marked, how set (firmly, loosely), and how far projecting above ground or how far set in the ground.

(4) When a stake is found, it must be described as to kind, size, and how marked and set.

(5) When an iron post with a brass cap is found, it must be described as to size of iron post, how far it projects above ground, and how it is marked.

(6) The original accessories also must be described. For a mound of stone, describe how large a diameter, how high, and where placed in relation to the corner point, provide exact description, location, and markings of bearing objects and bearing trees found.

(7) Any new accessories established by an authorized cadastral surveyor must be fully and correctly marked in the field and stated in the field notes.

(8) A mound of stone will be described by size and relationship to the corner point.

(9) If a corner is remonumented (by an authorized surveyor), the disposition of the found monument must be stated as to whether buried, deposited alongside, or inverted inside the new monument.

(10) Bearing trees will be listed as to kind, diameter in inches, bearing from the corner point, distance in feet, and markings. Tree sizes frequently increase considerably since the original survey.

(11) At all corner points there must be a complete description of what was done to perpetuate a corner. When a monument is set by an authorized land surveyor, the new post must be described as to size and how far set in the ground. The brass cap must be correctly marked, and the marks, including the township, range, section numbers, date, horizontal and vertical bars, and when used, must be correctly oriented on the brass cap.

LS-12 R1 Revised 1982

COLORADO LAND SURVEY MONUMENT RECORD

REPORT ONE MONUMENT ONLY ON THIS FORM

REPRODUCTION OF THIS FORM IS AUTHORIZED.

All items to be filled in by the Land Surveyor using permanent black lettering and lines which can be reproduced. (Except)*

1. TYPE OF MONUMENT (Check one) ▶ ☐ Section Corner ☐ Quarter Corner ☐ Bench mark ☒ Other Mineral Survey Corner

2. DESCRIPTION OF MONUMENT FOUND

A stone, 24x12x9 ins. firmly set in mound of stone, 3' base, flush with ground, mkd. cross (+) in top (record wood post 48x6x6 ins. in mound of stone). Stone found under excessive debris from a mine flume. This stone thought to have been set to replace less permanent wood post. Stone monument located within 2' of record retracement position, therefore accepted.

3. DESCRIPTION OF MONUMENT ESTABLISHED BY YOU TO PERPETUATE THE LOCATION OF THIS POINT.

Set a standard BLM aluminum monument, 28" long, 2½" diam., 16" in the ground, with supporting mound of stone, 2' base, to top, with cap mkd. as shown:

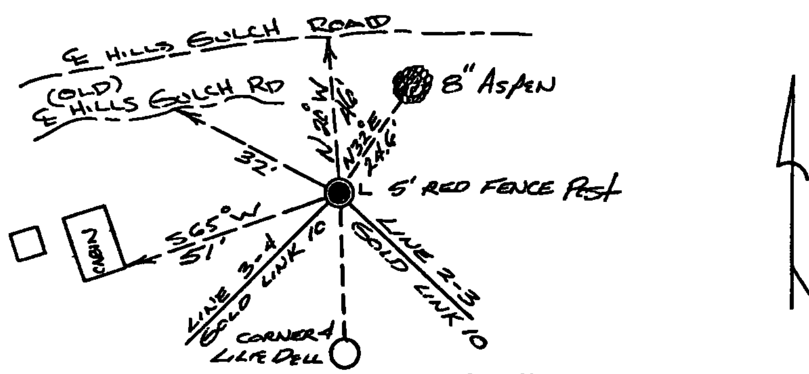
19761 LD 3 GL10 15656 1985

From which: An aspen, 8" diam., bears N32°E, 24.6', mkd. 3/15656 BT
Corner 4, Lillie Dell lode, MS 19761, bears S2°W, 93.8'

4. SKETCH SHOWING RELATIVE LOCATION OF MONUMENT ACCESSORIES AND REFERENCE POINTS STATING WHETHER FOUND OR SET. SHOW SUPPORTING AND/OR CONTRADICTORY EVIDENCE WHERE APPLICABLE.

Set a 5' steel fence post, with USFS monument sign attached, alongside mound.

Corner was established as part of BLM resurvey, by best available evidence.



Date of Field Work 9/03/85

5. CERTIFICATION

This is to certify that I was in responsible charge of the surveying work described in this record and that to the best of my knowledge the information presented herein is true and correct.

Date 12/14/85   Signature [signature]

date received 9-15-86

*(Do not fill in)

Accepted for Filing

State Board of Registration for Professional Engineers and Land Surveyors:

By John B. Guyton

Date 9-15-86

RECEIVED AT OFFICE OF THE COUNTY CLERK:

_______________ COUNTY

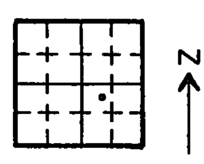
By _______________

Date _______________

Record to be filed by Index Reference Number, numerically, then alphabetically, under appropriate Township, Range, and Meridian.

6. LOCATION DIAGRAM

1" = 1 Mile



• = Location of Monument

DENNIS L. VALDOVINOS REGISTERED 17506 LAND SURVEYOR STATE OF COLORADO

Surveyor's Seal

7. SEC. 36, T 51N, R 3½E, NM P.M.
COUNTY Gunnison INDEX REF. NO. 23.8.B.4

8. SEC. ____, T ____, R ____, ____ P.M.
COUNTY ____ INDEX REF. NO. ____

Department of Regulatory Agencies
PROFESSIONAL ENGINEERS AND PROFESSIONAL LAND SURVEYORS BOARD.
600B State Services Building, 1525 Sherman Street, Denver, Colorado 80203

Figure 14-4.--Colorado land survey monument record.

Unit 15
Corner Record Report & Index

REPORT

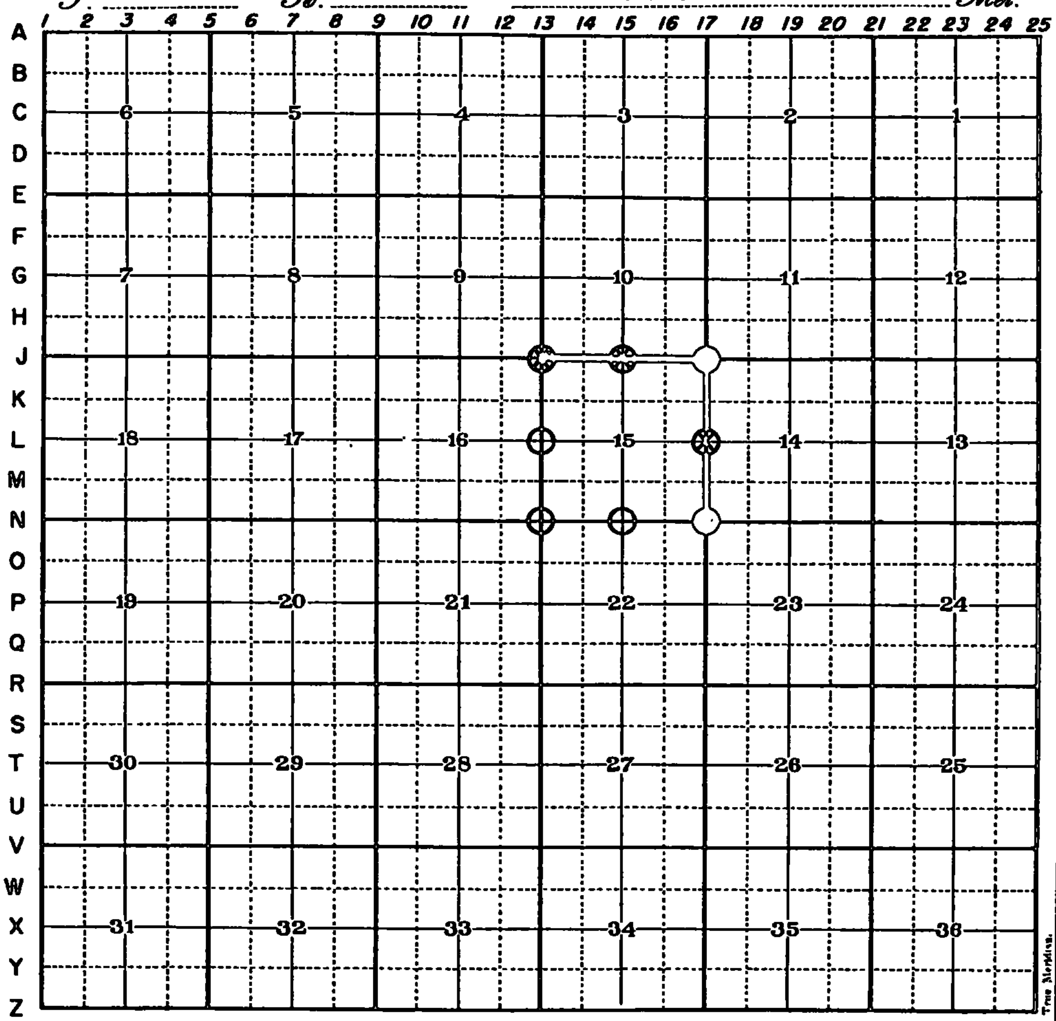
CORNER SEARCH, EVALUATION, MONUMENTING and BOUNDARY MARKING

(Rev: FSM 7150)

From 6/06/79 To 9/30/79

Region 2 Forest Grand Mesa, Uncompahgre & Gunnison

T. 44 N R. 10 W New Mexico Mer.



SCALE.—One inch = 1 mile.

LEGEND

○ Corners searched for

⊗ Evidence believed acceptable

○ Corners monumented

○—○ Boundary posted (line only in red)

GPO 876-118

FS 7100-53 (12/80)

Figure 15-1.--Sample corner search, evaluation, monumenting, and boundary marking reports. Such reports are excellent for district use.

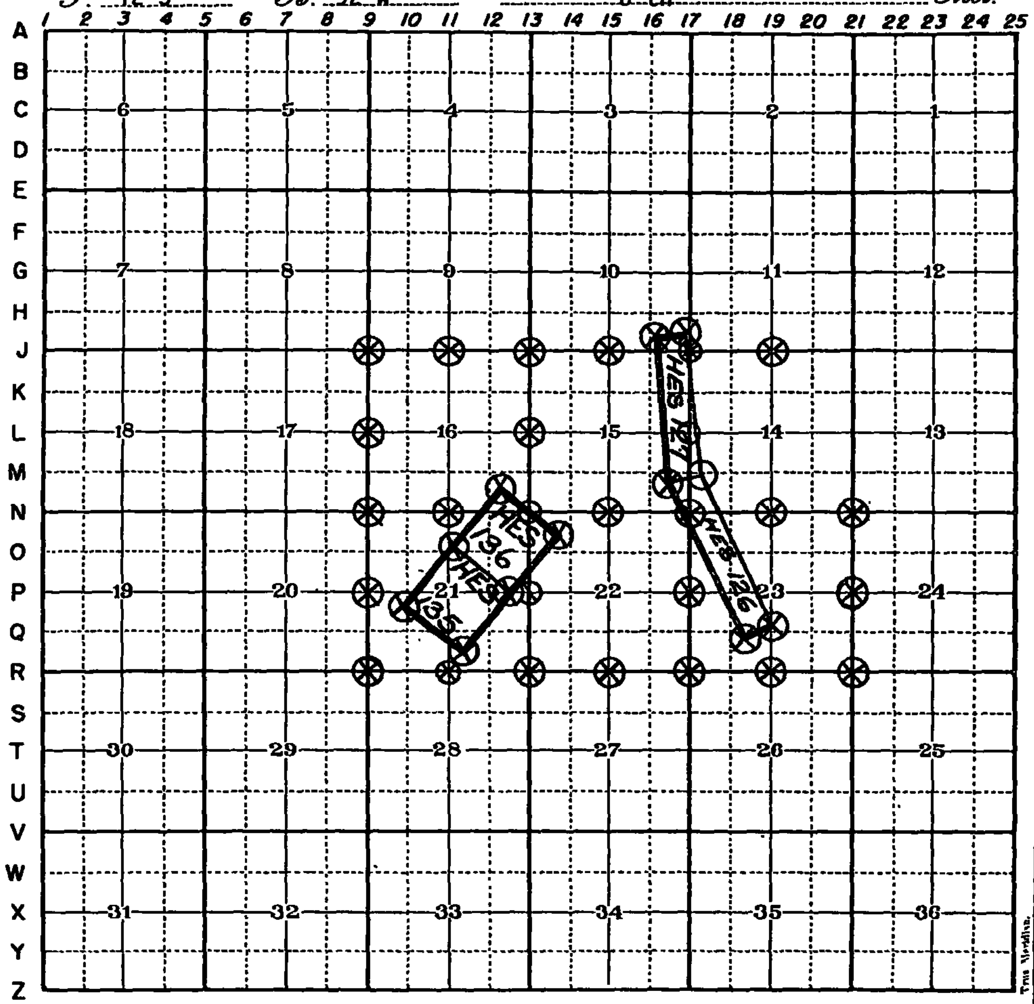
REPORT

CORNER SEARCH, EVALUATION, MONUMENTING and BOUNDARY MARKING

From 7/15/80 To 9/14/80

Region 2 Forest Grand Mesa, Unc. & Gunnison

T. 12 S R. 92 W 6 th Mer.



SCALE.—One inch = 1 mile.

LEGEND

- ○ Corners searched for
- ⊗ Evidence believed acceptable
- ● Corners monumented
- ●—● Boundary posted (line only in red)

7100-53

Figure 15-1. (cont.)--Sample corner search, evaluation, monumenting, and boundary marking reports.

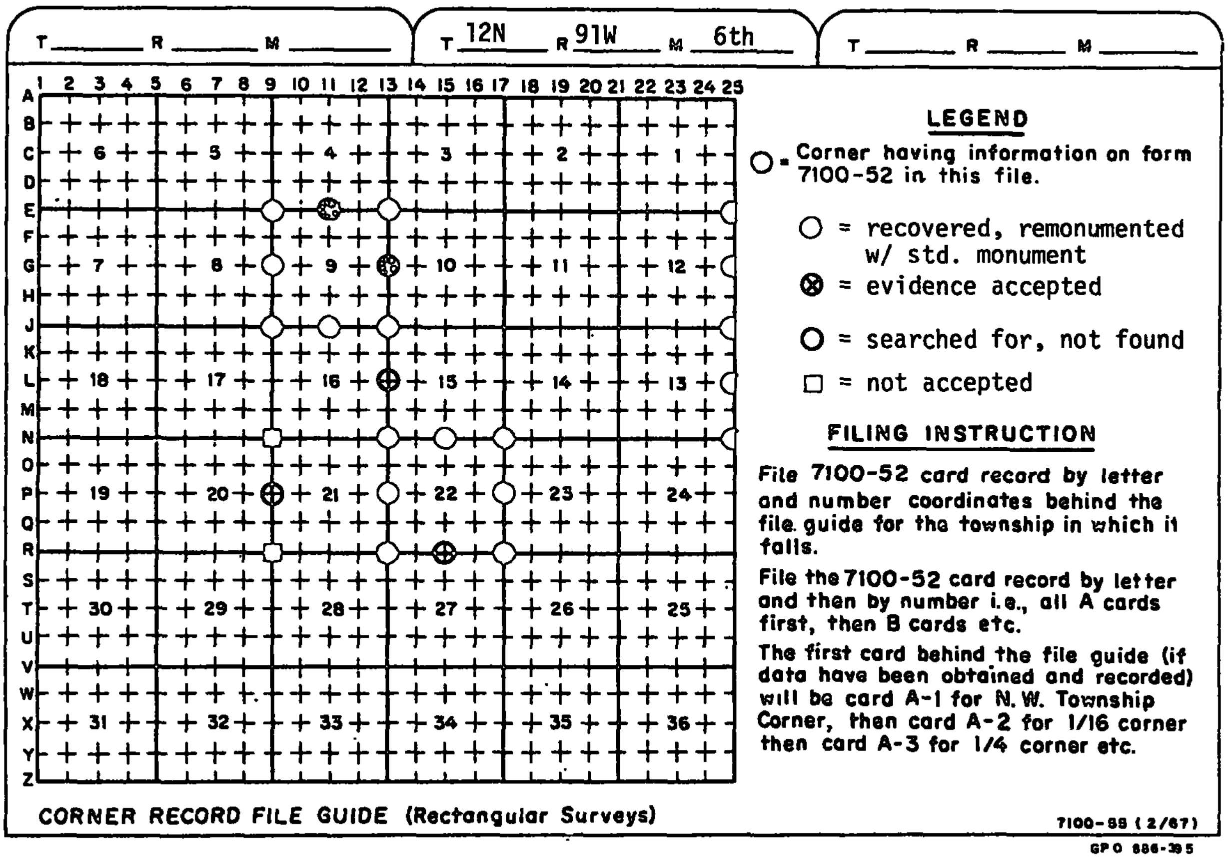
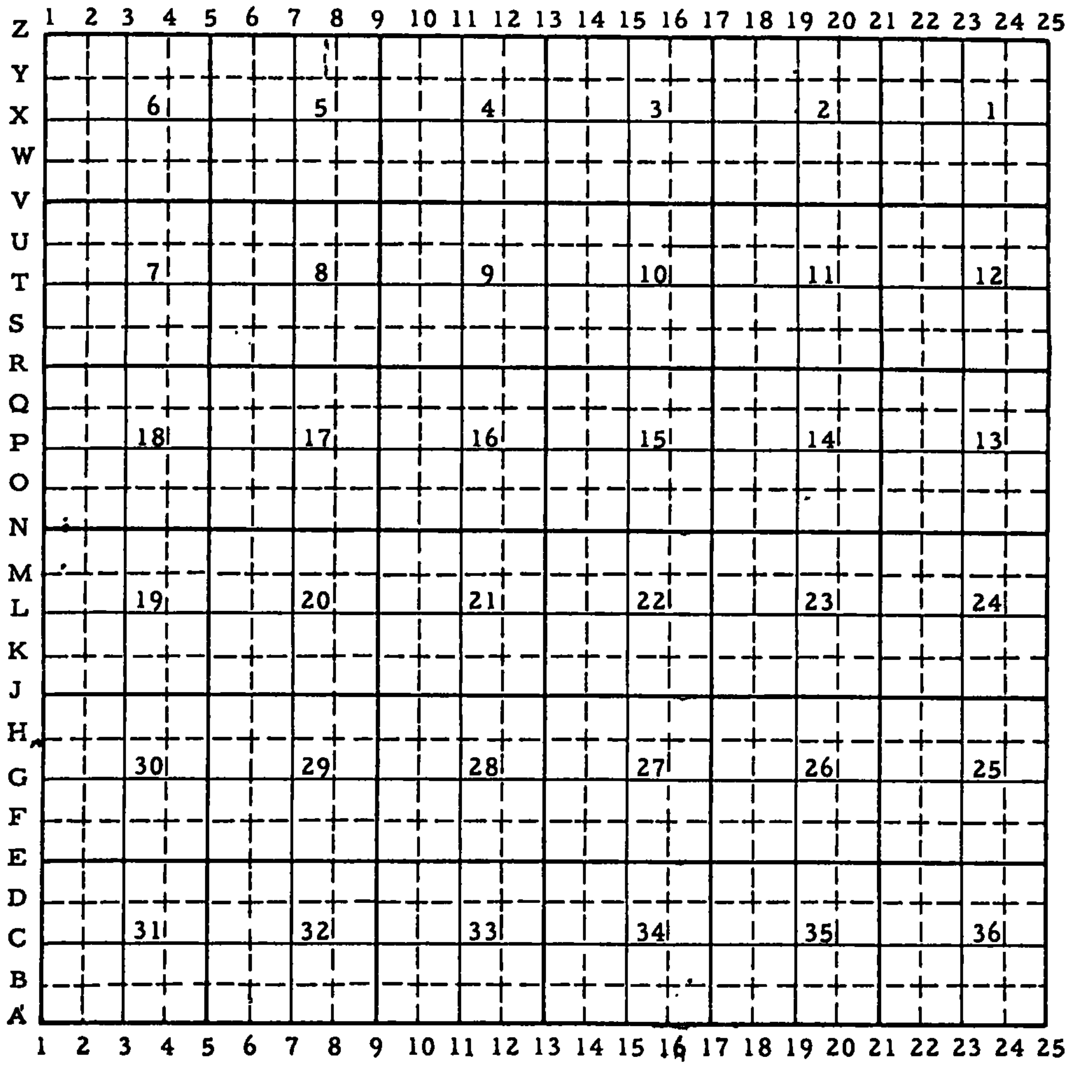


Figure 15-2.--Corner Record File Guide, used for separating recovery cards by township and range. The alphanumeric system with grid lines is the accepted indexing method. Corners may be indicated by the dots or circles for a quick reference.

COLORADO LAND SURVEY MONUMENTS MASTER INDEX

TOWNSHIP ______, RANGE ______, ______ P.M.



LEGEND

N

Scale
1" = 1 Mile

Location of Monument. Record filed under this township.

or

Location of Monument. Record filed under adjoining township as indicated by solid quadrant(s).

Figure 15-3.--Colorado land survey monuments master index.

07/29/80 SURVEY INFORMATION FOR CORNER LOCATION ON THE GM-UNC-GUNN NF VALDOVINOS

ID NR LOCATES THE POINT ON A GRID OF THE TOWNSHIP (GPO 892-953).

ID NR	TOWN SHIP	RNG	SEC.	DIST NAME	COUNTY NAME	TYPE OF CORNER	AGENCY OF MARKER	DATE OF INFO YYMMDD	ORTHOPHOTO QUAD NAME	AERIAL PHOTO ID NR.	STATUS OF CORNER
G1	50N	15W	7	G.J.	MESA	N.F.	BLM	670906	SNIPE MTN	ENZ-5-53	REMONUMENTED
G5	50N	15W	7	G.J.	MESA	N.F.	BLM	670907	SNIPE MTN	ENZ-5-51	REMONUMENTED
J1	50N	15W	7	G.J.	MESA	N.F.	BLM	670829	SNIPE MTN	ENZ-5-53	REMONUMENTED
N17	50N	15W	14	G.J.	MESA	N.F.	BLM	670823	SNIPE MTN	ENZ-5-73	REMONUMENTED
N13	50N	15W	15	G.J.	MESA	N.F.	BLM	670823	SNIPE MTN	ENZ-5-71	REMONUMENTED
N15	50N	15W	15	G.J.	MESA	N.F.	BLM	670823	SNIPE MTN	ENZ-5-71	REMONUMENTED
V3	50N	15W	30	G.J.	MESA	N.F.	BLM	710726	SNIPE MTN	ENZ-5-70	REMONUMENTED
A21	50N	16W	1	G.J.	MESA	N.F.	BLM	710702	UNCOMPAHG.BUTTE		SEARCH, NOT FOUND
A23	50N	16W	1	COLL	MESA	N.F.	BLM	710706	UNCOMPAHG.BUTTE		SEARCH, NOT FOUND
A25	50N	16W	1	COLL	MESA	N.F.	BLM		UNCOMPAHG.BUTTE		SEARCH, NOT FOUND
C21	50N	16W	1	G.J.	MESA	PVT.LAND	BLM	710702	UNCOMPAHG.BUTTE		SEARCH, NOT FOUND
C5	50N	16W	1	G.J.	MESA	N.F.	BLM	711005			REMONUMTED,BRASS CAP
E21	50N	16W	1	G.J.	MESA	N.F.	BLM	710702	UNCOMPAHG.BUTTE		SEARCH, NOT FOUND
E23	50N	16W	1	G.J.	MESA	N.F.	BLM	710707	UNCOMPAHG.BUTTE	ENZ-5-52	REMONUMENTED
E23	50N	16W	1	G.J.	MESA	N.F.	BLM	711005			REMONUMTED,BRASS CAP
A19	50N	16W	2	G.J.	MESA	N.F.	BLM	710702	UNCOMPAHG.BUTTE		SEARCH, NOT FOUND
C17	50N	16W	2	G.J.	MESA	N.F.	BLM	710624	UNCOMPAHG.BUTTE	ENZ-5-54	REMONUMENTED
C17	50N	16W	2	G.J.	MESA	PVT.LAND	BLM	711005	KELSO POINT		REMONUMTED,BRASS CAP
E17	50N	16W	2	G.J.	MESA	N.F.	BLM	670719	UNCOMPAHG.BUTTE	ENZ-5-53	REMONUMENTED
E17	50N	16W	2	G.J.	MESA	PVT.LAND	BLM	711005	KELSO POINT	ENZ-5-53	REMONUMTED,BRASS CAP
A15	50N	16W	3	G.J.	MESA	N.F.	BLM	711005			REMONUMTED,BRASS CAP
A15	50N	16W	3	G.J.	MESA	PVT.LAND	BLM	710622	UNCOMPAHG.BUTTE	ENZ-5-54	REMONUMENTED
E13	50N	16W	3	G.J.	MESA	N.F.	BLM	710617	X LAZY F RANCH		SEARCH, NOT FOUND
E15	50N	16W	3	G.J.	MESA	N.F.	BLM	710617	UNCOMPAHG.BUTTE	ENZ-5-54	SEARCH, NOT FOUND
A11	50N	16W	4	G.J.	MESA	N.F.	BLM	710622	UNCOMPAHG.BUTTE	ENZ-5-54	REMONUMENTED
A11	50N	16W	4	G.J.	MESA	PVT.LAND	BLM	711005			REMONUMTED,BRASS CAP
A9	50N	16W	4	G.J.	MESA	PVT.LAND	BLM	671027	UNCOMPAHG.BUTTE	ENZ-5-54	REMONUMTED,BRASS CAP
C9	50N	16W	4	COLL	MESA	N.F.	BLM	710617	UNCOMPAHG.BUTTE	ENZ-5-54	SEARCH, NOT FOUND
E11	50N	16W	4	G.J.	MESA	N.F.	BLM	710617	UNCOMPAHG.BUTTE	ENZ-5-54	REMONUMENTED
E11	50N	16W	4	G.J.	MESA	N.F.	BLM	711005	SNIPE MTN		REMONUMTED,BRASS CAP
E9	50N	16W	4	G.J.	MESA	N.F.	BLM	710617	UNCOMPAHG.BUTTE		SEARCH, NOT FOUND
A7	50N	16W	5	G.J.	MESA	N.F.	BLM	671027	UNCOMPAHG.BUTTE	ENZ-5-54	SEARCH, NOT FOUND
A1	50N	16W	6	G.J.	MESA	N.F.	BLM	670711	UNCOMPAHG.BUTTE	ENZ-5-55	REMONUMTED,BRASS CAP

Figure 15-4.--Computer printout listing the Survey Corner Information File developed on the Grand Mesa, Uncompahgre, Gunnison National Forest. The file conveniently maintains information on thousands of corners. Although information is basic, it does serve as a quick-reference record. Printouts can be made available to surveyors upon request. It also is feasible to develop a computerized file that contains corner card descriptive data. This may be possible with FLIPS.

Unit 16
Perpetuation

MAINTENANCE & PERPETUATION of CORNERS

Perpetuation is the marking, rehabilitation, and preservation of corner monuments of the U.S. public land system, as well as other survey monuments. Failure to perpetuate land corner monuments will lead ultimately to expensive litigations as a result of numerous trespass situations. Costly surveys will be required to resolve these situations.

The Forest Service has established standard procedures and specifications for perpetuating corner monuments. Most are adopted from BLM methods and procedures, with modifications. It is the responsibility of all field-going personnel to protect and maintain property survey lines, corner monuments, and corner evidence that are encountered during their field work.

Point

Normally only a few minutes may be required to perpetuate a corner monument. This can be the most valuable time spent, since it often requires an official survey to reestablish a lost corner monument. Although the steps listed to perpetuate a corner appear to be lengthy, not all steps are required for all corners.

The following actions are recommended to perpetuate evidence of recovered corner monuments:

(1) Drive a 5- to 6-foot red steel post approximately 2 feet into the ground adjacent to the monument with Attention Sign 54-4 or Survey Monument Sign 54-9 firmly attached. If this is not practical when the corner is recovered, mark with flagging and arrange (with the Forest cadastral surveyor) to have a post set as <u>soon</u> as possible. This fact should be noted on the recovery card. Driving a post at the assumed corner position (when monument is not found) may destroy valuable evidence of the original monument.

(2) Straighten a leaning or loose monument, but only under either of the following conditions:

(a) If the monument is in danger of destruction.

(b) The monument is proven to be in the original position.

The corner searcher should verify the monument position by comparing original measurements with field measurements (original field notes) to the original accessories. The Forest Service land surveyor should be notified prior to straightening a monument.

(3) Various Forest Service signs are invaluable in perpetuation of corner monuments. Attach the Forest Service Bearing Tree Sign 54-3 to all identifiable bearing trees, regardless of whether the trees are living or dead, standing or down, or a remaining snag or stump. Forest Service location posters should be attached to trees or posts in the vicinity of the monument and at appropriate locations (trails, roads, and so forth). Placement of the location posters is one of the most valuable steps in perpetuating a corner.

(4) Painting the old bearing tree blazes not only assists with recovery but also possibly reduces decay. Flagging is useful to aid subsequent searchers but does deteriorate fairly rapidly. Red paint should be used to avoid confusion with other colors used by cruisers, etc.

(5) Fill out a Corner Record Card, Form 7100-52, completely and retain the original. Be certain that both the Supervisor’s Office and the District Office have a copy of each recovery record. Complete records are necessary to allow the program to function properly.

Any suspected conditions must be recorded, such as a disturbed monument, stone markings not facing the claim, a non-original bearing tree, or conflicting measurements.

(6) If possible, make a precise aerial photograph identification of the recovered corner. If the corner is not visible, photoidentified objects may be pricked directly on the photo and the corner tied to these objects (bearings and distances). These photographs should be submitted to the cadastral surveyor, who will, in turn, provide you with a photo. Notes, township, range, and sections are shown on the back of each photo. Section numbers are reversed.

(7) All underbrush should be cleared within a 12- to 15-foot radius of the corner. Unobstructed lines are desired between corner monuments and accessories.

(8) Where native stone is available and the surface of the ground is favorable, a mound of stone is employed as an accessory to a corner monument, or to surround it, even though a full quota of trees or other bearing objects can be utilized. A mound of stone erected as a corner accessory should be built as stable as possible, should consist of not fewer than five stones, and should be not less than 2 feet by 1-1/2 feet high (if stones are available). Where the ground is suitable, the stone mound is improved by first digging a circular trench 4 to 6 inches deep for an outer ring, then placing the base of the larger stones in the trench. In stony ground, the size of the mound should be increased to make it conspicuous. The nearest point on its base should be about 6 inches from the monument; however, a large mound of stones should be placed so as not to interfere with an instrument setup. Painting must be used with care to avoid painting over the marks on the monuments.

(9) Often the only evidence that may remain of the original monument is discolored soil from the rotted post monument or perhaps some charcoal or other memorial. Any digging must be performed with this in mind and must be done with care to avoid destroying the evidence. Taking cross sections of the soil may disclose the discolored areas. Mechanical diggers are very good at destroying this type of evidence.

It must be emphasized that a corner will not be considered lost if any evidence can be recovered. It is a good policy to record what may be evidence rather than to ignore it. Evidence recovered and not recorded by the searcher may be overlooked by the subsequent surveyor-corner searcher. It may be years later after a new corner is established that some private surveyor discovers the unreported evidence. This can cause many corners to be wrongly located. It cannot be overstressed that "lost" corners ultimately are not lost at all. One should adopt the philosophy that all corners are most likely existent corners.

If time does not allow an exhaustive search, any and all evidence (or lack of) should be recorded on a standard recovery card and a copy submitted to the cadastral surveyor.

The searcher should be aware that the acceptance of the corner by the Bureau of Land Management surveyor or the Forest Service cadastral surveyor will depend on the remaining evidence of the original corner as reported by the field personnel.

(10) New bearing trees with standard markings should be established only by authorized surveyors. In the event reference trees (witness trees) are selected, they should be marked in a manner to avoid confusion with the original surveyor's marks. The notes should cite the point measured to (center of tree or blaze).

Bearing trees often are in bad condition. If a chain saw is available, the bearing tree in such condition may be trimmed off above the blaze. The sloped surface will allow the moisture to run off and reduce decay. Painting the surface will offer further protection. High-stumping prevents windthrow and thus adds to the life of endangered bearing trees.

(11) The original accessories (reference objects) to a corner are often in poor condition. Sufficient supplemental accessories should be noted that will aid in the recovery of the corner position. Such objects may include cattle guards, boulders, ponds, fences, and power poles. An X may be chiseled into the boulders. Bearings and distances can be obtained to any such permanent objects and recorded on the corner card. Bearings also may be taken to prominent peaks or other features.

(12) Reference monuments must be established with care. This work is normally accomplished by authorized surveyors with appropriate equipment.

(13) Affidavits (testimony) can serve as parole evidence for perpetuation of a corner position (see figure 16-1). The corner card should reference such affidavit. When a corner has been perpetuated based on such parole evidence, the corner recordation card should have a copy of the affidavit attached. The affidavit of parole evidence of a corner should be left in a permanent file by the Forest Supervisor. A copy also should be recorded with the county. A courtesy copy also should be forwarded to the BLM State Office cadastral surveyor.

PAROLE EVIDENCE (TESTIMONY)

In the absence of corner evidence, testimony (parole evidence) becomes an effective means of establishing corner positions. Information concerning the location of a corner may be taken from local residents. The surveyor should have the resident state under oath that he or she had knowledge of the following facts:

(1) What the corner looked like.

(2) Number of years the resident resided in the area.

(3) How the resident knew it was the corner.

(4) When the resident last was at the corner.

(5) The date.

(6) The resident's name and age.

This information should be entered in a field book. The statement should be signed by the resident. In addition, the surveyor should enter a statement stating the following:

(1) The person was under oath.

(2) The statements were made by that person.

(3) What the survey showed the person and what was placed there.

(4) The person was of good character and of sound mind.

AFFIDAVIT OF E. ROWLAND TRAGITT IN SUPPORT OF QUARTER CORNER
COMMON TO SECTIONS 13 and 24, T. 23 N., R. 7 E.

STATE OF NEW MEXICO)
) ss.
County of Bernalillo)

SAMPLE

E. ROWLAND TRAGITT, Arizona Professional Engineer #2613, being first duly sworn, deposes and says that he is a mining engineer for the U.S. Forest Service in the Abluquerque, New Mexico, Regional Office and that he is personally acquainted with the geographic location of what is known as the quarter corner common to Sections 13 and 24, T. 23 N., R. 7 E., G&SRB&M, Coconino County, Arizona.

That he has examined the affidavit of Hale C. Tognoni dated July 6, 1967, the maps and affidavits and pictures thereof concerning said quarter corner.

That the quarter corner pictured in those pictures is the same quarter corner which was pointed out to him by the local forest ranger as being said quarter corner.

That he examined the Fisher 1 and Fisher 1(A) mining claims to determine the validity of same for patent in the fall of 1957.

That at that time upon his visit to the claim with said forest ranger, he went to said quarter corner and followed the stakes of Harvey W. Smith, Deputy Mineral Surveyor around the outside of the claim.

That at that time, it appeared to be no conflict as to the location of said quarter corner and to his knowledge was accepted as the proper location of said quarter corner in the community.

That until the fall of 1966, when Mr. Waara's survey was made, his first mineral survey from said quarter corner, and raised the question of the location of said quarter corner, that he had never known that anyone claimed any other location of said quarter corner.

That in his opinion, said quarter corner's location is the accepted location of said quarter corner.

E. Rowland Tragitt

Subscribed and sworn to before me this 24th day of July, 1967.

Notary Public

My Commission Expires:
March 14, 1971

Figure 16-1.--Sample affidavit.

The surveyor signs and dates the statement. As soon as possible, the surveyor should file a corner affidavit with the proper authorities with a copy of the statement as recorded in the field book. This is necessary, because a person may change his or her testimony. When a survey of record is filed it also should show the statement.

The affidavit of parole evidence of a corner should be kept in a permanent file by the Forest Supervisor. The corner record card will have a notation as to the file and book number for reference.

REFERENCING THREAD-HANGING EVIDENCE

A situation may exist where a corner or its accessories is in poor condition and in danger of being lost regardless of the physical evidence. The field party should reference and describe all existing evidence that remains. The corner monument may be completely destroyed, but portions of the rotted but identified bearing tree still exist. This tree may be referenced to other live trees that have been flagged. The bearing and distance should be recorded. The size, diameter, and true bearing and distance from the evidence to the selected reference object should be measured and recorded on the corner card.

The corner card should be submitted to the Forest Service cadastral surveyor at the earliest possible date. If a corner card could not be completed for various reasons, this situation can be conveyed by phone or other means. This action can result in the corner being perpetuated as opposed to lost indefinitely. The restoration of the corner often will depend upon the remaining evidence of the original corner as reported by the creator of the bearing objects and the corner itself. Quality and authenticity of the record are critical.

Care should be exercised not to disturb the natural condition of the evidence. There should be no attempt to dig up the corner if the original survey notes indicated that it was a wooden post. A stone may be reset in its original position only if it is in danger of being moved or rolled down the hillside. Any operation performed at a corner that is in poor condition should be recorded in the recovery notes. The Forest land surveyor should be notified of such situations for validation of evidence and perpetuation.

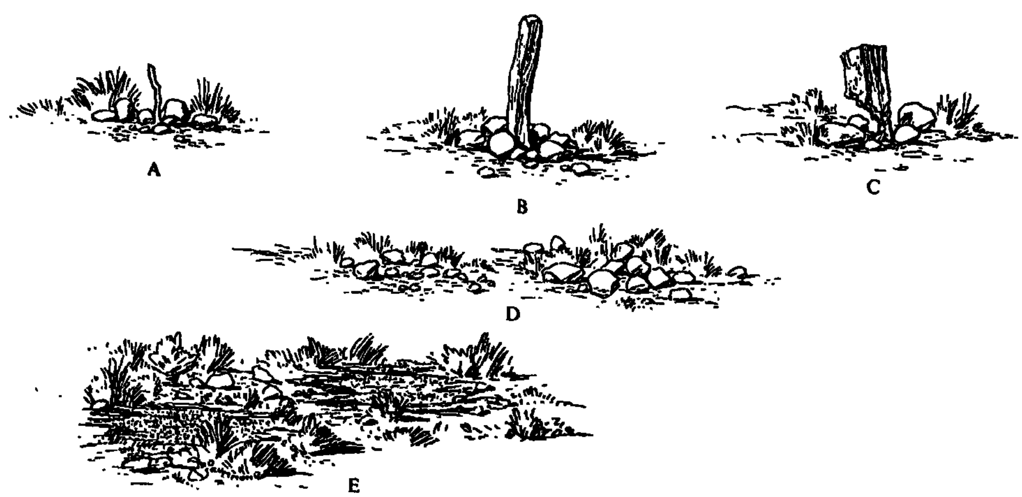


Figure l6-2.--Evidence at various stages of decay and/or obliteration: (A,B) wooden posts, the one on the left not much more than a twig; (C) wooden post showing decay at ground line; (D) corner monument obliterated (remnants of stone mounds identify corner position); (E) corner monument obliterated (evidence of old pits fixes corner position).

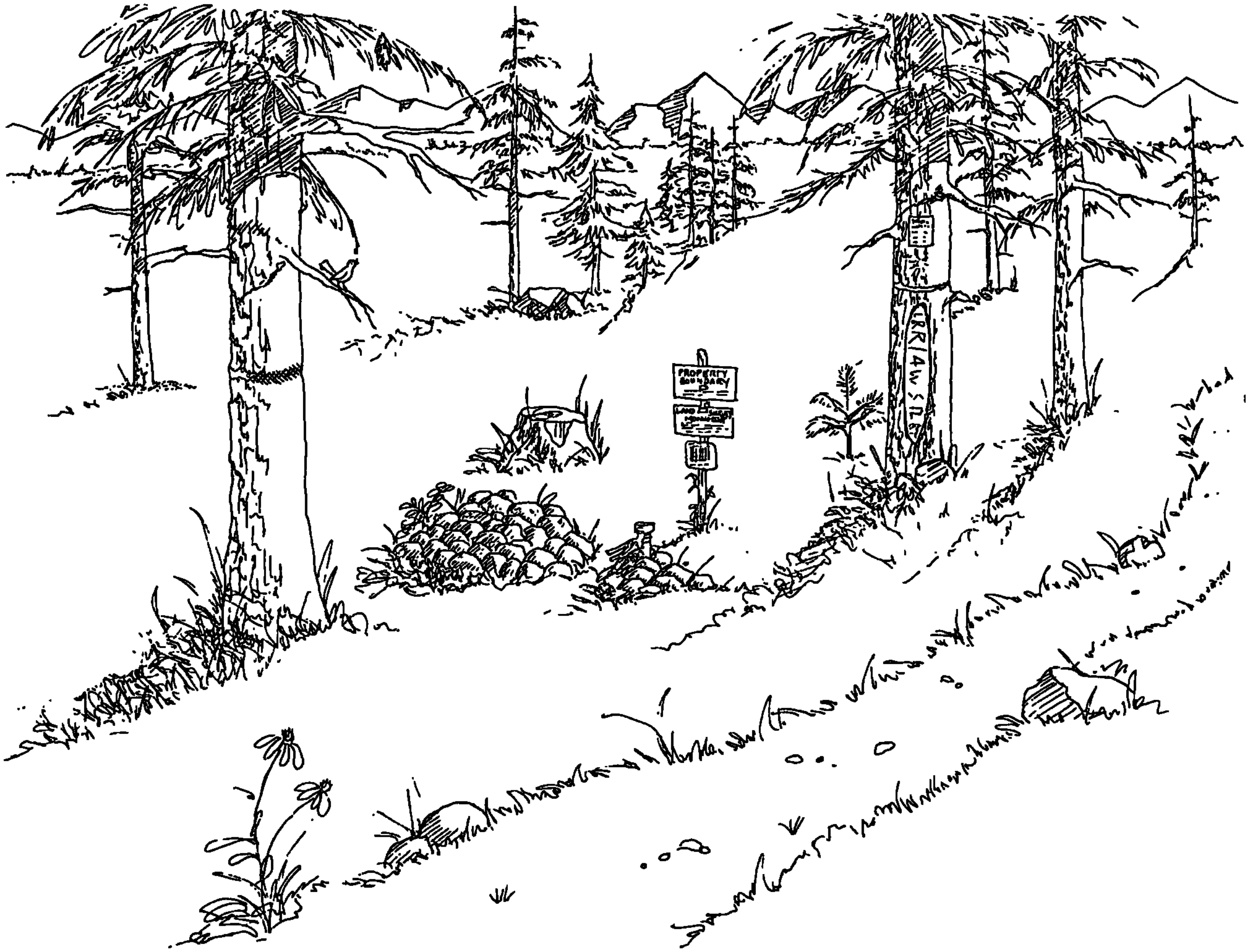
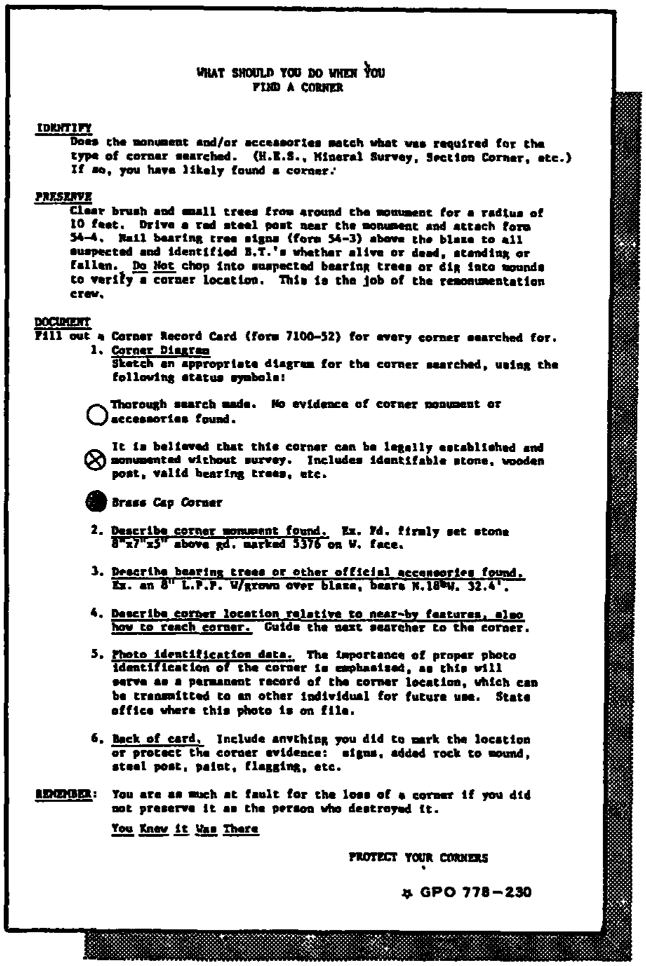


Figure 16-3.--Sketch showing typical application of Forest Service signs and posters. Note the placement of signs. At angle points, property signs are placed along the boundary. The location posters may be attached to trees, as opposed to the posts.



WHAT SHOULD YOU DO WHEN YOU
FIND A CORNER

IDENTIFY

Does the monument and/or accessories match what was required for the type of corner searched. (H.E.S., Mineral Survey, Section Corner, etc.) If so, you have likely found a corner.

PRESERVE

Clear brush and small trees from around the monument for a radius of 10 feet. Drive a red steel post near the monument and attach form 54-4. Nail bearing tree signs (form 54-3) above the blaze to all suspected and identified B.T.'s whether alive or dead, standing or fallen. Do Not chop into suspected bearing trees or dig into mounds to verify a corner location. This is the job of the remonumentation crew.

DOCUMENT

Fill out a Corner Record Card (form 7100-52) for every corner searched for.

1. Corner Diagram
   Sketch an appropriate diagram for the corner searched, using the following status symbols:

   ○ Thorough search made. No evidence of corner monument or accessories found.

   ⊗ It is believed that this corner can be legally established and monumented without survey. Includes identifable stone, wooden post, valid bearing trees, etc.

   ● Brass Cap Corner

2. Describe corner monument found. Ex. Fd. firmly set stone 8"x7"x5" above gd. marked 5376 on W. face.

3. Describe bearing trees or other official accessories found. Ex. an 8" L.P.P. W/grown over blaze, bears N.18°W. 32.4'.

4. Describe corner location relative to near-by features, also how to reach corner. Guide the next searcher to the corner.

5. Photo identification data. The importance of proper photo identification of the corner is emphasized, as this will serve as a permanent record of the corner location, which can be transmitted to an other individual for future use. State office where this photo is on file.

6. Back of card. Include anything you did to mark the location or protect the corner evidence: signs, added rock to mound, steel post, paint, flagging, etc.

REMEMBER: You are as much at fault for the loss of a corner if you did not preserve it as the person who destroyed it.

You Knew it Was There

PROTECT YOUR CORNERS

☆ GPO 778-230

Figure 16-4.--Form listing procedure when a corner is found. The form can be attached to field books or other convenient location; it sums up the basic items to complete. These forms may be available through the U.S. Government Printing Office.

Unit 17
Geodetic Control Stations

GEODETIC CONTROL STATIONS & CORNER SEARCH

General

Corner search includes not only land survey corner monuments but also geodetic control stations. Geodetic monuments refer to horizontal and vertical control as well as gravity and magnetic stations. Permanently established control stations are monumented by metal tablets (brass or aluminum) set in masonry or rock or attached to galvanized iron, aluminum pipe, or rods. The metal disks are 2 to 4 inches in diameter. One mark can serve as both a horizontal and vertical control station (bench mark). The disks are prestamped with the agency name, type, and station name with date.

Agencies responsible for the establishment of control stations include the National Geodetic Survey (formerly the Coast and Geodetic Survey), U.S. Geological Survey, the Defense Mapping Agency (Corps of Engineers), the International Boundary Commission, Bureau of Land Management (Alaska State Office), Bureau of Reclamation, highway departments, State geodetic surveys, county surveys, mining and geophysical exploration companies, utility companies, and others.

The purposes of most of these surveys include control of highway alignment and elevations, map control and mineral mapping, coastal boundary mapping, positioning of airport facilities and navigational aids, control of offshore rigs, and many others. The station data include latitude, longitude, and state plane coordinates or universal transverse mercator (UTM) coordinates.

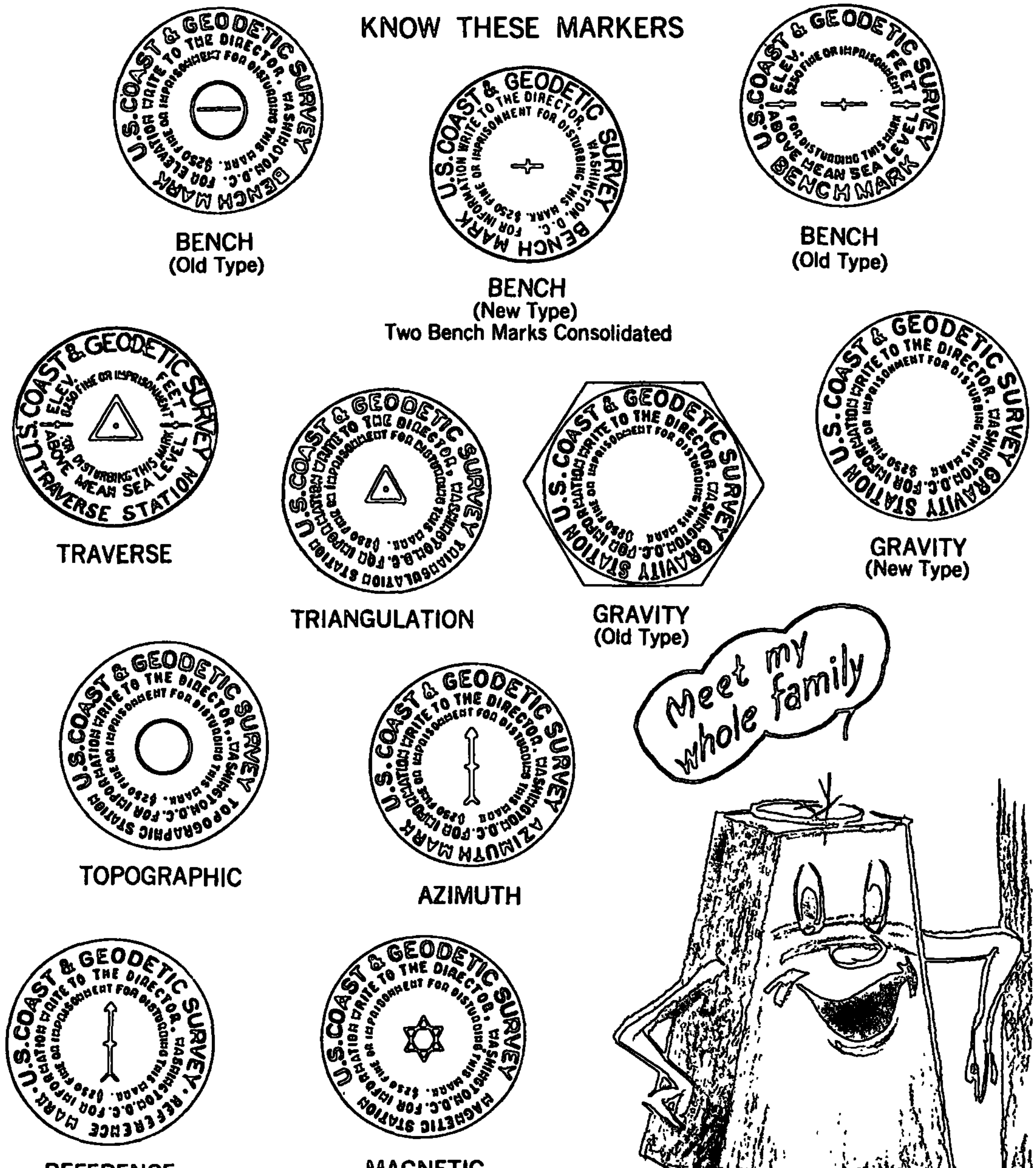
Corner Search

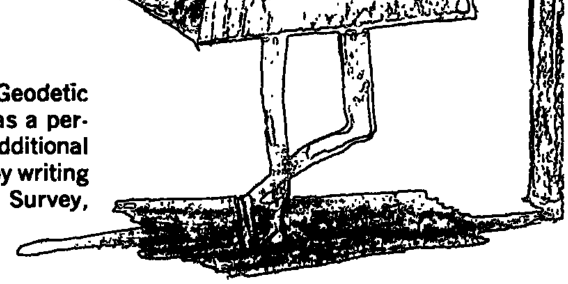
The work involved in the recovery of basic horizontal and vertical control requires the utmost care to provide positive information. The description of a station must be thoroughly evaluated and checked with any existing marks, reference ties, and ground details at the station site. If any discrepancies are noted, they must be reconciled and the corrections or changes incorporated in a revised description. If the description is inappropriate or the station has not been adequately described, a complete new description must be prepared. Triangulation-intersection stations, such as stacks, tanks, navigational aids, and radio masts, are subject to erroneous recovery. Such structures may be demolished and rebuilt close to but not in exactly the same location, or structures of similar appearance may exist in the same vicinity. The recovery of such stations should be verified by interrogating city and plant engineers, local officials, and residents, or if need be, by plotting the station on a topographic map, and verifying its plotted map position with the ground detail. In all cases (situations), where there is any uncertainty of recovery, this fact must be noted in the applicable field records submitted for such doubtful stations.

SUMMARY

This training guide has detailed the various pertinent phases of corner search, perpetuation, and recordation methods and techniques. The basic procedures involved in the location of <u>remaining evidence</u> of a corner have been detailed in a concise manner. A logical, systematic search procedure will become more apparent to the individual as field experience is gained.

The stated objectives of the guide have been presented in a manner understandable to even the less experienced personnel.





FACE LEGENDS

Standard bronze station marks of the Coast and Geodetic Survey that are set in concrete or bedrock to serve as a permanent mark for the particular station it represents. Additional information concerning these marks may be obtained by writing to the Director, United States Coast and Geodetic Survey, Washington 25, D.C.

Figure 17-1.--Marker face legends.

Most importantly, the primary objective--to outline and define clearly what actions an employee may take to perpetuate or rehabilitate a corner monument--has been presented.

As stated in the text, corner monuments and original evidence are to remain in their original recovered state unless they are in real danger of being destroyed. Unless a qualified surveyor is present, new bearing trees are not to be scribed nor are original bearing trees to be re-scribed or “blocked out.” Reestablishment of corners and the selection of and marking of accessories (except posters, posts, bearing tree signs, and other signs) is to be left to the designated cadastral surveyor. The acceptance of a public land corner from the recovered and documented evidence can officially be determined only by an authorized cadastral surveyor. Frequently, qualified surveyors are required to obtain additional measurements to verify a corner position or evidence. The surveyor must evaluate the proficiency of the searchers and the authenticity of the recovery notes.

The accurate recordation of the recovered corner evidence on the standard corner card and, if feasible, the precise photoidentification of the corner or reference image points on an aerial photograph are prime factors to the land line location program. It must be emphasized that all photoidentification must be accurate and thorough. All recorded evidence is to be made available to the designated Forest cadastral surveyor and the respective District. All evidence should be referenced to more permanent objects or features, if feasible.

An informed corner search crew or lone searcher may play a vital role in the land line location program. An act of perpetuation, such as attaching a location poster in a logical location or a bearing tree tag on a rotting original bearing tree, normally requires but a few minutes and can result in a tremendous savings of time and money.

To be successful, the search crew must be fully aware of its duties and limitations. They must exercise good judgment and remain ethical to avoid creating problems for those who follow. Litigation is both expensive and frustrating. The basis for most litigation is the absence of concern and an adequate corner search program.

With the present rate of destruction of land corner monuments, the assistance of all field-going employees is needed to preserve and perpetuate our land corner monuments. However, sound training and experience are vital to proper corner search, perpetuation, and documentation.

OCTOBER 1963
U.S. DEPARTMENT OF COMMERCE
ENVIRONMENTAL SCIENCE SERVICES ADMINISTRATION
COAST AND GEODETIC SURVEY

REVISED MAR 1968

HORIZONTAL CONTROL DATA

by the
Coast and Geodetic Survey
NORTH AMERICAN 1927 DATUM

QUAD 381081 STATION 1002
COLORADO
LATITUDE 38°30' TO 39°00'
LONGITUDE 108°00' TO 108°30
DIAGRAM NJ 12-6 MOAB

MONT (Montrose-Delta County, Colo., F.G.J., 1937)--This station is located 12 miles SW of Delta, near the Delta-Montrose County line, on the E rim of Dry Fork Canyon, about 72 feet W of the road and 83 feet E of the canyon rim.

Station mark is a standard bronze disk set in concrete in a depression in a boulder.

Reference and azimuth marks are standard bronze disks set in concrete in depressions in outcropping bedrock.

The azimuth mark is on the eastern rim of the canyon, about 0.15 mile SSW of the station.

To reach station from the Conoco gas station on 5th Street, in Delta, go W on main-traveled road (passing Texaco. Bulk station on railroad) 2.2 miles to fork, keep straight W on main-traveled road 3.1 miles to steel bridge over creek; continue on main-traveled road 6.6 miles to a turn in the road and a new corrugated iron culvert and some deep drain furrows on the left side of the road. Go to the end of these furrows, turn left and pick up the dim road which leads W and SW; follow this road 0.7 mile to where it comes to the edge of the deep canyon; turn left on track road along the edge of the canyon and follow main-traveled road 1.9 miles to a blaze on a cedar tree on the left side of the road and station.

OBJECT	DISTANCE	DIRECTION
LUJANE	meters	0°00'00".0
Az. Mk. (SSW) (approx.)	0.15 mile	65 33 01.38
R.M.No.1 (SW)	36.32	85 17 41.48
R.M.No.2 (W)	25.420	159 28 40.68

Height of light above station mark - 1 1/2 meters.
Height of telescope above station mark - 2 meters.

RECOVERY NOTE, TRIANGULATION STATION

NAME OF STATION MONT
ESTABLISHED BY USC&GS YEAR 1937 STATE COLORADO
RECOVERED BY USDA Forest Serv YEAR 1966 COUNTY Montrose-Delta

Station recovered.

This station is located 12 miles SW of Delta, Colo., on the east rim of Dry Fork Canyon, about 72 feet west of a track road and 83 feet east of the canyon rim.

Standard station and reference marks were found as described, in good condition, in the original C&GS description. However, the blazed tree at left of road opposite station could not be found.

Following are amended instructions for reaching the station from the Delta County Courthouse in Delta, Colorado.

To reach the station from the Delta County Courthouse in Delta, Colorado which is at the corner of 5th and Palmer, proceed west on 5th Street 0.45 miles crossing the Uncompahgre River, thence continue westerly 1.7 miles on paved road to end of pavement at a Y fork, thence proceed straight ahead (left) westerly, 3.1 miles crossing Monitor Creek near the old townsite of Roubideau, thence continue southwesterly 1.7 miles to a Y fork. The left goes into the Colo. State Prison Honor Camp. Bear right and continue westerly on main traveled graded dirt road 5.9 miles to a track road left at a point where main road bends right (north) near east edge of the Dry Fork of the Escalante Canyon.

Take track road left and follow the main set of tracks southerly which follows closely the canyon rim for 2.5 miles to the station site on right between road and canyon rim about 50 yards west.

Station Mark: a 3x3 flourescent pink cross target was mounted atop a tall survey stand which was centered over the tablet. The legs of the instrument stand were bolted to angle iron plates which were set in concrete. The top of the instrument stand was 11.8' above the tablet. The cross target measured 11.8'-14.8' above the tablet.

ADJUSTED HORIZONTAL CONTROL DATA

NAME OF STATION MONT YEAR 1937

STATE Colorado LOCALITY Longmont to Steamboat Sps and Soil Conser Area

Second -ORDER Triangulation SOURCE G-6931 FIELD SKETCH COLO 4-I

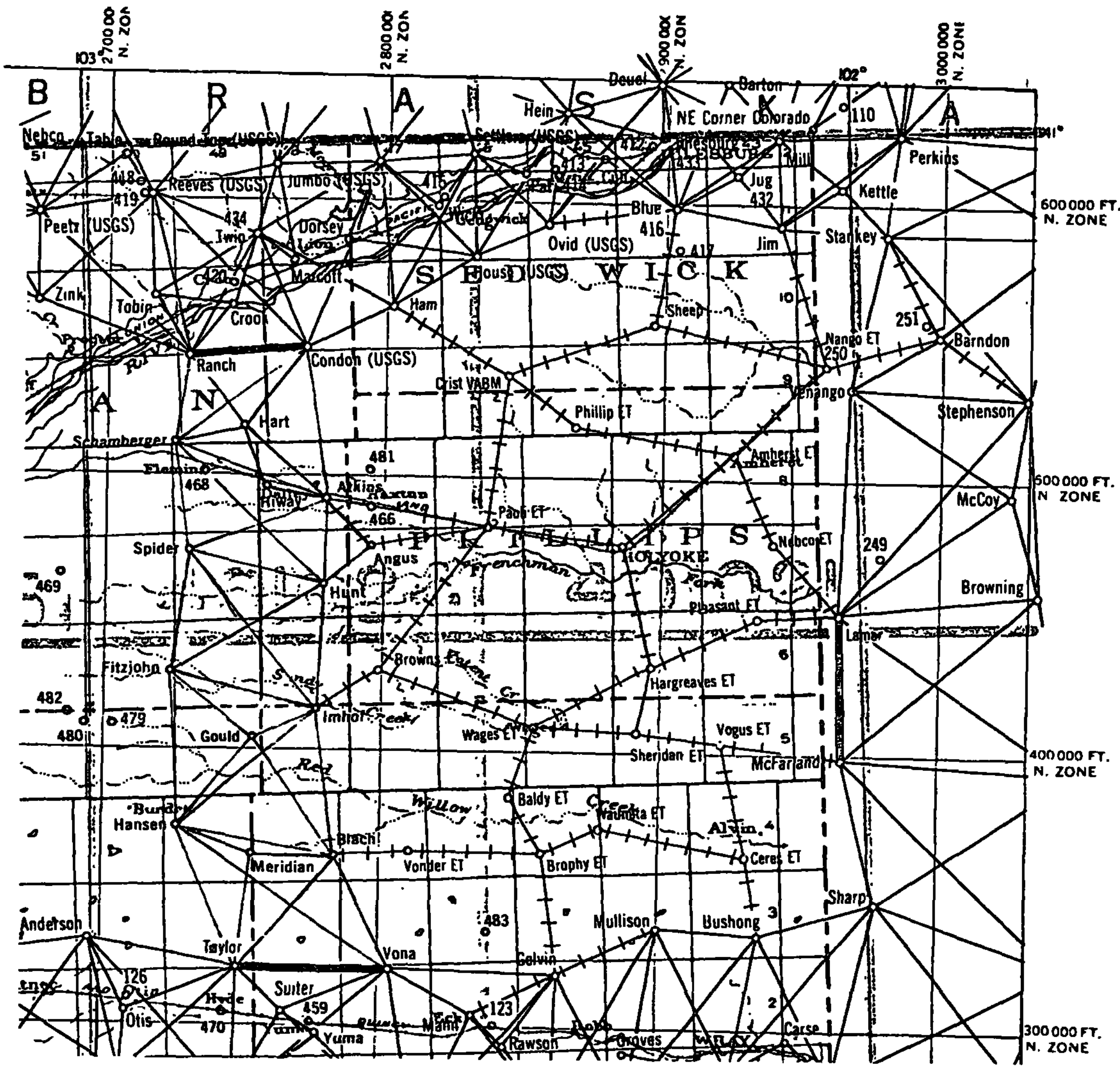
GRID DATA	COORDINATES (Feet)	PLANE AZIMUTH θ (OR Δα) ANGLE	MARK
STATE: Colo ZONE: C CODE: 0502	x 1,210,704.13 y 315,157.00	4°19'50" - 1 44 37	AZ MK
STATE: Colo ZONE: S CODE: 0503	x 1,210,629.58 y 739,602.61	4 16 58 - 1 41 45	AZ MK

GEODETIC DATA	POSITION		SECONDS IN METERS	ELEVATION
	LATITUDE 38°39'56".595	NORTH		METERS
	LONGITUDE 108 15 52.861	WEST		FEET

TO STATION	GEODETIC AZIMUTH (From south)	DISTANCE LOGARITHM (Meters)	DISTANCE METERS
	SECOND-ORDER		
LUJANE	297°02'10".78	4.707 9260	51,041.80
COLONA	309 26 10.51	4.762 6520	57,896.45
SILESCA	335 59 10.54	4.591 3035	39,021.46
	THIRD-ORDER		
AZIMUTH MARK	2 35 13.4		

USCOMM-DC 6317

Figure 17-2.--Sample horizontal control data.



LEGEND:

o Taylor	Triangulation Station	⊢+⊢+⊢+⊣	Electronic Traverse
▬▬▬	Base Line (Baseline)	300 000 FT.	State Plane Coordinates

Figure 17-3.--Portion of a National Geodetic Survey triangulation diagram. These are 1° x 2° diagrams at a 1:250,000 scale. National Geodetic Survey, some Corps of Engineers, U.S. Geological Survey, and some Forest Service control stations are plotted. More recent diagrams include both triangulation, trilateration, and electronic traverse stations. State diagrams also are available.

REPLACES LISTS AS INDICATED *

PUBLISHED AND PRINTED BY:
U.S. DEPARTMENT OF COMMERCE
COAST AND GEODETIC SURVEY
WASHINGTON D.C.

VERTICAL CONTROL DATA
by the
Coast and Geodetic Survey
SEA-LEVEL DATUM OF 1929

PAGE NO. 7
68 COLO.
MAY 1961

DESCRIPTION OF BENCH MARK

Designation R 8 — State Colorado — County Gunnison
Nearest town Sargents — County Saguache — Chief of party
Distance and direction from nearest town 16.9 miles northwest — Leveling date
Character of mark Disk — Stamping
Established by USC&GS
Detailed description

In Gunnison County, 16.9 miles northwest along the Denver & Rio Grande Western Railroad from the station at Sargents, Saguache County, 330 feet northwest of milepost D-274, in a diagonal fence line near a bend in the Tomichi River, 44 feet northeast of the track, 6 feet southwest of the right-of-way fence, and 1-1/2 feet lower than the track. A standard disk, stamped "7972.530 R 8 1926" and set in the top of a concrete post.

DESCRIPTION OF BENCH MARK

Designation S 8 — State Colorado — County Gunnison
Nearest town Gunnison — County — Chief of party
Distance and direction from nearest town 12.3 miles southeast — Leveling date
Character of mark Disk — Stamping
Established by USC&GS
Detailed description

12.3 miles southeast along the Denver & Rio Grande Western Railroad from the station at Gunnison, Gunnison County, 0.1 mile northwest of milepost D-276, 65 feet east of the track, 15 feet (?) east of the right-of-way fence, 2 feet higher than the track, and in rock 2 feet above ground. A standard disk, stamped "S 8 1926".

NOTE: It was reported in October 1934 that this bench mark had been covered by fill during highway construction in 1931.

DESCRIPTION OF BENCH MARK

Designation T 8 — State Colorado — County Gunnison
Nearest town Gunnison — County — Chief of party
Distance and direction from nearest town 10.4 miles southeast — Leveling date
Character of mark Disk — Stamping
Established by USC&GS
Detailed description

10.4 miles southeast along the Denver & Rio Grande Western Railroad from the station at Gunnison, Gunnison County, 1.0 mile west of the station at Parlin, 0.1 mile east of milepost D-278, 470 feet west of the yard-limit sign, 100 feet east of the crossing of a telephone line, 35 feet south of the track, 15 feet north of the right-of-way fence, 3 feet higher than the track, and in the west side of a large rock outcrop projecting about 2 feet above ground. A standard disk, stamped "7914.016 T 8 1926."

DESCRIPTION OF BENCH MARK

Designation V 8 — State Colorado — County Gunnison
Nearest town Gunnison — County — Chief of party
Distance and direction from nearest town 6.2 miles southeast — Leveling date
Character of mark Disk — Stamping
Established by USC&GS
Detailed description

6.2 miles southeast along the Denver & Rio Grande Western Railroad from the station at Gunnison, Gunnison County, 210 feet east of the station sign at Steele, 240 feet west of milepost D-282, 47 feet north of the track, 3 feet south of the right-of-way fence, and 3 feet lower than the track. A standard disk, stamped "7783.754 V 8 1926" and set in the top of a concrete post.

NOTE: First-order leveling by this Bureau in 1938 indicated that the elevation of bench mark V 8 at that time was 2,372.636 meters or 7, 784.223 feet, but it was reported that frost action would likely cause further disturbance in the future.

DESCRIPTION OF BENCH MARK

Designation W 8 — State Colorado — County Gunnison
Nearest town Gunnison — County — Chief of party
Distance and direction from nearest town 4.3 miles east — Leveling date
Character of mark Disk — Stamping
Established by USC&GS
Detailed description

4.3 miles east along the Denver & Rio Grande Western Railroad from the station at Gunnison, Gunnison County, 240 feet northwest of milepost D-284, 47 feet northeast of the track, 3 feet southwest of the right-of-way fence, and 3 feet lower than the track. A standard disk, stamped "W 8 1926" and set in the top of a concrete post.

NOTE: First-order leveling by this Bureau in 1938 indicated that the elevation of bench mark W 8 at that time was 2,359.502 meters or 7,741.133 feet, but it was reported that frost action would likely cuase further disturbance in the future.

Figure 17-4.--Sample vertical control data.

REPLACES LISTS AS INDICATED *

PUBLISHED AND PRINTED BY:
U.S. DEPARTMENT OF COMMERCE
COAST AND GEODETIC SURVEY
WASHINGTON D.C.

VERTICAL CONTROL DATA

by the
Coast and Geodetic Survey
SEA-LEVEL DATUM OF 1929

Reprinted December 1961

PAGE NO. 1

68 COLO.

MAY 1961

Salida to Grand Junction, Colorado
(First-order leveling)

The original (first-order) field work for this line was done in the summer and fall of 1926 by a party supervised by G. E. Boothe. Second-order leveling was done from Salida to Salida Airport in September 1951 by a party supervised by W. M. Hellman; second-order leveling was done at Montrose Airport in May 1955 by a party supervised by William T. Johnson; and second-order leveling was also done from Gunnison to Gunnison Airport in the summer of 1960 by a party supervised by Wm. T. Johnson.

* This list of adjusted elevations REPLACES the elevations published with the list of descriptions dated December 31, 1941 and reprinted April 28, 1952 and a list of field elevations for the Supplement dated January 28, 1953 and reprinted October 23, 1958. Almost all the elevations in this list are the same as published in the former lists.

These adjusted elevations are derived from the original first-order leveling of 1926, and the airport leveling of 1951, 1955 and 1960. The airport leveling is based on a supplementary adjustment of 1960.

Bench Mark	Adjusted Elevation (Meters)	(Feet)
SPUR LINE TO SALIDA AIRPORT (1951 Leveling) (Second-order)		
K 7	2157.836	7079.500
T 286	2163.205	7097.115
S 286	2193.734	7197.276
L 7	2206.515	7239.208
R 286	2229.712	7315.313
M 7	2253.597	7393.676
N 285	2260.674	7416.895
M 285	2272.291	7455.008
PONCHA RM 1	2274.896	7463.555
PONCHA 1935	2275.309	7464.910
PONCHA RM 2	2275.698	7466.186
PONCHA AZI.1935	2280.078	7480.556
END OF THE SPUR LINE		
ORIGINAL 1926 LEVELING		
N 7	2288.895	7509.483
Q 7	Destroyed	
P 7	2532.503	8308.720
T 7	2568.090	8425.475
Q 7	2595.942	8516.853
R 7	2664.687	8742.394
S 7	2774.031	9101.133
U 7	2883.064	9458.852
V 7	3021.285	9912.332
W 7	3109.267	10200.987

Bench Mark	Adjusted Elevation (Meters)	(Feet)
X 7	3222.612	10572.853
Y 7	3305.838	10845.903
Z 7	3218.905	10560.694
A 8	3104.973	10186.899
B 8	3005.409	9860.245
C 8	Destroyed	
D 8	2789.450	9151.720
E 8	2704.736	8873.788
F 8	2641.479	8666.252
G 8	2604.198	8543.940
H 8	2583.682	8476.630
J 8	2568.003	8425.190
K 8	2544.738	8348.861
L 8	2517.654	8260.003
M 8	2495.172	8186.243
N 8	2482.184	8143.632
O 8	2462.070	8077.641
Q 8	2451.342	8042.444
P 8	2439.936	8005.023
R 8	2430.032	7972.530
S 8	2422.566	7948.035
T 8	2412.197	7914.016
V 8	2372.636	7784.223
W 8	2359.502	7741.133
X 8	2347.391	7701.399
LEVELING AT GUNNISON COUNTY AIRPORT (AND VICINITY) 1960 LEVELING (second-order)		
Y 8	2339.462	7675.385
Y 8 RM 1	2340.136	7677.596

Bench Mark	Adjusted Elevation (Meters)	(Feet)
STA. B	2336.656	7666.179
AIRWAY AZI.MARK	2332.935	7653.971
AIRWAY	2331.841	7650.382
AIRWAY RM 1	2332.054	7651.080
AIRWAY RM 2	2332.073	7651.143
END OF AIRPORT LEVELING		
ORIGINAL 1926 LEVELING		
H 3	2347.739	7702.540
H 3 RESET	(Approx. same elevation)	
H 4 (USGS)	2357.376	7734.158
Z 8	Destroyed	
A 9	Destroyed	
B 9	2315.004	7595.142
C 9	2293.213	7523.650
D 9	2285.048	7496.862
E 9	2273.077	7457.587
7454.164 (USGS)	2271.471	7452.318
F 9	2262.687	7423.499
G 9	2255.785	7400.855
7401.910 (USGS)	2255.533	7400.028
H 9	2245.455	7366.964
7356.606 (USGS)	2241.689	7354.608
J 9	2236.166	7336.488
K 9	2228.861	7312.521
7312.822 (USGS)	2228.407	7311.032
L 9	2221.198	7287.380
7292.48	Destroyed	

Bench Mark	Adjusted Elevation (Meters)	(Feet)
M 9	2213.704	7262.794
7238.406 RESET 1941	2205.580	7236.140
N 9	2203.919	7230.591
O 9	2201.128	7221.534
7170.550 (USGS)	2185.000	7168.621
P 9	2174.708	7134.854
7094.851 (USGS)	2161.963	7093.040
Q 9	2148.185	[illegible]
R 9	2126.259	6975.901
S 9	2105.271	[illegible]
T 9	2087.098	6847.421
U 9	2104.931	6905.928
V 9	2234.534	[illegible]
7471.574 (USGS)	2276.830	7469.900
W 9	2369.904	[illegible]
X 9	2348.319	[illegible]
Y 9	2204.038	[illegible]
Z 9	2071.812	6797.270
6531.622 (USGS)	1990.318	6529.902
A 10	1972.397	6471.100
A (USGS)	1966.969	[illegible]
B (USGS)	1967.160	[illegible]
B 10	1910.857	6269.203
6146.776 (USGS)	1873.101	[illegible]
C 10	Destroyed	
5838.29 (USGS)	Destroyed	
D 10	1776.550	5828.564
E 10	1769.750	[illegible]
5794.134 (USGS)	1765.665	5792.866
F 10	1766.431	5795.366
G 10	1760.685	[illegible]

Figure 17-4. (cont.)--Sample vertical control data.

NOAA FORM 76-91
(10-80)

REPORT ON CONDITION OF SURVEY MARK

Form Approved: OMB No. 41-R1923
Approval Expires: April 30, 1983

SSN-- _ _ _ DRC CODE-- R QUAD-- N _ _ _ _ _ _ _ _ QSN-- _ _ _ _

STATION NAME-- _

STATE CODE/COUNTY-- _ YEAR ESTABLISHED-- _ _ _ _

Organization's Mark-- ____________________

RECOVERY BY--Name- ____________________ YEAR RECOVERED-- _ _ _ _

Organization- _

Address- ____________________

Please report on the thoroughness of the search in case a mark was not recovered, suggested changes in description, need for repairing or moving the mark, or other pertinent facts. Record letters and numbers found stamped in (not cast in) each mark.

Mark stamped: Condition:

If additional forms are needed, indicate number required. ____________

This report is authorized by law (Title 33 USC Section 883a). While you are not required to respond, your cooperation is needed to make the results of this report comprehensive, accurate, and timely.

☆ U S GOVERNMENT PRINTING OFFICE. 1980-765-01

U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION
NATIONAL OCEAN SURVEY
ROCKVILLE, MARYLAND 20852

National Geodetic Information Center, OA/C18
National Ocean Survey, NOAA
Rockville, MD 20852

Figure 17-5.--Recovery card available through the National Geodetic Information Center. Such cards completed are most useful to the National Geodetic Survey.

NOAA FORM 29-3 (9-79) U.S. DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND ATMOSPHERIC ADMIN.

GEODETIC CONTROL DATA
AUTOMATIC MAILING LIST AGREEMENT

1. REQUISITION OR ORDER NO.

2. NOAA AGREEMENT NO.

INSTRUCTIONS – (See reverse side). Return original to the National Geodetic Information Center, C18, National Ocean Survey, NOAA, Rockville, Maryland 20852.

3. DATE

4. APPLICANT'S NAME AND ADDRESS

5. ADDITIONAL MAILING INSTRUCTIONS

6. AGREEMENT – The applicant agrees to accept all requested geodetic control data and to pay for the same upon receipt. Prices will be based on the current price list.

7. ☐ Check here if Federal Government agency – Review your requirements and confirm your subscription agreement by completing item 12.

8. ☐ Check here if other than Federal Government subscriber – Review your requirements and confirm your subscription agreement by completing item 12.

9. INDICATE AREA AND TYPE OF DATA DESIRED.

☐ NUMBER OF COPIES ☐ VERTICAL CONTROL ☐ HORIZONTAL CONTROL ☐ DIAGRAMS

LATITUDE °

LONGITUDE °

10. ☐ Check here if the applicant desires field data and recently adjusted projects in manuscript form for the area.

11. ☐ Check here if the applicant desires an initial shipment of above requested data. The purpose of this shipment is to establish an initial file for new subscribers.

12. AUTHORIZED OFFICIAL *(Applicant)*	NAME	TITLE
	SIGNATURE	DATE
13. ACCEPTED BY NATIONAL GEODETIC SURVEY	NAME	TITLE Director, National Geodetic Information Center, National Geodetic Survey, NOS, NOAA
	SIGNATURE	DATE

NOAA FORM 29-3 (9-79) SUPERSEDES PREVIOUS EDITION.

Figure 17-6.--Geodetic control data automatic mailing list agreement. It is possible for an individual to get on the automatic mailing list if this type of information is needed. The type of data to obtain in this manner includes newly adjusted coordinates for control stations, level data, and other information.

Appendix A
Forest Service Memo, “Protection of Land Survey Monuments” & National Geodetic Survey Memo, “Disturbing or Removal of Geodetic Control Stations

COMMENT on MEMO

Figure A-1 contains the memo “Protection of Land Survey Monuments.” This memo emphasizes the standards as set forth in FSM 7153.45. These standards state that line trees and bearing trees shall be protected. However, the memo states that blazed trees are available for harvest and are not protected by FSM 7153.45.

It must be emphasized that the harvest of blazed trees is dependent upon several variables and therefore will be left up to the individual Forest personnel. There are many situations where the harvest of all blazed trees on the National Forest would obliterate all evidence of the boundary line. The memo clearly states the need to protect line trees and bearing trees. However, line trees may be sparse or nonexistent on a marked line. Bearing trees are not relevant to the physical property line location. To harvest all blazed trees would most likely destroy all evidence of the marked land line.

There are alternatives that, if employed, oblige both requirements. Possibly younger trees may be blazed or line points (monuments) could be set to perpetuate a line. Such practices will permit the harvest of mature blazed trees up to the property line. The field person must consider future management practices and establish evidence accordingly. This approach will frequently permit maximum management benefits. Communication is especially important in light of today’s high costs of conducting business. For example, if Foresters desire to harvest mature blazed trees, they may do well to notify the Forest cadastral surveyor early. Such notice will allow the blazing of younger trees or additional posting.

United States Department of Agriculture

Forest Service

WO

RECEIVED '82

Reply to: 7150 Surveying cc:
2430 Commercial Timber Sale
RF. cc:

Subject: Protection of Land Survey Monuments

To: Regional Foresters

Date: OCT

RECEIVED

NOV 01 '82

TIMBER MANAGEMENT

The Standard Clause B6.23, Protection of Land Survey Monuments, has presented problems when bearing trees and blazed trees along the property line are planned for harvest. This letter presents guidelines to follow when these situations are encountered. Each case is discussed separately.

BLAZED TREES ALONG THE PROPERTY LINE

Trees are blazed along a property line within a 5-link corridor on each side of the true line between land corners established by an official cadastral survey. Property boundary signs are also posted along the property line. Trees on the public land side of the line are quarter blazed. Trees on the private side of the line are face blazed. The blazing, posting, and painting are all intended to make the property line visible to the casual observer in order to prevent encroachment on a neighbor. Line marking and posting standards are set forth in FSM 7153.45.

It should be recognized that blazed trees on the public land side of a property line are available for harvest and are not protected by Standard Clause B6.23.

LINE TREES

Line trees are trees that grow on the property line with the line passing through the tree.

Line trees have a specific blazed marking and may have a property line sign nailed to the appropriate side of the tree.

Line trees are identified in the official notes and records of the survey and are an official surveying reference monument. They are, therefore, protected by Standard Clause B6.23.

Line trees may be harvested if some precautions are taken to preserve the identity as a line tree. The tree may be "high stumped" above the identifying blazes and cut at an angle to allow rain runoff to defer rot. The top of the cut stump should be painted "Land Line" red with heavy implement paint (GSA #8010-00-616-7486), and property line signs should be nailed on the appropriate side of the tree.

Figure A-1.--Forest Service memo.

The usual practice is for adjoining landowners to equally share line trees by harvesting every other line tree.

Special precautions need to be taken to ensure the sawyer recognizes what trees are line trees and how they are to be cut. These precautions are the sale administrator's responsibility.

CORNER MONUMENTS AND BEARING TREES

Corner monuments and bearing trees require protection by Standard Clause B6.23. If land corners are located in authorized clearing areas and road construction areas, the Forest Service is obligated to take protective or perpetuative actions that will cause no delay to the purchaser. This is arranged by contacting the Forest Registered Staff Surveyor who will make the necessary arrangements. This will usually occur as part of the surveyor responsibilities for presale planning activities. In many past cases, the surveyor was not contacted until after the damage was done. Early involvement of the surveyor is essential.

The same thing is true for monuments which could possibly be damaged by logging operations.

Again, the Forest Service may have taken protective action, but it is necessary for the Sale Administrator to be sure that the operator knows where and what to look for.

Bearing trees as corner references need protection and perpetuative actions but may be harvested in the same way line trees are cut. High stump the tree above the blaze, paint, and sign the stump. Reference monuments may also be set by the Forest Registered Staff Surveyor.

By following these guidelines, we can ensure that trees which should be harvested are cut, but their value as official survey reference objects is preserved. This procedure also ensures that survey monuments which would require expensive resurvey will not be obliterated or destroyed.

RICHARD D. HULL
Acting Associate Deputy Chief

Limited Distribution

Figure A-1. (cont.)--Forest Service memo.

U.S DEPT OF COMMERCE
NATIONAL GEODETIC SURVEY

RICHARD S COHEN

NOAA/OMPA MP2
NATIONAL GEODETIC SURVEY
325 SO BROADWAY
BOULDER CO 80303

303-497-6530
FTS 320-6530

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL OCEAN SURVEY
Rockville, Md. 20852

July 20, 1981

Dear Land Surveyors and Engineers,

I would like to inform you of my new assignment as National Geodetic Survey Mark Maintenance man for the states of Colorado, Wyoming, Utah, and New Mexico. My job is to repair existing survey marks that the National Geodetic Survey has positions on and has used in the past. This would include the marks of NGS, USC and GS, USGS, and other Federal agencies. I can at times raise or lower these marks as well as move them out of the way of construction.

The National Geodetic Survey has two types of marks, horizontal control marks and vertical control marks. The vertical control marks can be moved by you if you request a form which gives instructions on how to move it and a recording space. You will also receive a stamped disk. These can be obtained either from me or from:

Mark Maintenance Branch, C-172
National Geodetic Survey, NOAA
Rockville, Maryland 20852

You are not allowed to move the horizontal control system because NGS has many specifications on what has to be done at these stations. Therefore, I maintain this system and your help is always appreciated when this work is done, and your reports outlining which stations need work is very important.

The other services I can offer you are assisting you in getting data from National Geodetic Survey, assisting you in making contact with the appropriate person in NGS for any problem you might have, and assisting you with problems whenever possible. My specialty is astronomic observations with the wild T-4 theodolite.

At this time, National Geodetic Survey is in the process of rerunning first order level lines that have not been run in the last 10 years. Southern New Mexico and Montana have been completed. The party doing this, is working north in the summer and south in the winter. The areas in the middle of the U.S. will be surveyed last.

Triangulation may be a thing of the past in a few more years as NGS will have only one party by the end of the year. If you have areas that need horizontal control, contact me and we can see what can be done. A global positioning system may be used in the future, but until then, plan as if what is in the ground is all there is going to be.

10TH ANNIVERSARY 1970-1980
National Oceanic and Atmospheric Administration
A young agency with a historic tradition of service to the Nation

Figure A-2.--National Geodetic Survey memo.

NGS may also reevaluate the role mark maintenance has in the organization. There is some chance that areas of the U.S. will be without maintenance people because NGS will use the limited number of personnel where there is support and money. This is a good reason to promptly report marks that need work. The system has been in operation for about 175 years and offers a lot of information about surveying, geology, and the changing land. I would appreciate your supporting this system by sending in reports as to the condition of the marks.

I hope to meet you at either the ACSM convention in 1982 in Denver, or down the road somewhere.

Regards,

Richard S. Cohen

Richard Cohen

Enc.

Figure A-2. (cont.)--National Geodetic Survey memo.

Appendix B
Topographic Map & Aerial Photo Scales & Conversions

TOPOGRAPHIC MAP SERIES

Series	Scale	One Inch Represents	Standard Quadrangle Size (latitude & longitude)	Quadrangle Area (square miles)
7.5-minute	1:24,000[1]	2,000 feet	7.5 x 7.5 min.	49 to 71
15-minute	1:62,500[2]	about 1 mile	15 x 15 min.	197 to 282
Intermediate-scale quadrangle	1:100,000	over 1.5 miles	30 min. x 1°	1,145 to 2,167
U.S. 1:250,000[3]	1:250,000	about 4 miles	1° x 2°	4,580 to 8,669
International Map of the World[3]	1:1,000,000	about 16 miles	4° x 6°	73,734 to 102,759

[1] For Alaska, the scale is 1:25,000 and for Puerto Rico, 1:20,000.

[2] For Alaska, the scale is 1:63,360 (1 inch represents 1 mile) and the quadrangle size is 15 x 20 to 36 minutes.

[3] Maps of Alaska and Hawaii vary from these standards.

TABLE 1.—*Scale conversions for vertical aerial photographs*[1]

Representative fraction (scale)	Feet per inch	Chains per inch	Inches per mile	Acres per square inch	Square miles per square inch
(1)	(2)	(3)	(4)	(5)	(6)
1:7,920	660.00	10.00	8.00	10.00	0.0156
1:8,000	666.67	10.10	7.92	10.20	.0159
1:8,400	700.00	10.61	7.54	11.25	.0176
1:9,000	750.00	11.36	7.04	12.91	.0202
1:9,600	800.00	12.12	6.60	14.69	.0230
1:10,000	833.33	12.63	6.34	15.94	.0249
1:10,800	900.00	13.64	5.87	18.60	.0291
1:12,000	1,000.00	15.15	5.28	22.96	.0359
1:13,200	1,100.00	16.67	4.80	27.78	.0434
1:14,400	1,200.00	18.18	4.40	33.06	.0517
1:15,000	1,250.00	18.94	4.22	35.87	.0560
1:15,600	1,300.00	19.70	4.06	38.80	.0606
1:15,840	1,320.00	20.00	4.00	40.00	.0625
1:16,000	1,333.33	20.20	3.96	40.81	.0638
1:16,800	1,400.00	21.21	3.77	45.00	.0703
1:18,000	1,500.00	22.73	3.52	51.65	.0807
1:19,200	1,600.00	24.24	3.30	58.77	.0918
1:20,000	1,666.67	25.25	3.17	63.77	.0996
1:20,400	1,700.00	25.76	3.11	66.34	.1037
1:21,120	1,760.00	26.67	3.00	71.11	.1111
1:21,600	1,800.00	27.27	2.93	74.38	.1162
1:22,800	1,900.00	28.79	2.78	82.87	.1295
1:24,000	2,000.00	30.30	2.64	91.83	.1435
1:25,000	2,083.33	31.57	2.53	99.64	.1557
1:31,680	2,640.00	40.00	2.00	160.00	.2500
Method of calculation	$\frac{\text{RFD}}{12}$	$\frac{\text{RFD}}{792}$	$\frac{63,360}{\text{RFD}}$	$\frac{(\text{RFD})^2}{6,272,640}$	$\frac{\text{Acres/sq. in.}}{640}$

[1] Conversions for scales not shown can be made from the relationships listed at the bottom of each column. With the scale of 1:7,920 as an example (column 1, line 1), the number of feet per inch is computed by dividing the representative fraction denominator (RFD) by 12 (number of inches per foot). Thus, 7,920÷12=660 feet per inch (column 2). By dividing the RFD by 792 (inches per chain), the number of chains per inch is derived (column 3). Other calculations can be made similarly. Under column 4, the figure 63,360 represents the number of inches in one mile; in column 5, the figure 6,272,640 is the number of square inches in one acre; and in column 6, the number 640 is acres per square mile.

Figure B-1.--Topographic map and aerial photo scales and conversions.

Appendix C
Some Forest Service Post & Mark Specifications

BLAZES

Face or quarter blazes (figure C-1) will be used as follows:

(1) Trees on Property Line. Place face blazes on opposite sides, along the direction of the line, so that the blazes face a person proceeding along the line in either direction.

(2) Blazes on Forest Service Side of Property Line. Place quarter blazes on a reasonable number of available trees within 3 feet of the line. They should be easily visible to any person traveling in either direction along the property line.

(3) Trees on Opposite Side of Property Line from Forest Service Side. Place a face blaze on a reasonable number of available trees within 3 feet of the line on the side of the tree facing the line. Written permission should be obtained from adjoining owners before trees on private lands are marked.

There will be instances when it will be obvious that clearing or marking should not be done on private land. Examples include property owned by persons known to be hostile to the Forest Service, property lines of resorts, and summer home sites.

PAINTING

Blazes may be painted with a heavy-base red enamel implement paint. Paint also may be applied at random to some of the rocks used to make cairns or piled around the bases of monuments and posts. Posts will be painted by contractor or Forest Service personnel with a heavy-base red or red-orange (poppy-red) implement paint.

An insecticide may be mixed with the paint to possibly protect the blaze from insects and disease.

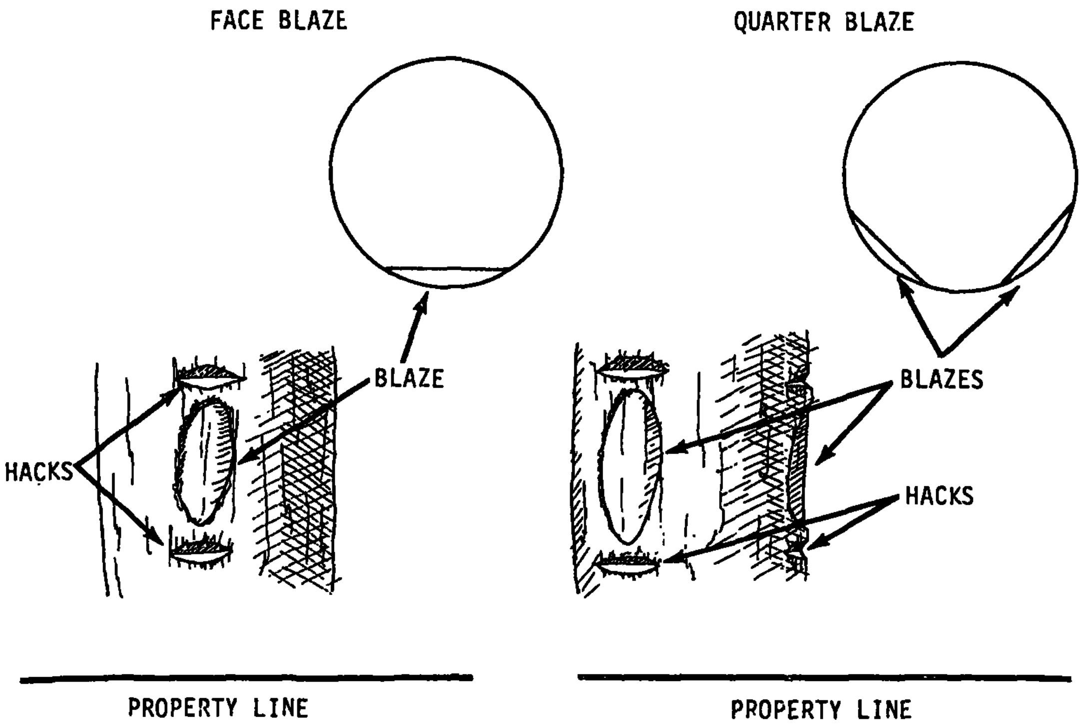


Figure C-1.--Blazes.

POSTS

These should be at least 5 feet long and must be made of metal, treated wood, or other approved material. A length of 5-1/2 feet is most suitable. They are to be firmly set, with about 4 feet extending above the ground. Posts with appropriate signs attached will be set near corner points and on property lines as follows:

(1) As a guard post near each corner monument. If the corner monument is a tree, a post is not required. Both the land survey monument sign and the property boundary sign may be attached to the tree.

(2) Where property lines cross roads or trails. Generally, wood posts should be used at road crossings.

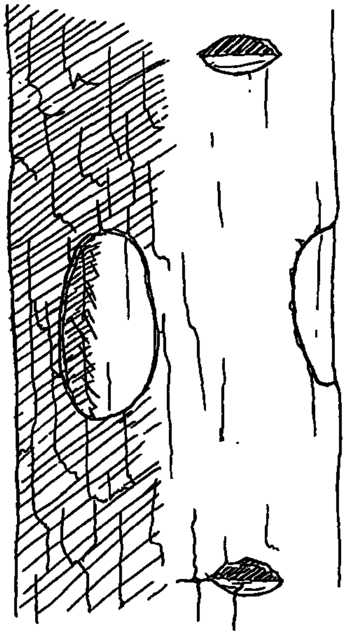


Figure C-2.--Optional method for the placement of hacks. This is time-saving and also meets standards. The hacks are cut above and below some distance to prevent obstruction of the flow of sap.

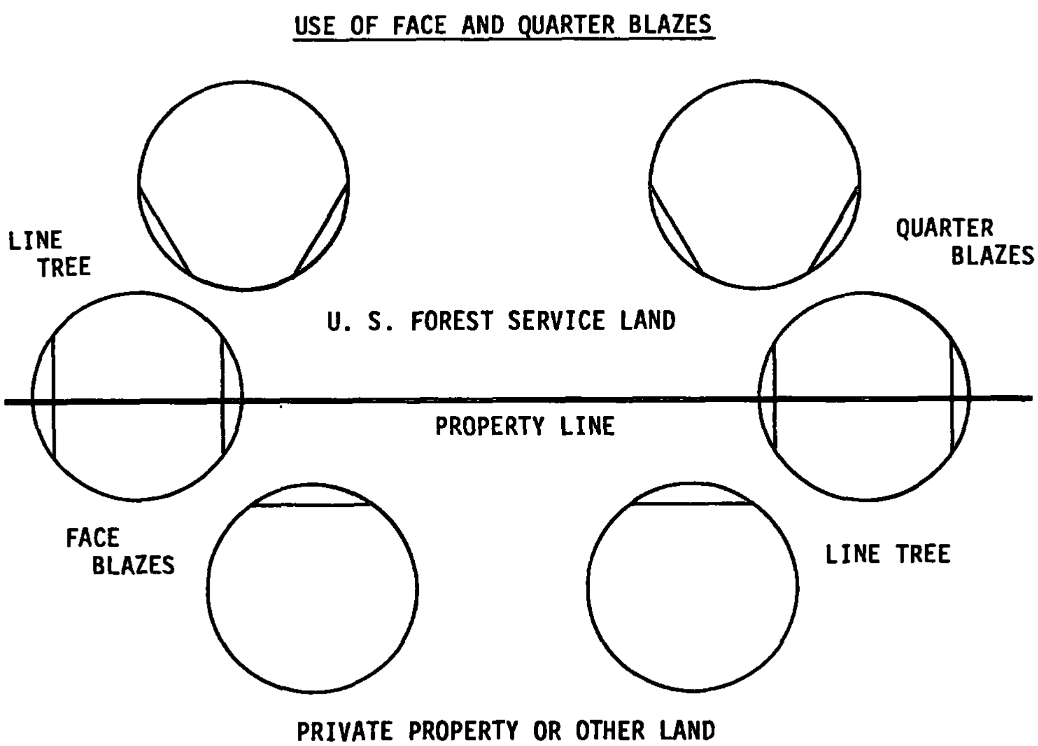
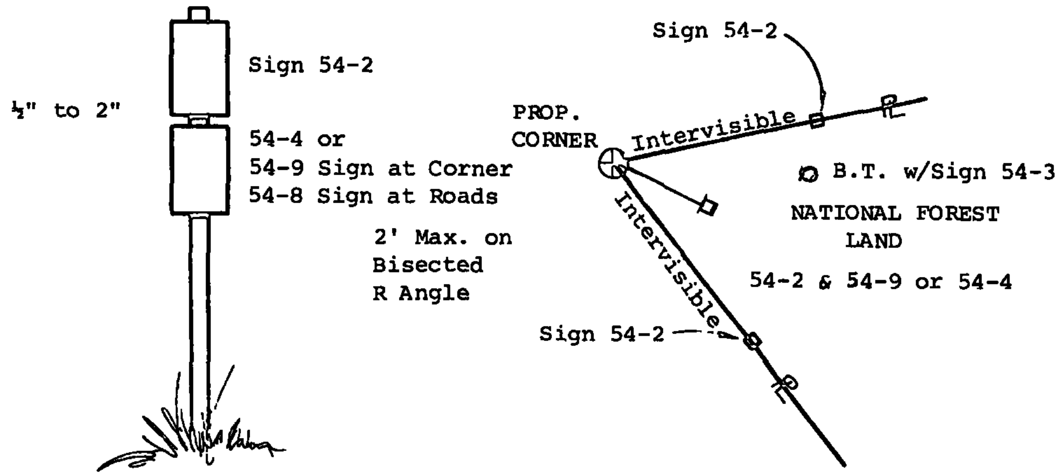
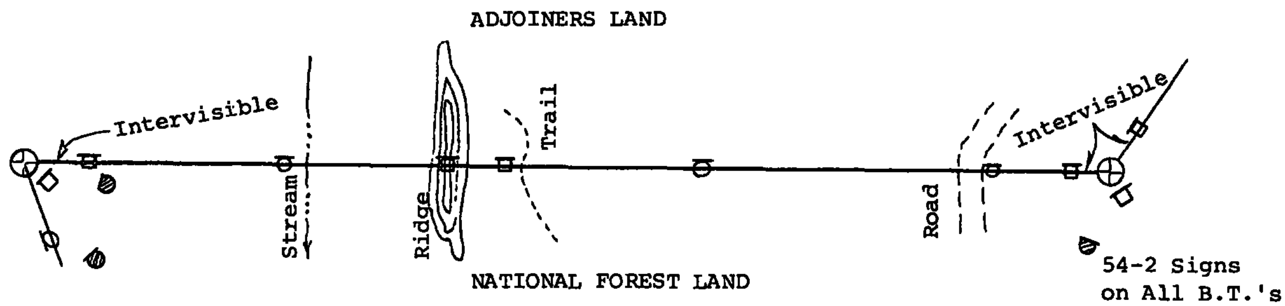


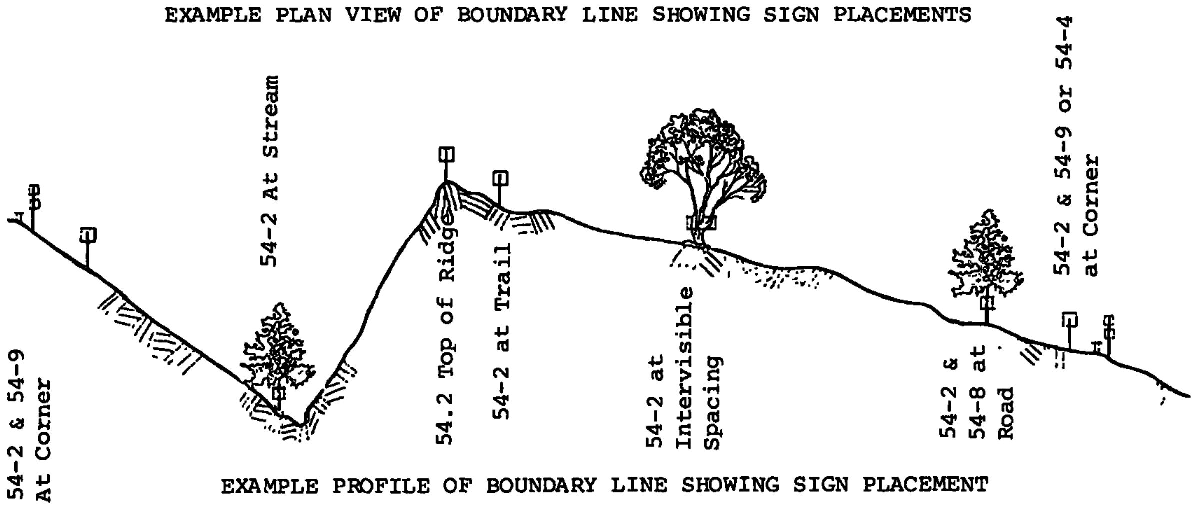
Figure C-3.--Use of face and quarter blazes. Permission should be obtained from landowner prior to face-blazing. No hacks are needed for line trees. When blazing is performed the cambium layer (living tissue) must be removed.



TYPICAL SIGN AND POST INSTALLATION

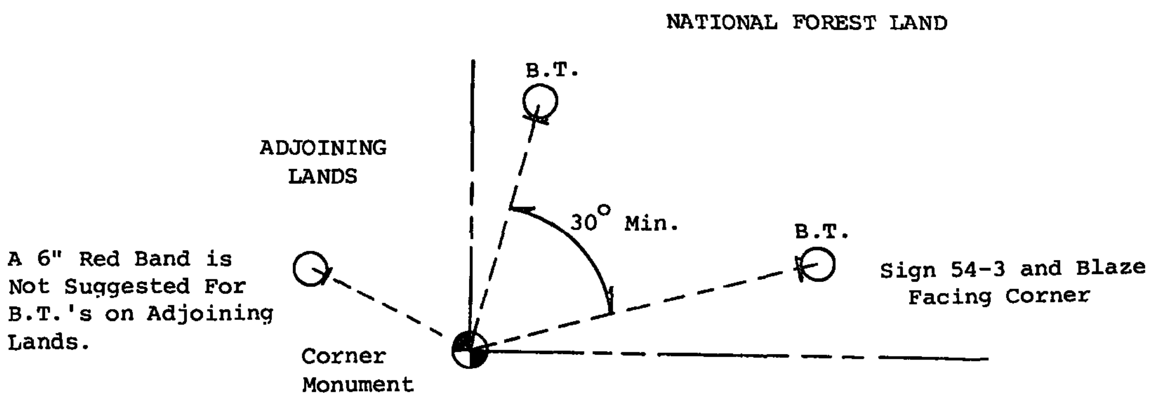


EXAMPLE PLAN VIEW OF BOUNDARY LINE SHOWING SIGN PLACEMENTS

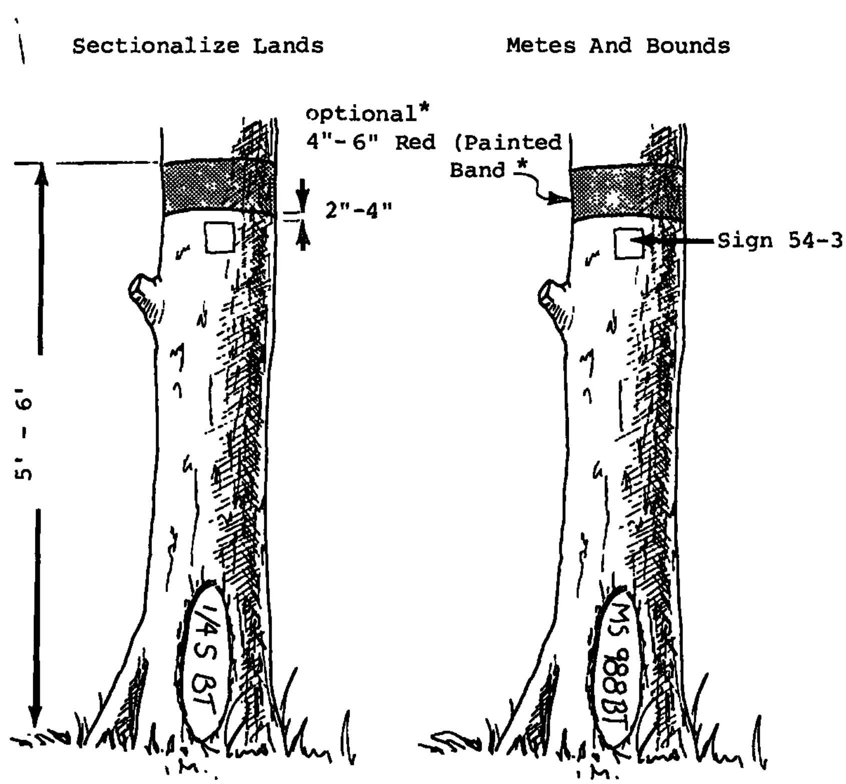


EXAMPLE PROFILE OF BOUNDARY LINE SHOWING SIGN PLACEMENT

Figure C-4.--Sign placement.



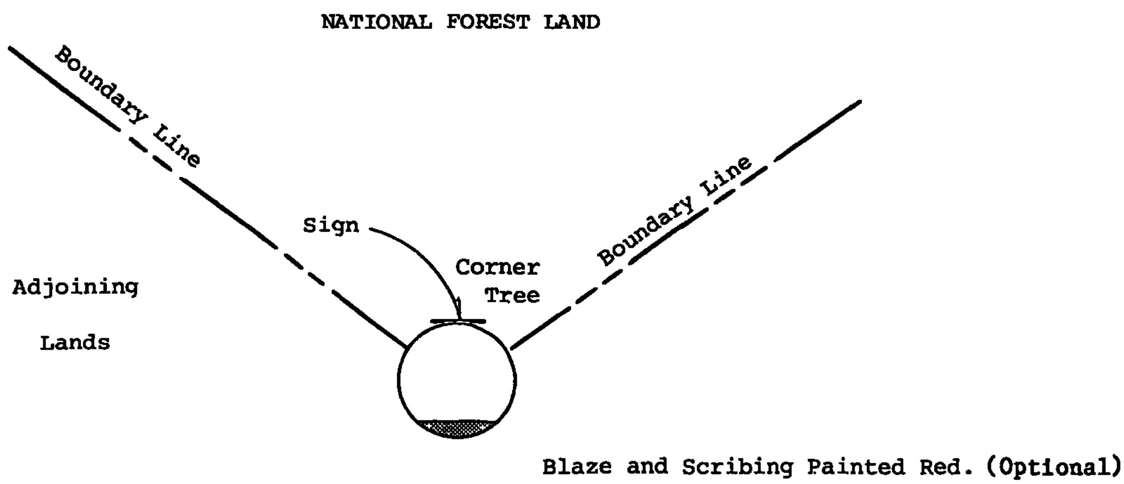
TYPICAL PLAN VIEW OF BEARING TREE LAYOUT



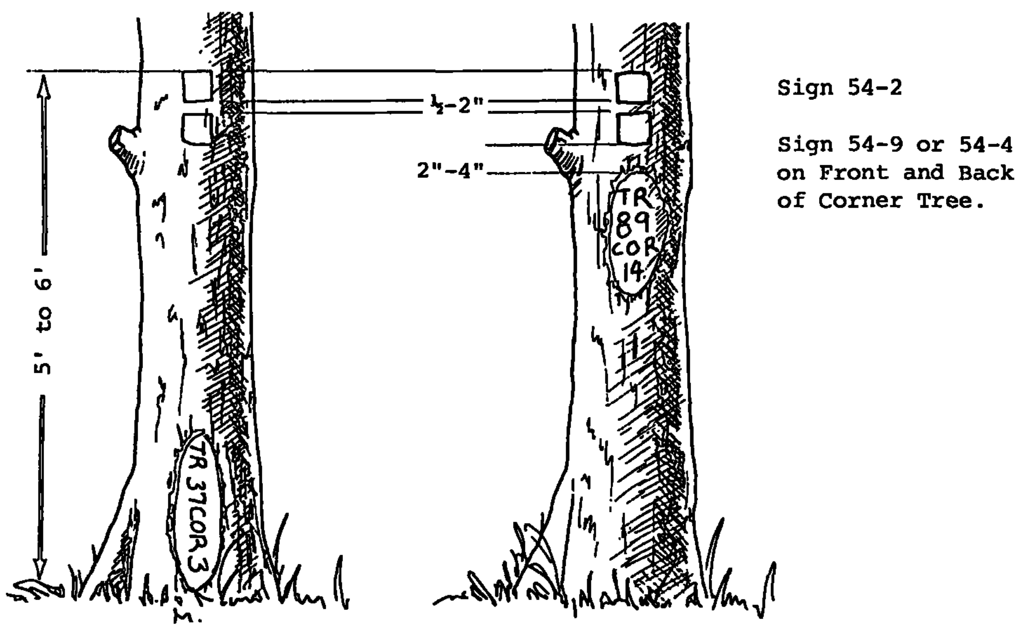
TYPICAL BEARING TREE ON NATIONAL FOREST LAND

NOTE: The painting of bearing trees is optional and such factors as aesthetic impacts may restrict such action.

Figure C-5.--Bearing trees.



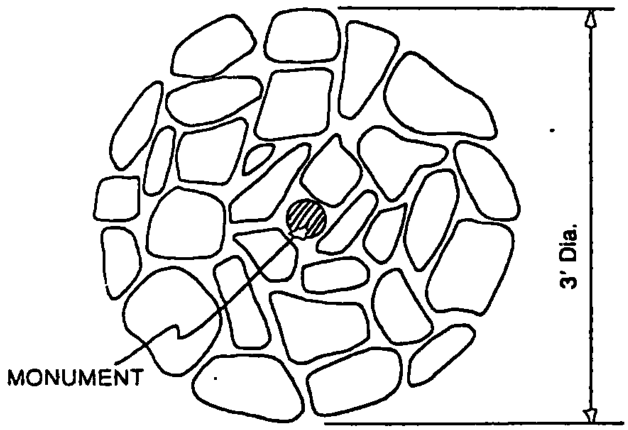
TYPICAL PLAN VIEW OF CORNER TREE



TYPICAL FRONT VIEW OF CORNER TREE

Figure C-6.--Corner trees.

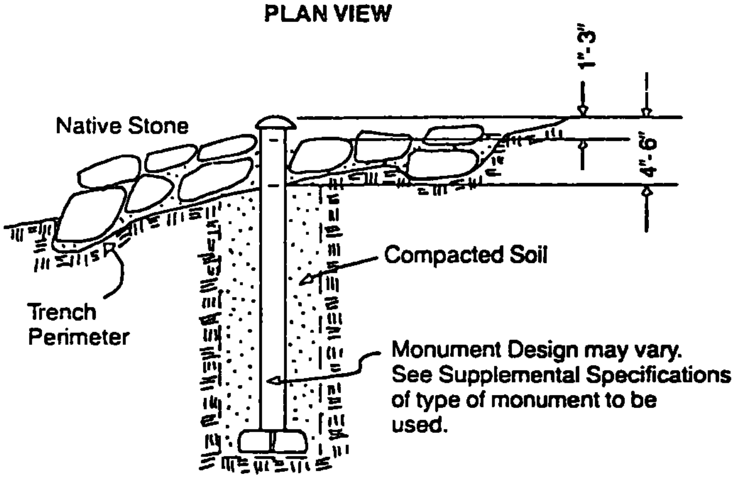
Appendix D
Corner Marking Diagrams & Placement of Monuments



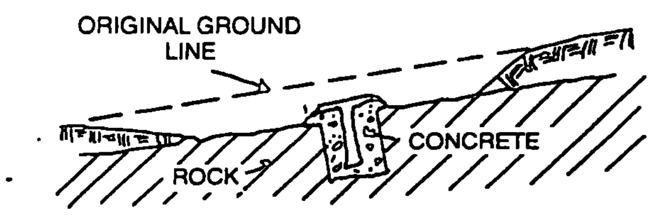
MONUMENT w/MOUND of STONES - TYPICAL
PLAN VIEW

NOTES:

1. Native stones within 100' of the corner shall be used to construct a mound around the monument. Where the number of available stones is insufficient to construct a 3' diameter mound, the contractor shall construct a mound as large as the available stones will permit.
2. Monuments shall be set plumb with the backfill soil compacted to 4" to 6" layers.
3. Only those monuments designed to be driven shall be driven.



TYPICAL SECTION VIEW

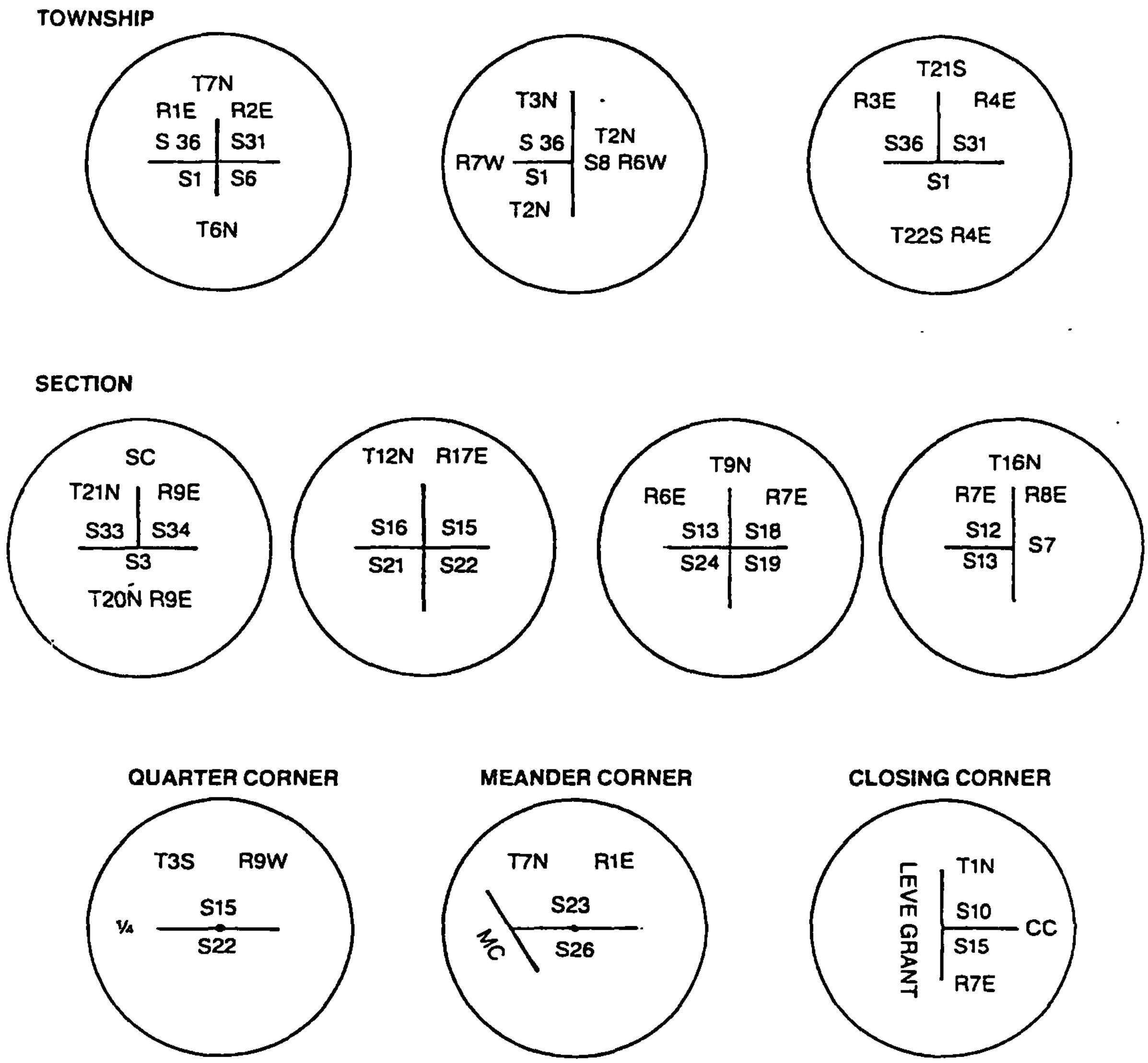


TYPICAL ROCK TABLET INSTALLATION.

NOTES:

1. Rock Tablets shall be used in solid rock or in large planted stones impractical to remove.
2. The Contractor shall clean the rock surface and provide for drainage.
3. Rock tablets shall be flush to surface.

Figure D-1.--Placement of monuments and rock collars.



Notes:

1. The markings on the cap shall be made to read from the south side of the monument.
2. In addition to the markings shown, the land surveyor's registration number and the year the monument is established shall be stamped on the cap.
3. See the Manual for specific corner markings.

Figure D-2.--Examples of stamping for rectangular monuments.

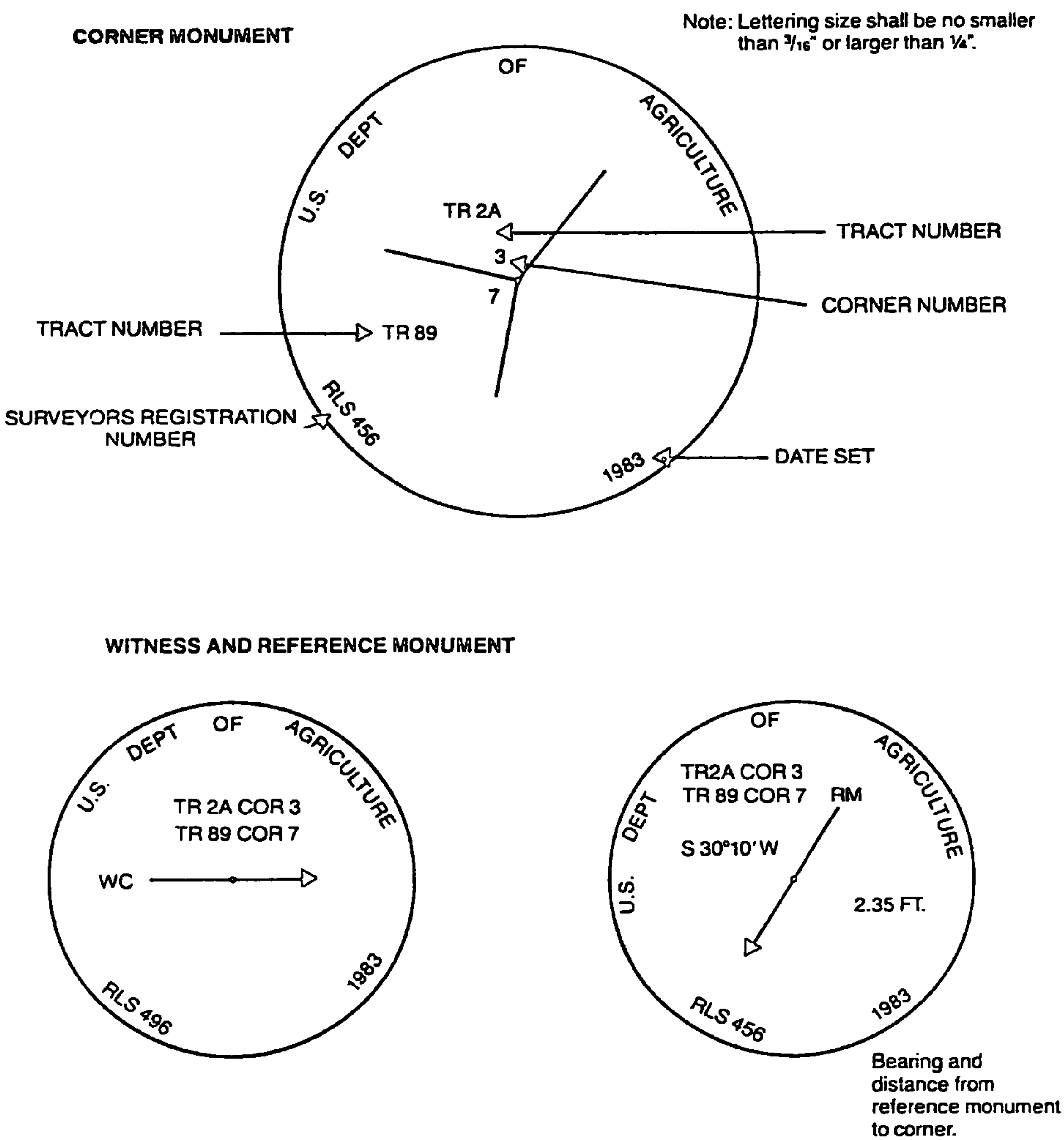


Figure D-3.--Examples of stamping for tract monuments. The "RM" and "WC" may be above the tract information.

References

(1) Avery, Thomas Eugene, Forest Consultant, Agriculture Handbook No. 308, U.S. Department of Agriculture, Forest Service, Forester's Guide to Aerial Photo Interpretation. Revised November 1978. pp. 8-22.

(2) Bouchard, Harry and Moffitt, Francis H., Ch. 17, Surveying, 6th ed. Harper & Row, 1975. pp. 711-740.

(3) Brown, Curtis M. and Eldridge, C. Winfield H., Evidence and Procedures for Boundary Location. John Wiley & Sons, Inc., pp. 67-138.

(4) Davis, Raymond E., Foote, Francis S., and Kelly, Joe W., Surveying Theory and Practice, 5th ed. McGraw-Hill, pp. 571-629.

(5) Drahn, Richard, Land Surveyor, Ottawa National Forest, and Stefan, Milo, Surveyor, Nicolet National Forest, U.S. Department of Agriculture, Forest Service, Decayed Wood Identification of Bearing Trees of Public Land Surveys. 1981. pp. 1-7.

(6) Cazier, Lola, U.S. Department of the Interior, Surveys and Surveyors of the Public Domain 1785-1975. pp. 65-113.

(7) Fulkerson, Marshall, Regional Land Surveyor, Pacific Northwest (R6), A paper titled Homestead Entry Surveys.

(8) Graves, Henry S., Forester, U.S. Department of Agriculture, Forest Service, Instructions for Making Forest Surveys and Maps. pp. 3-85.

(9) Clark, Frank Emerson, A Treatise on the Law of Surveying and Boundaries, 3rd Edition. Edited by John S. Grimes, LLB., J.D.. Indianapolis, IN: Bobbs-Merrill *Co.,* Inc., 1959. pp. 342-424.

(10) Engineering Staff, U.S. Department of Agriculture, Forest Service, Land Surveying Guide, August 1985.

(11) Lappala, Donald J., Retracement and Evidence of Public Land Surveys. pp. 1-46.

(12) Mahoney, Harry, Civil Engineering Technician, Pike-San Isabel National Forest, Various Short Papers on Corner Search and Recordation.

(13) Dodds, J.S. (Editor). Original Instructions Governing Public Land Surveys 1815-1855. Ames, IA, 1944. pp. 101-127, 181-215.

(14) Mulford, A. C., Boundaries and Landmarks.

(15) Parrish, Steve, Land Surveyor, Corner Search Handbook. 1965 (unpublished).

(16) Sumner, Bruce, Regional Cadastral Surveyor, U.S. Forest Service, The Film, Corner Search and Rescue.

(17) White, C. Albert, U.S. Department of the Interior, BLM, A History of the Rectangular Survey System.

(18) U.S. Department of the Interior, BLM, Manual of Instructions for the Survey of the Public Land of the United States 1973. pp. 99-134, 219-226, 239-323.

(19) U.S. Department of the Interior, BLM, Manual of Instructions for the Survey of the Public Land of the United States 1947. pp. 164-308.

(20) U.S. Department of the Interior, BLM, Restoration of Lost or Obliterated Corners and Subdivisions of Sections--A Guide for Surveyors. pp. 1-40.

(21) U.S. Department of the Interior, General Land Office, Public Lands Laws and Regulations 1882-1906.

(22) U.S. Department of the Interior, BLM, Video/tape program, Corner Point Identification. 1976. pp. 1-75.

(23) Ferguson, C. W. Concepts and Techniques of Dendrochronology. University of Arizona, Laboratory of Tree-Ring Research. Los Angeles: University of California Press, 1970.

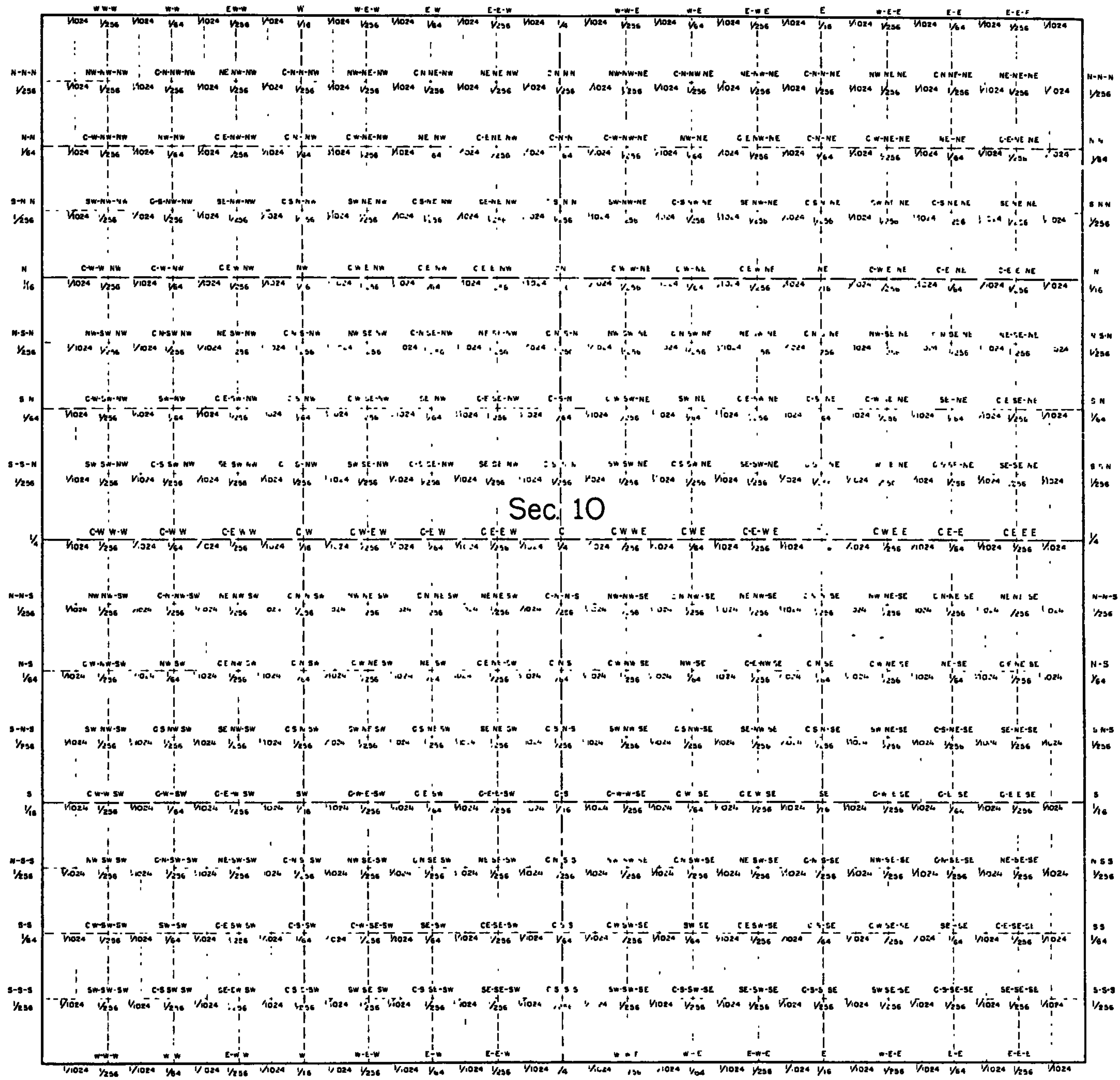
(24) Clevenger, Shobal V., U.S. Deputy Surveyor, A Treatise on the Methods of Government surveying, 3rd Ed. Revised. Hopkins, MN: Carben Surveying Reprints. pp. 13-38, 64-75.

(25) U.S. Department of Commerce, Environmental Science Services Administration, Coast and Geodetic Survey, Photogrammetry Instructions No. 22, Revision 2. September 30, 1965. pp. 1-14.

(26) U.S. Department of the Interior, BLM, Land & Survey Records. pp. 1-36.

(27) U.S. Department of the Interior, BLM, Cadastral Survey Training Staff, Durability of Bearing Trees. pp. i-iii.

IDENTIFICATION OF CORNERS ON SUBDIVISION OF SECTION LINES



EM 7150-4
November 1986

Corner Search, Perpetuation, & Recordation-A Training Guide

USDA United States Department of Agriculture | Forest Service | Monongahela National Forest | 200 Sycamore Street
Elkins, WV 26241
304-636-1800

File Code: 1900; 2700
Date: March 9, 2017

Ms. Leslie Hartz
Vice President, Pipeline Construction
Dominion Resources Services, Inc.
5000 Dominion Boulevard
Glen Allen, VA 23060

Dear Ms. Hartz:

Thank you for your letter dated March 6, 2017, received March 7, 2017, requesting assistance moving forward with the steep slope design coordination between Atlantic Coast Pipeline, LLC (ACP) and the Forest Service. The Forest Service has been working closely with ACP on the steep slope design issue since our October 24, 2016 letter that requested site-specific designs on example sites, and our respective staffs have been coordinating informally since our November 21, 2016 meeting.

We regret that the draft design materials did not get distributed to team members prior to the November 21 meeting. The delay was caused by a technical difficulty related to the file size, and we were not aware until the morning of the meeting that the materials had not been successfully distributed. Since then, we have instituted a procedure for the third party contractor to gather and distribute meeting materials and provide them to attendees via an ftp site.

Despite the late distribution of meeting materials, the Forest Service geologist, hydrologist, and soil scientists were able to provide substantial technical feedback on the designs, including requests for greater site specific detail and documentation of the effectiveness of the techniques. Our November 21 feedback reiterated previous requests made at scoping (April 27, 2015), in comments on draft resource reports (July 30, 2015, comments 156, 167-189, 191, 192, 202, and 203), and in comments on the draft Construction, Operation, and Maintenance plan (November 10, 2016, comments 41-42, 116-118, 135, 153, 259, 336, 398, 402, 441, and 445-446)

You are correct that we agreed to schedule small group technical work sessions. We held such sessions on December 8, 2016 (3:00 pm to 5:00 pm) and February 17, 2017 (10:00 am to 1:30 pm) that were attended by Forest Service and ACP technical experts. These technical sessions occurred via teleconferences with online meeting components for viewing design drawings and other materials. During these sessions, the Forest Service provided substantial technical feedback and reiterated previous requests for ACP to provide site specific detail and documentation of effectiveness. Thus, the claim that the Forest Service has not granted a single technical work session is false.

At the December 8 work session, the Forest Service again requested documentation of the effectiveness of slope stabilization techniques, we requested that ACP provide a construction narrative, and we reiterated many of the earlier requests to provide more site-specific detail in the drawings. We also agreed to provide written clarification of the verbal requests made during the session. This written clarification was provided to ACP via e-mail as part of the draft meeting notes on December 21, 2016, and again as part of the final meeting notes on February 15, 2017.

We are sorry that you viewed the February 17, 2017 work session as unproductive. We feel that some progress was made toward developing the site-specific detail that is needed to properly address the steep slopes issue. However, as we noted in that session, the information submitted on January 10, 2017 still lacked important details regarding specific areas of concern, and the effectiveness information and construction narrative were requested once again. It is not true that the January 10 designs were not distributed to Forest Service specialists in time for a thorough review; only the third-party contractor specialists received the documents late due to the timing of when the contractor was brought on staff. Because ACP specifically requested a meeting with the Forest Service Geologist to seek his input on designs, the delay in assignment of the contractor to the project had no bearing on the meeting.

We agree that face-to-face work sessions are ideal. However, the five-hour travel time that is required for many of the key Forest Service staff reduces the practicality of such sessions and decreases safety, particularly during winter months. We appreciate ACP providing a third party contractor with the capability of administering online meetings that allow meeting attendees to view documents and confer via telephone.

We agreed to schedule an in-person meeting to follow the December 8 and February 17 technical sessions. March 24 was selected as the earliest possible meeting date that could accommodate a 4-hour in-person meeting and allow technical specialists ample time to review the revised Construction, Operation, and Maintenance Plan; Draft Environmental Impact Statement; and the additional site-specific detail and effectiveness documentation that ACP committed to providing at previous meetings, which we have not yet received. We understand your desire to meet sooner, but having only received your letter on March 7, 2017, and with critical information still outstanding, we are unable to accommodate a meeting on or before March 10, 2017.

We respect ACP's commitment to the Federal Energy Regulatory Commission (FERC) to demonstrate that ACP has satisfied Forest Service requests regarding site-specific designs of representative construction segments on steep slopes. We acknowledge your readiness for a meeting and recognize that ACP must have the site specific design and effectiveness information that we have requested since April 2015.

The most efficient means for making appreciable progress in our March 24 discussion would be to submit the information to the Forest Service and file it with FERC so that Forest Service specialists can review the site specific details and effectiveness techniques prior to the meeting. Because of the volume of material that must be reviewed to ensure a productive meeting, the Forest Service specialists will need ample review time.

The Forest Service stands ready to continue working with ACP to resolve the issues surround slope stability and site-specific designs. Please contact Jennifer Adams, Special Projects Coordinator, by phone at (540) 265-5114 or email at jenniferpadams@fs.fed.us, for any questions or concerns.

Sincerely,

Clyde O Thompson

CLYDE THOMPSON
Forest Supervisor

cc: Richard B. Gangle, Dominion Resources Services, Inc.
Jennifer Adams, Special Projects Coordinator, U.S. Forest Service

Auth ID: GWP433202T
Contact ID: 587243010602
Use Code: 411

FS-2700-23 (v. 10/09)
OMB No. 0596-0082

U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE
AMENDMENT
FOR

SPECIAL-USE AUTHORIZATION

Amendment#: 2

This amendment is attached to and made a part of the GWP433202T special use authorization for site survey and testing issued to **ATLANTIC COAST PIPELINE, LLC** on 04/11/2016 which is hereby amended as follows:

To conduct geotechnical drilling investigations at two separate sites located approximately at Mileposts (MP) 120.3 and 123.1 of the proposed Atlantic Coast Pipeline (ACP) route. These activities will be conducted in accordance with the Project Description attached as Appendix A. The holder shall endeavor to conduct the vegetation clearing associated with this activity by March 31, 2017. In the event it is necessary to clear vegetation after March 31, the holder shall provide documentation from the USFWS of their approval prior to conducting any further vegetation clearing.

The temporary logging road identified for access to the MP123.1 boring site (known as the White Way Timber Sale temporary road) and shown on the attached Appendix C shall be restored to the existing condition (i.e. revegetated and tank trapped) in accordance with the specifications attached as Appendix B.

This Amendment is accepted subject to the conditions set forth herein, and to conditions attached hereto and made a part of this Amendment.

[signature]	[signature] Acting For Toby Timm
Holder	Authorized Officer
VP - Pipeline Construction	Forest Supervisor
Holder Title	Title
3/17/17	3/17/17
Date	Date

According to the Paperwork Reduction Act of 1995, an agency may not conduct or sponsor, and a person is not required to respond to a collection of information unless it displays a valid OMB control number. The valid OMB control number for this information collection is 0596-0082. The time required to complete this information collection is estimated to average one (1) hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

APPENDIX A

Project Description
Atlantic Coast Pipeline Project
Proposed Geotechnical Investigations at Potential Slope Instability Sites
George Washington National Forest, Highland County, Virginia
October, 2016

The Atlantic Coast Pipeline Project (ACP) proposes to conduct geotechnical drilling investigations at two separate sites located within the George Washington National Forest (GWNF), where potential slope instability has been identified. These sites are located at Mileposts (MP) 120.3 and 123.1 of the proposed pipeline route, in Highland County, Virginia. The objective of these geotechnical drilling investigations is to identify and characterize the subsurface conditions at these potential slope instability sites in order to develop measures to ensure that construction of the ACP does not result in the activation of landslides at these locales.

Each drilling investigation location will include two boreholes. Each borehole will require a 15 foot by 25 foot drill pad area, within which the drilling rig will be set up. Both drilling investigation locations will also include a separate staging area which can be accessed along existing unimproved roads. Each drilling investigation location will also require access to the drill pads. These proposed locations have been sited to minimize ground disturbance and removal of vegetation, consistent with the objectives of the investigations. Locations of these features are shown on the attached maps.

Drill Pads

Each drilling investigation location will contain two drill pad sites. Pad dimensions are 25 feet long by 15 feet wide. Each drill pad site was sited in an area that will require minimal grading to provide a level rig set-up area. Vegetation will be cleared and topsoil segregated and stockpiled at the edge of the site. Erosion and sediment controls, consisting of 8-inch silt socks at the edge of the site and water bars as necessary, will be implemented progressively as work proceeds. A drill rig, similar to that shown in the attached photos, will be set up to take the samples.

Equipment Staging Areas

Both drilling investigation locations will include a 50-foot by 75-foot equipment staging area. The proposed staging locations are sited in previously disturbed areas that will require minimal vegetation clearing and no grading. From the staging areas, tracked equipment and four-wheeled ATVs will be utilized for road improvements and materials transport, respectively. Erosion and sediment controls, consisting of 8-inch silt socks at the edge of the site and water bars as necessary, will be installed at the equipment staging areas.

The staging areas will also be used to store and pump water for the drilling operations, with one or two 500-gallon tanks located at each site. A gasoline-powered pump will be used to pump water from the staging area to the drill pads via temporary hoses. All pumps will be set up within secondary containment vessels to protect the soil from fluid spills or leaks. No fuel or other hazardous substances will be stored at the staging areas; support trucks will have an external fuel tank for fueling the drill rig. Spill pads and other related cleanup equipment and material will be kept on site to clean up any inadvertent leaks or spills of equipment/vehicle fluids.

Access

Access roads to the proposed drill pad and staging area locations are shown in the attached maps. With the exceptions noted below, access routes to the sites will utilize active and abandoned Forest Service roads. The abandoned roads are largely overgrown; consequently, downed and growing vegetation will need to be cleared to allow vehicles and equipment to reach the work sites. However, no widening, grading or graveling of these roads appears necessary, so no surface disturbance on or along roads is anticipated. It is possible that localized, minor ground disturbance may be required where cross-slope conditions will not permit safe passage of a light weight track mounted rig.

Proposed Access at MP 120.3

The MP 120.3 site is located approximately 0.6 mile north of Highway 250. Vehicular access to this site will follow the Buckhorn Creek Forest Service road to the north and into White Oak Draft to a proposed staging area located in an open space on the north side of the proposed ACP centerline (Figure 1). Between this staging area and the drill sites, an old logging road will be utilized. The length of the access route between the staging area and drill sites is approximately 1000 feet, of which 200 feet deviates from the old logging road. This segment would require clearing of vegetation only, for a width of about 8 feet. Approximately 800 feet of the old logging road would require clearing of downed and growing vegetation; no grading or graveling is anticipated, although minor, localized ground disturbance may be required where cross-slope conditions will not permit safe passage of a light weight track mounted rig. One stream crossing will be required where a low-water crossing already exists.

Proposed Access at MP 123.1

The MP 123.1 site is located approximately 2.3 miles east of Stover Shop Road (Route 728) along an active Forest Service logging road (Figure 2). If available, the equipment staging area will utilize a site where previous timber loading operations were situated, approximately 0.1 to 0.25 miles from the proposed drilling investigation sites. From the staging area, tracked equipment and four wheeled ATVs will be utilized associated with road improvements and materials transport, respectively. No stream crossings will be required and approximately 600 feet of new access road will be required upslope of the existing logging road to access the two drill pad sites and the staging area.

Environmental Surveys

With the exception noted below, cultural and biological surveys were carried out for all work areas associated with the proposed geotechnical investigations. No sensitive resources were identified in any of the proposed work areas.

At the MP 120.3 location, the portion of the old logging road that lies north of the ACP Project survey corridor (see Figure 1) was not surveyed for cultural or biological resources, as there are no plans to use it during pipeline construction. The proposed improvement of this road for the geotechnical investigations will be limited to clearing vegetation from overgrown segments. No grading or graveling is anticipated; proposed, although it is possible that minor, localized ground disturbance may be required where cross-slope conditions will not permit safe passage of a light weight track mounted rig. Use of the cleared roadway by vehicles and equipment would be similar to historical uses of the road. Consequently, the proposed improvement and use of this segment of road would not have the potential to affect historic properties, or other sensitive resources.

At the MP 123.1 the location the new access road, as well as the drill sites, are located within the area surveyed for cultural and biological resources (Figure 2). The staging area is located at the edge of the survey corridor in a previously disturbed area. No sensitive resources were identified during environmental field surveys at these locations.

Staging and Environmental Health and Safety Compliance

Prior to any clearing, grading or mobilization to the sites, work areas will be staked, flagged, and/or signed by ACP personnel. Limits of approved clearing along access roads will be flagged/staked. The perimeters of approved drill pad and staging area sites will be staked, and signs will be posted directing the contractor to approved access routes. No exclusion areas within or adjacent to the proposed work areas requiring special signage have been identified.

Prior to beginning work on any access roads, drill sites or staging areas, ACP personnel will hold one or more meetings with the contractor's personnel to review the environmental and safety requirements of the job. One or more ACP inspectors will be present during the work to oversee compliance with permit conditions and company requirements, and to interface with GWNF staff as necessary. All equipment and vehicles will be inspected prior to entering the GWNF to ensure they are free of soil that may contain invasive weed propagules, and free of fluid leaks.

The contractor will develop and maintain a site-specific Health and Safety Plan (HASP) in accordance with Occupational Safety & Health Administration (OSHA) requirements, as necessary. The HASP will address potential hazards, including requirements for worker protection based on the anticipated activities. At least 48 hours prior to commencing work at the site, the contractor will delineate the proposed locations of the individual explorations and contact Underground Service Alert (USA, Dig-Alert) to identify the location of any existing underground utilities in the immediate vicinity.

Investigatory Drilling

Four geotechnical borings (two borings at MP 120.3 and two borings at MP 123.1) are proposed to be advanced using a combination of 8-inch diameter hollow-stem auger (HSA) and core drilling (NQ or NX) methods to anticipated maximum depths of approximately 50 feet below ground surface (ft bgs) at MP 120.3 and 30 ft bgs at MP 123.1. Coordinates for the proposed locations, along with anticipated subsurface conditions and proposed depths are included in the following table:

Investigation Site (Boring ID)	Coordinates Latitude/Longitude (Decimal Degree WGS84)	Mapped Geologic Unit	Anticipated Maximum Depth (Feet)
MP120.3 (B-1)	38.291879 -79.235864	Devonian-age Brallier Formation Shale/Siltstone	50
MP120.3 (B-2)	38.291940 -79.235626	Devonian-age Brallier Formation Shale/Siltstone	50
MP123.1 (B-1)	38.28891103 -79.18890255	Devonian to Silurian-age Undivided Sandstone/Limestone/Shale	30
MP123.1 (B-2)	38.28914881 -79.18969272	Devonian to Silurian-age Undivided Sandstone/Limestone/Shale	30

The borings will be advanced utilizing a light-weight rubber track mounted Dietrich D-50 drill rig as shown in the attached photos. Based on results from previous geotechnical subsurface investigations performed elsewhere on the ACP Project, and a review of logs for the shallow test pits performed as part of the Order 1 Soil Survey within the immediate vicinity, it is we assumed that HSA drilling methods will only be advanced in the upper 10 to 15 ft bgs (the estimated depth of the overburden material and/or weathered bedrock). During HSA drilling, drive samples will be collected at 30 inch intervals using a 2.5-inch diameter, 24-inch long Standard Penetration Test (SPT) sampler to facilitate lithologic logging and sample collection for laboratory testing. SPT sampling will be performed through the entire overburden material profile and into the underlying bedrock, to the extent practical.

Following auger or SPT refusal, or upon encountering competent formation (bedrock) material, the investigation will switch to core drilling methods until the borehole is advanced at least 15 feet into intact bedrock. The core drilling process requires circulation of water mixed with a naturally occurring bentonite based drilling fluid additive to regulate the temperature of the core bit, to carry cuttings to the surface, and to promote borehole stability. During the coring process, drilling fluid is pumped through the drill rods and past the bit before returning to the surface with cuttings through the annular space between the drill rods and the wall of the boring. At the surface, the fluid and cuttings will discharge into a baffled sump tank to allow the cuttings to fall out prior to recirculating the drilling fluid back down the borehole. Water for this process will be hauled to the site and stored in one or two 500 gallon tanks at the staging areas. To convey water to the drilling sites, temporary hoses will be extended from the staging area and water will be pumped using a portable gasoline powered pump. An example of this type of pump is presented in the photos attached.

Recovered cores will be logged with respect to geologic unit, material/rock type, and structural orientation and discontinuities will be recorded by a geologist in the field. Upon completion of logging, the cores will be photographed and retained in core boxes for subsequent sample selection and/or archiving.

Upon completion of drilling activities, borings may be selected for instrumentation as described in the following section. If instrumentation is not needed, the borings will be backfilled from the bottom up through a tremmie pipe using bentonite-cement grout.

Instrumentation

Upon completion of the core drilling and evaluation of the subsurface conditions, select boreholes may be identified for instrumentation consisting of either a piezometer to monitor groundwater levels or an inclinometer to record potential slope movement over time. It is anticipated that up to one inclinometer and piezometer may be installed at each of the two investigation sites.

Piezometers

Temporary piezometer may be installed in the exploratory borings if groundwater is encountered during drilling investigations. The standard configuration for piezometers will consist of a 1-inch diameter PVC pipe placed into the open boring with a section of slotted or perforated pipe (screened interval) placed below the depth where groundwater is encountered. The annular space around the screened interval will be backfilled with a permeable material generally consisting of coarse-grained sand. At the top of the sand, a bentonite seal will be placed and the remainder of the annular space will be backfilled with bentonite-cement grout to prevent conveyance of surface water into the ground. Where installed, access to the piezometer for periodic readings will be provided through a locked surface monument, landscape vault, or well box which will also be used as a benchmark for subsequent level surveys. It is anticipated that piezometers may be monitored through construction if deemed necessary. On completion of monitoring, the PVC pipe will be cutoff below the ground surface and will be backfilled with bentonite-cement grout.

Inclinometers

Inclinometers may be installed in selected borings to confirm or monitor the absence or the presence of progressive slope movement that may be imperceptible to the eye. Dependent on the findings of the borings, the inclinometer casing would initially be installed to a targeted depth within the selected borehole and the annular space between the wall of the boring and the inclinometer casing will be backfilled using a lean cement grout mixture. The inclinometer casing provides access for insertion of a special tool that will obtain subsurface measurements and potential deflection of the casing over time in order to determine the depth of any movement surfaces. Following an initial baseline survey (zero reading), grooves inside the casing provide a track from which repeatable tilt measurements can be obtained and potential deflection can be recorded. Similar to the piezometers, access to the inclinometers for periodic readings will be provided through a locked surface monument, landscape vault, or well box which will also be used as a benchmark for subsequent level surveys. It is anticipated that inclinometers may be monitored through construction if deemed necessary. On completion of monitoring, the casing will be cut off below the ground surface and will be backfilled with bentonite-cement grout.

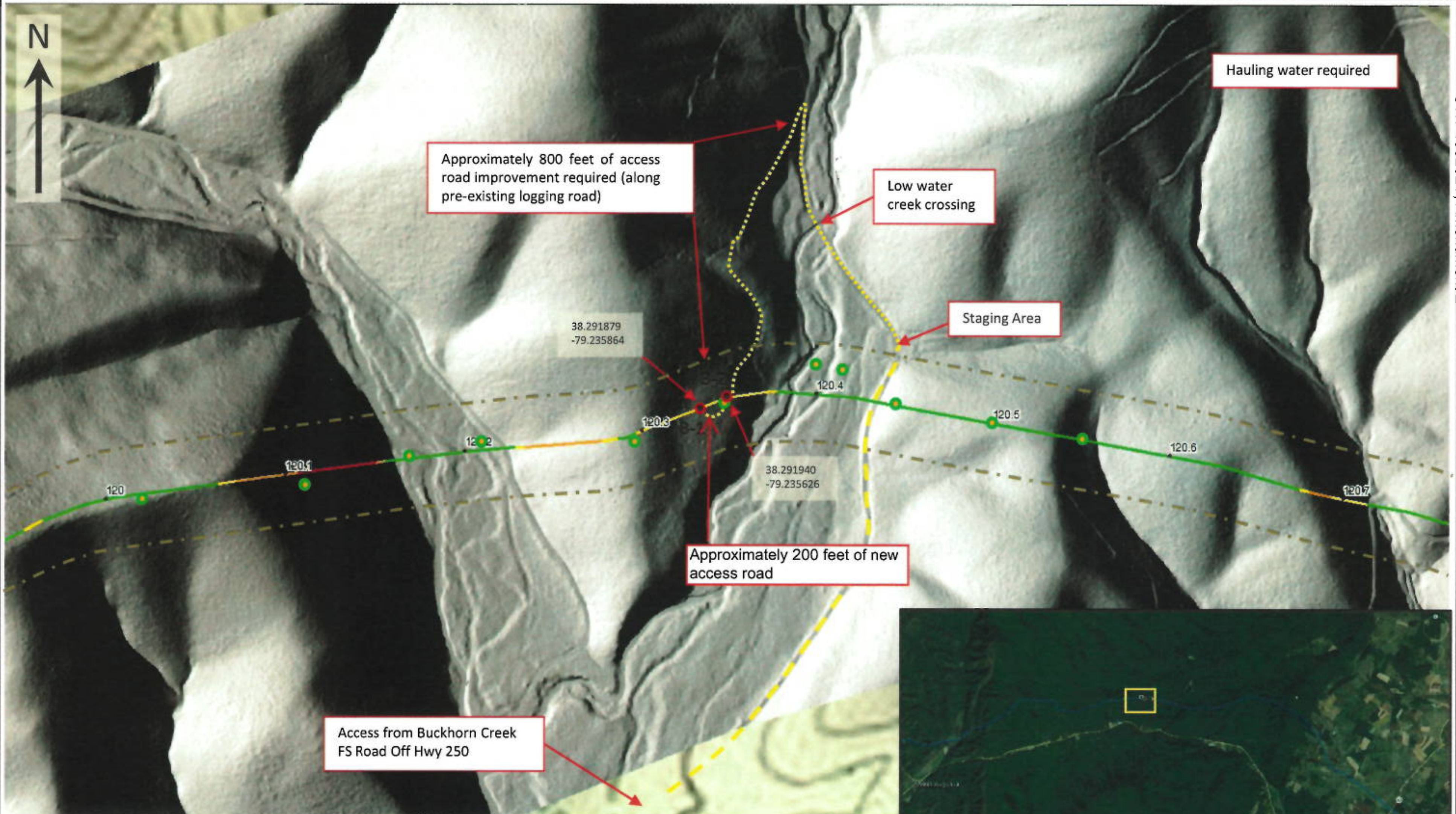
Restoration

Immediately following completion of drilling at each of the boring sites, restoration activities will be performed. Excess cuttings from the borings will be thinly spread within the limits of disturbance and the ground surface will be re-contoured to match that of pre-existing conditions to the extent feasible, stockpiled topsoil will be spread, and the area will be seeded as specified by the GWNF. Silt socks will be slit and straw will be spread over exposed soil. All non-biodegradable materials will be removed from the site. The new access road segments, staging areas, and drill pads will be rehabilitated and re-seeded.

Schedule

A tentative schedule for anticipated field activities described herein is provided below.

Approximate Field Day	Work Activity Description	Estimated Duration
1	Mobilize field crew to MP 120.3 location. Begin access road improvement and installation of erosion/sediment control	1 Day
2	Continue access road improvements and erosion/sediment control installation. Mobilize drill rig onto first drilling location, set up water system. Begin drilling.	1 Day
3	Investigation drilling, begin restoration at first drilling location when complete	2 Days
5	Complete drilling at MP120.3. Begin access road work at MP123.1	1 Day
6	Complete access road work and installation of erosion/sediment control at MP123.1, begin restoration at MP120.3. Mobilize drill rig to MP123.1, setup and begin drilling.	2 Days
8	Complete drilling at MP 123.1. Begin restoration at MP123.1.	1 Day
9	Demobilize drill rig and crew. Finish restoration activities.	1 Day
10	Demobilize remaining equipment and crew	1 Day



LEGEND

- Truck Access
- Dozer/Excavator and Tracked Drill Rig Access (with improvements)
- Proposed Exploratory Boring
- Location of Order 1 Soil Survey Test-pit

AP-1 REV 11 Centerline

- <30% slope
- 30 to 40% slope
- 40 to 58% slope
- >58% slope
- 120.3 Project Milepost
- 150-foot Project Buffer

SCALE

0 250 500 750 FT

Reference: ELEV_ACP_MP115_189_LidarHillshade280_P.tif
Original map scale 1:3000. Inset imagery date 9/18/15
Google Earth Pro.

PROPOSED GEOTECHNICAL INVESTIGATION PLAN
AP-1 Milepost 120.3

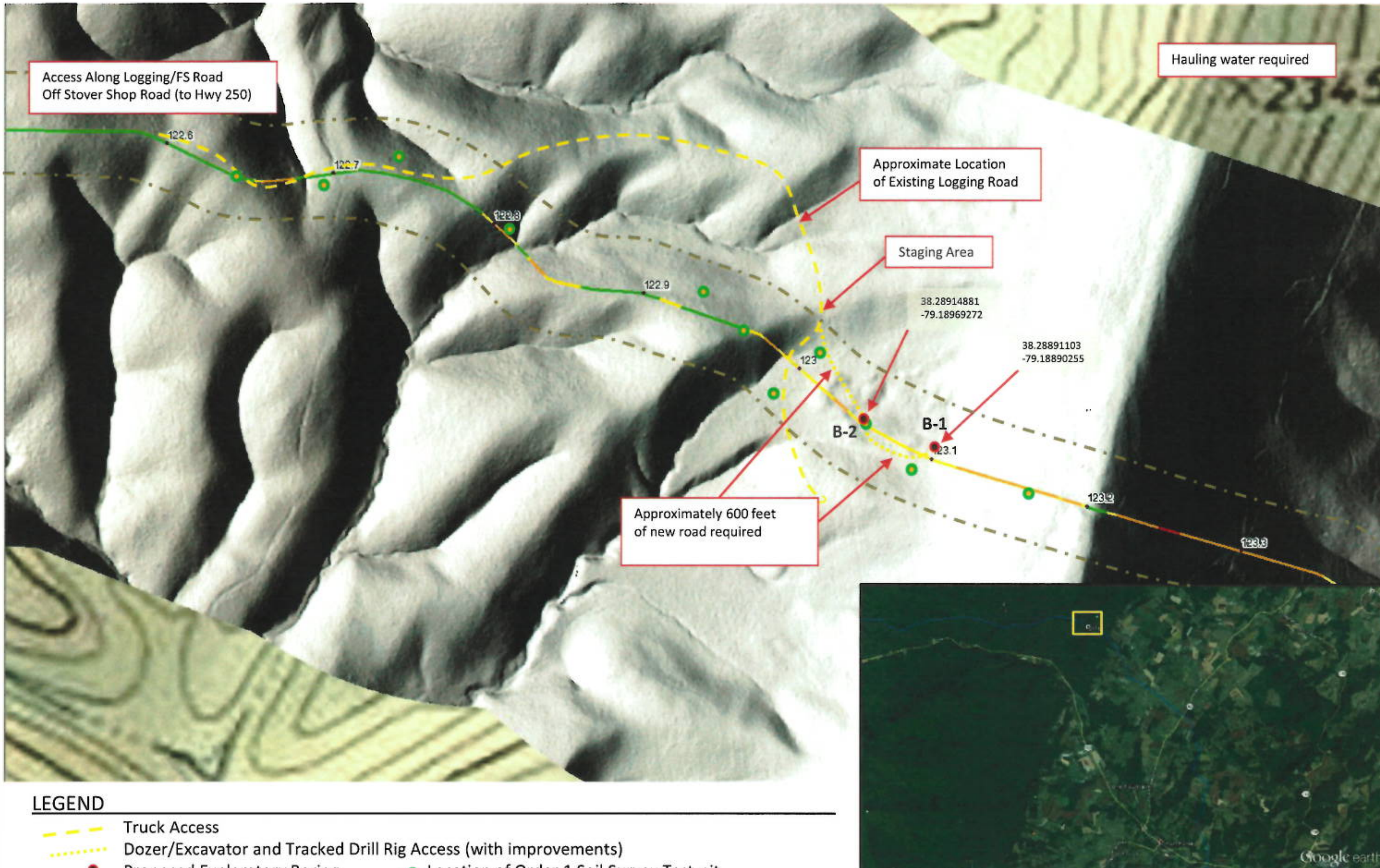
Atlantic Coast Pipeline – Highland County, Virginia

Geosyntec consultants

DATE: October 2016

PROJECT NO. TXG0007

Figure 1



LEGEND

- Truck Access
- Dozer/Excavator and Tracked Drill Rig Access (with improvements)
- Proposed Exploratory Boring
- Location of Order 1 Soil Survey Test-pit

AP-1 REV 11 Centerline
- <30% slope
- 30 to 40% slope
- 40 to 58% slope
- >58% slope

- 120.3 Project Milepost
- 150-foot Project Buffer

SCALE

0 250 500 750 FT

Reference: ELEV_ACP_MP115_189_LidarHillshade280_P.tif
Original map scale 1:3000. Inset imagery date 9/18/15
Google Earth Pro.

PROPOSED GEOTECHNICAL INVESTIGATION PLAN
AP-1 Milepost 123.1

Atlantic Coast Pipeline – Highland County, Virginia

Geosyntec consultants

DATE: October 2016

PROJECT NO. TXG0007

Figure 2

Geosyntec consultants

Attachment A –Photos of Proposed Equipment

	Photo 1 Image of a typical John Deere 650K dozer. Dozer may be used during site preparation and access road improvement activities.
	Photo 2 Image of a typical John Deere 85D mini excavator. Excavator may be used during site preparation and access road improvement activities.
	Photo 3 Image of a typical Diedrich track mounted D-50 drill rig is to be used during the geotechnical drilling investigation.

Geosyntec consultants

Attachment A –Photos of Proposed Equipment

<table>
<tr><td></td><td><u>Photo 4</u>

Image of a Diedrich D-50 track mounted drill rig (with raised mast) is to be used during the geotechnical drilling investigation</td></tr>
<tr><td></td><td><u>Photo 5</u>

Image of a typical tower pump. Pump is to be used for conveying water from water tanks to drilling locations.</td></tr>
</table>

APPENDIX B

Revegetation and tank trap requirements for proposed ACP boring site access
March 15, 2017

Affected area:

- Approximately 0.4 mile from end of FR1757;
- Estimated 1 acre of disturbance for revegetation purposes.

Revegetation Specifications

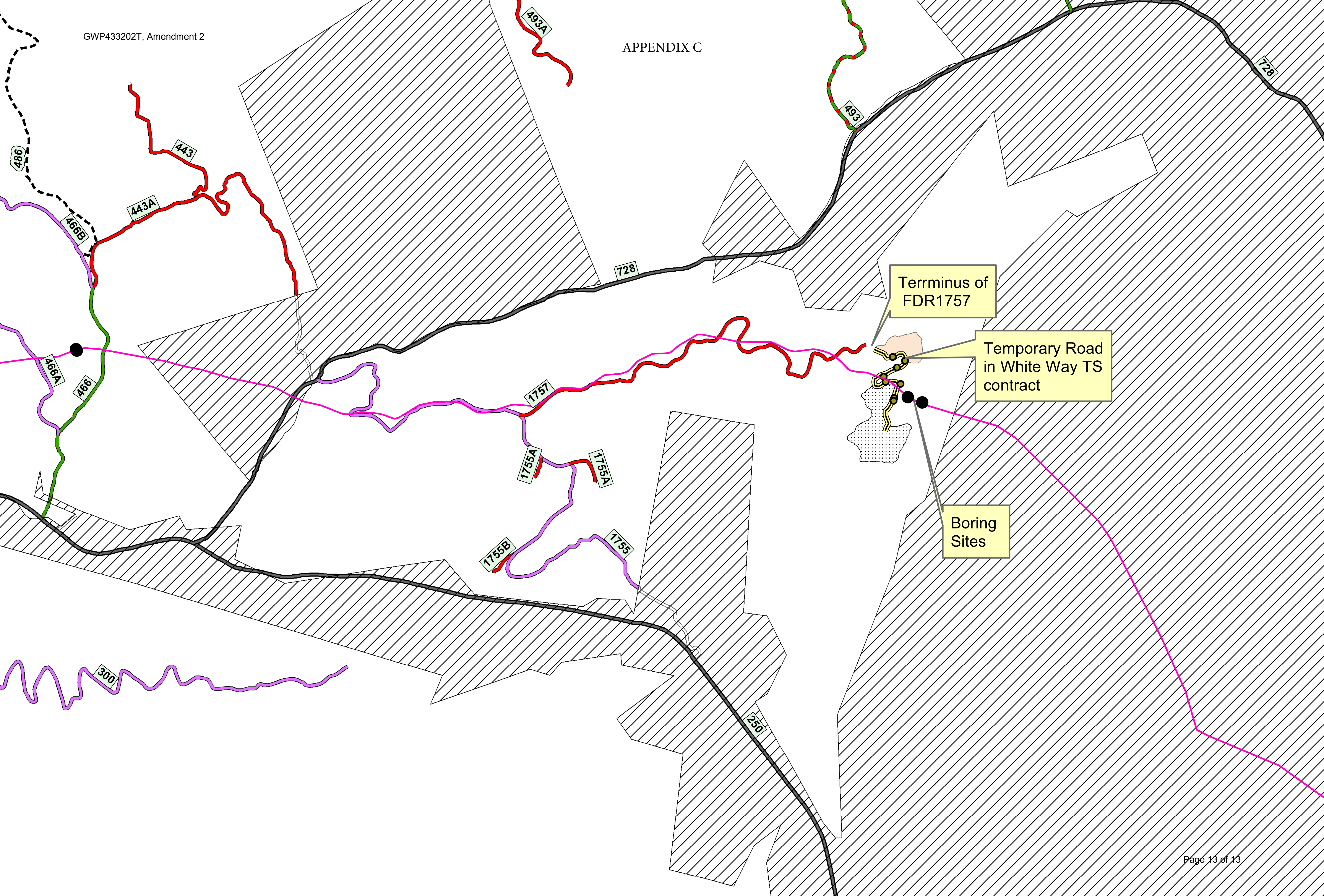
Fertilizer/Lime/Straw	Pounds/Acre
10-10-10	500 lbs.
Lime	500 lbs.
Straw	3,500 lbs. (70 bales)

Seed	Pounds/Acre
Orchard Grass	50 lbs.
Clover	10 lbs.
Millet	20 lbs.
Annual Rye	10 lbs.
Perennial Rye	10 lbs.

Tank trap at start of Temporary Road

Immediate view beyond tank trap.

APPENDIX C


Terrminus of FDR1757
Temporary Road in White Way TS contract
Boring Sites
728
493
493A
443
443A
486
466B
466A
466
1757
1755A
1755A
1755B
1755
300
250

U.S. Fish and Wildlife Service

ATLANTIC COAST PIPELINE
PROJECT MEETING MINUTES

MEETING WITH (COMPANY/AGENCY):

U.S. Fish and Wildlife Service (FWS), U.S. Army Corps of Engineers (USACE), Dominion, Environmental Resources Management (ERM), Dawson Associates (Dawson)

DATE:	LOCATION:
November 29, 2016	Staunton, VA

ATTENDEES AND THEIR AFFILIATION:

Live meeting:	Via Phone:
Liz Stout, FWS West Virginia	Sarah Nystrom, FWS Virginia
Kim Smith, FWS Virginia	Troy Andersen, FWS Virginia
John Ellis, FWS North Carolina	Sumalee Hoskin, FWS Virginia
Bill Hartwig, Dawson	Emily Wells, FWS North Carolina
Richard Gangle, Dominion	Sarah McRae, FWS North Carolina
Spencer Trichell, Dominion	Samantha Dailey, Wilmington USACE
Colin Olness, Dominion	Steve Gibson, Norfolk USACE
Tracy Brunner, ERM	Jennifer Broush, Dominion
Sara Throndson, ERM	
Maggie Voth, ERM	

PREPARED BY:

Maggie Voth

MEETING MINUTES:

Representatives from FWS, USACE, Dominion, ERM, and Dawson met to discuss the updated version of the Biological Assessment (BA) and Migratory Bird Plan (MBP) filed with FERC on October 20, 2016. The purpose of the meeting was to identify any informational gaps that the FWS needs to initiate consultation, as well as discuss any FWS concerns related to additional survey information provided in the updated BA.

FWS agreed to provide written comments on the October 20th BA draft by December 9th.

FWS stated that they have not been receiving updates from FERC and have not seen the administrative version of the DEIS. FWS asked that FERC add Troy Andersen and Liz Stout to the recipient list for FWS WV and FWS VA since John Ellis is the only FWS contact currently listed.

<u>Project Schedule and Time-of-Year Considerations</u>

The following Project schedule changes were discussed:

- Dominion explained that first-year construction tree clearing periods shifted to winter with the majority of clearing now planned for winter to avoid Migratory Bird Treaty Act (MBTA) bird and bat time-of-year restrictions (TOYR). The updated schedule includes tree clearing starting in November 2017, though some areas were selected for potential early clearing starting mid-October.

- FWS stated that within Indiana bat hibernacula buffer areas, tree clearing would need to adhere to the TOYR, particularly in Randolph and Pocahontas Counties, West Virginia. FWS clarified that the clearing restriction applies to known use areas from Indiana bat captures and hibernacula, but does not apply to positive acoustic results with negative follow-up mist netting from Dominion surveys. All three FWS offices agreed that positive acoustics in 2015 and negative mist-netting in 2016 following the current range-wide Indiana bat summer survey guideline, would indicate unoccupied habitat. FWS requested that no out-of-season clearing be conducted near swarming areas (within 10 miles of Priority 1/2 hibernacula or 5 miles of Priority 3/4 hibernacula).

FWS requested additional clearing restrictions including the following:

- No grubbing or tree clearing between November 15 and April 1 within 50 feet of waterbodies located within 12-digit HUCs (subwatersheds) containing listed aquatic species. This request is not related specifically to a spawning period or species biology, but is intended to reduce runoff to sensitive waters outside the growing season and prevent erosion events in winter that could be detrimental to the 4 or 5 streams crossed with known mussel populations in North Carolina.
- Dominion explained that tree felling would occur in the winter months to adhere to TOYRs associated with migratory birds and bats, but the clearing and grubbing of these would occur later in the year (spring/summer) so this should not cause a concern.
- FWS agreed to provide a list of streams/waterbodies where this restriction would be applicable.

Additional Temporary Workspace and Erosion & Sedimentation Controls

The FWS requested a 300-foot buffer for workspace on sensitive streams and the following was discussed explaining that larger buffers can increase in-water work timeframes.

- Equipment and construction staging sites at stream crossings increases efficiency and allow construction to work quickly in the stream bed (and disturb the stream itself for less time).
- The FERC standard for waterbody buffer is 10 feet from spoil to edge of waterbody; a 300 foot buffer would mean stream materials need to be moved during construction and would lengthen the in-stream disturbance period. Pipe and other construction materials are stored 50 feet away, but the soil is closer.
- Dominion will adhere to all erosion and sedimentation (E&S) control requirements including FERC industry standards, E&S permitting, construction general permits for each state, and a best-in-class program.

- FWS would like more information on the E&S controls that will be used. Dominion requested that the FWS provide a list of the 12-digit HUCs and streams in North Carolina and Virginia where sensitive species may warrant additional E&S controls.
- FWS requested that a 3rd party monitor be on the ground during stream crossing work and potentially karst work, as well.

Ground disturbance near listed species is a concern for FWS and the following was recommended to address potential effects of soil disturbance along new access roads:

- Conduct a cumulative effect analysis on soil disturbance within sensitive subwatersheds
- Adding gravel to existing access roads is not considered a disturbance, however activities such as adding a culvert or widening a road should be included.
- Include a breakdown of the type of workspace and planned activities within each of the 12-digit HUCs.
- FWS requested that Dominion continue to look for opportunities to avoid and minimize disturbance, particularly in sensitive catchments.

Bald Eagle Permitting

The updated MBP describes two bald eagle nests falling within 660 feet of the project and one within a half-mile of proposed blasting areas in Augusta and Nottoway Counties and the City of Chesapeake in Virginia.

- Eagle nest at AP-3 MP 76.5 in the City of Chesapeake, Virginia currently falls in the project workspace. A route adjustment is being considered to increase the distance to the eagle nest to approximately 100 feet, or equal to the nest distance from the existing railroad, but adjustments to reach the recommended 330 foot and 660 foot buffers are limited due to the constraints in the area. Tree clearing and pipeline construction near this nest are proposed outside the eagle nesting season. FWS stated that an eagle disturbance permit may still be required despite the eagles already acclimatized to the railroad disturbance because the route adjustment here would leave the nest with the railroad on one side and pipeline on the other.
- Eagle nest near AP-1 MP 244.1 in Nottoway County, Virginia lies within 330 feet of the proposed Project. This nest is also within a half-mile of potential in-trench blasting and adjacent to Lees Creek. Noise studies related to in-trench blasting were refiled on November 17, 2016. FWS recommended an eagle disturbance permit for this nest site even if construction occurs outside of the nesting season.
- Eagle nest near MP 147.8 in Augusta County, Virginia is located approximately 1,800 feet from the project area, but within ½ mile of in-trench blasting. No permit would be required if blasting occurred outside of the nesting chronology for this nest. FWS recommended mitigation measures such as sound dampening to prevent blast noise from being at a disturbance level. FWS did recommend obtaining a permit to prevent a potential project delay by seeking a permit during construction.

The FWS stated that the migratory bird permit office will handle bald eagle permitting and it is anticipated that it will take 3-6 months or longer to obtain the permits. Bald eagle permits require NEPA and NHPA tribal coordination that could be expedited if the FWS could utilize the FERC documents or be a part of FERC's NEPA process if timing overlaps. Bald eagle permits need a copy of record of decision, with finalized NEPA process prior to eagle permit issuance. The VA FWS will review draft eagle permits prior to submittal to migratory bird office.

Migratory Bird Plan

- Per the VA FWS, Bald eagle no longer state-listed in Virginia, but it is protected.
- ERM completed aerial survey for stick-nests in March 2016. Resurvey along portions of line where eagles more likely to occur (coastal NC and eastern VA) may need to be considered prior to construction.

Specific comments provided by the FWS included:

- For other raptors and owls nests that are less visible from the air, FWS recommends ground survey to identify nests and species, since the wider range of species will also mean a wider range of nesting seasons. Raptors and owls nest early in winter; Dominion will need to avoid and minimize impacts to those species when clearing during that period. Nests in use cannot be cleared or disturbed; activity restrictions for nests located adjacent to the project would depend on species and its individual noise tolerance. In the worst case, the project would need to avoid an area during nesting season, if an occupied nest was found. Unoccupied nests can be blocked or removed, so long as no adults or young are present. It is also possible to "discourage" nesting by making the nest unsuitable.
- Provide the distance to disturbance for nests for owls and raptors, including nests within 100 feet or so of clearing areas.
- For wintering eagles, the MBP currently states Atlantic will provide an "eagle observer" on USFS land. FWS recommends extending this to areas all where golden eagles are likely to occur. FWS will provide list of counties where this addition would be recommended.
- Concrete examples of avoidance and impact reduction should be added to the MBP. A link to the website referenced by the FWS during the last call (containing a list of conservation measures) will be provided by FWS.
- Section 5.2 page 20 is vague. FWS would like examples of what makes adherence possible or not possible, and for which species before they can address the effectiveness of the measures.

Habitat Equivalency Analysis

The FWS presented the assumptions of their Habitat Equivalency Analysis (HEA) for the project. The HEA was calculated for the project footprint plus acres of fragmented forest. Forest fragmentation was defined by forest cores currently containing greater than 225 acres of forest core dropping below that acreage threshold due to project clearing activities. Growth curves for indicator species in each bird conservation region were used to estimate forest recovery time to maturity. The output ratios are dependent on mitigation type, which makes calculating the HEA an iterative analysis. Impact acreages were multiplied by mitigation ratios to reach mitigation offset acres; land values, site preparation, and management and monitoring fees per acre were also incorporated. The FWS will coordinate with the states as they continue to revise the HEA.

Karst Survey Report and Karst Plan

The survey report included a desktop review of potential karst features within 0.25 miles of the project and field surveys within the 300-foot survey corridor. Dominion explained the report does not specifically address feature avoidance because those adjustments were previously implemented during routing. The FWS requested that the BA include the following:

- the routing process showing that karst avoidance has occurred
- The alternatives addressed in RR10 should be pulled into the BA to make the BA a stand-alone document.
- Cochran's cave is a good example of routing and avoidance, since secondary cave mapping data and electrical resistivity imaging (ERI) surveys were used to make additional route adjustments due to species concerns (Madison Cave isopod). Include this detail in the BA.

FWS in West Virginia and Virginia would like shapefiles of the karst survey data and the ERI survey results at Cochran's Cave.

FWS requested that Dominion clarify where impacts will and will not be minimized, including any conservation measures that will or will not be implemented in the vicinity of karst features. Conservation measures and impact minimization discussion should be broken into categories specific to the feature karst type (cave, open-throat, depression/sinkhole, etc.) and the feature location (within or not within project workspace). E&S controls and karst feature treatment should be explicit, and Dominion should clarify the distances and locations of disturbance buffers versus fueling buffers. FWS will be providing written comments in the next month or so on the revised karst plan submitted in September. FWS requested the following be incorporated into the Karst Survey Report:

- "Risk" should be clarified.
- The chain of notifications should also be clearly laid out in the karst plan, including both national and local contacts, for emergency response and impacts. This section should also include a notification time frame.
- A 3rd party observer should be present during construction at particularly sensitive features.
- Dominion prefers to assume presence of listed species in karst features rather than conduct dye trace. Dye trace studies will not be completed because of limited land access and likelihood of them being insufficient or incomplete.
- No fueling or lubrication will occur within 300 feet of identified karst features. These buffers should be included into post-construction maintenance (herbicides, mowing).

- Herbicide use restrictions near karst features should also be added to the invasive management plan; herbicides use in that plan already includes limitations within a set distance of federally listed species.

Karst-related species impacts - Madison Cave Isopod

FWS requested more specific information on potential drainage to open-throated and sinkhole features in the Madison Cave isopod habitat area, including karst survey data. Even without identified karst features, the project crosses 23 to 24 miles of potential habitat. The FWS expects a Likely to Adversely Affect determination for the Madison Cave isopod because this species cannot be surveyed for and therefore presence is assumed in potential habitat.

Karst-related species impacts - Bats

Although not desirable, ongoing hibernacula surveys can be dialed back from 1 km to 0.25 miles for survey in areas without land access. Assuming presence of direct impact to hibernacula in the data gap areas is an option, however no projects have attempted for a direct impact to Virginia big-eared bat or Indiana bat, so there is no precedent. If direct impacts are assumed, the project must prove that impacts are negligible and would not result in a jeopardy decision.

Where surveys cannot be conducted, West Virginia Speleological Society data can be used to interpolate potential caves. Passage direction and internal cave mapping of existing caves near the project is also important to know whether passages cross the project and could potentially open up caverns during construction. FWS stated that the karst plan should include plans for what will be done if a void (cavern) is opened.

Aquatic Species and In-Stream Concerns

Water withdrawals at any time of the year would be considered an adverse impact to aquatic species. FWS requested an alternatives analysis for alternative water sources and to provide detail on proposed intake velocity, water volume and purpose, seasonal timing, and screen size. Dominion stated that alternatives analysis tables including this information were filed with FERC in November in response to a data request. The following water withdrawal options were discussed:

- Municipal water sources may not be a good alternative due to discharge limitations.
- Water storage ponds should to be filled slowly and stored for construction work to avoid stream TOYR.
- The TOYR dates and methods for mussel species differ by state and species:
    - In North Carolina, moratorium dates for stream work because of dwarf wedgemussel presence are March 15 to May 31 and August 15 to September 30.
    - In Virginia, moratorium dates for stream work because of dwarf wedgemussel presence are March 15 to May 31 and August 15 to October 15.

  - o Virginia water withdrawal requirements include a 1 millimeter mesh screen and 0.25 feet-per-second intake velocity, were intended for larger fish and would not be able to result in a Not Likely to Adversely Affect finding for mussel glochidia.
- Proposed water storage ponds will be located by the drilling site so that water can be accessed for drilling mud, typically 300 feet away from the waterbody.

Dominion stated that the geotech reports provided risk of hydrofracture and not the risk of inadvertent returns which could occur from a hydrofracture. Most were low risk, but one was medium risk. The FWS recommended that information and contingency planning should be included in the BA (Attachment G HDD Plan), as well as more information on the steps to be taken and notification chain of command.

FWS stated that six mussel species under review for listing in North Carolina will have a listing decision by March 31, 2017.

The FWS would like text in the BA to describing the crossing options, how they work, and the potential pros and cons of each.

Small Whorled Pogonia

The group discussed the USFS field meeting held at the small whorled pogonia habitat in Virginia, which FWS staff did not attend. A report for small whorled pogonia describing the findings of requested wind and light-level change analyses has been drafted and is under internal review.

A Likely to Adversely Affect determination is expected as long as the project remained upslope of the GWNF small whorled pogonia population. The BA should include the following:

- The FWS requested that the BA include analysis on the previous route, including the wetlands that were avoided in arriving at the current route position.
- E&S controls and the effect on overland water flow in relation to plant populations and changes to the hydrology.
- Potential mitigation could include voluntary contribution to protect known small whorled pogonia sites elsewhere in the state may be an option for mitigation. Kim Smith is working on methodology for calculating the mitigation ratio.
- Other mitigation options discussed included monitoring the existing population over time for changes due to the project. Re-creating the current surface topography near the population to negate surface flow changes was mentioned proposed as an avoidance and minimization measure.

Roanoke Logperch

The FWS expects a Likely to Adversely Affect determination for the Roanoke Logperch. Any instream activity or water withdrawal from an occupied or assumed occupied waterbody would be considered an adverse impact and result in take. Relocation of fish prior to in-stream work is also considered take.

Chowanoke Crayfish & Green Floater

Brian Watson in Virginia and Janet Clayton in West Virginia should be contacted for locations where the chowanoke crayfish and green floater may occur, if there are any concerns for these species, and to confirm timing restrictions for these species.

Rusty Patch Bumblebee

According to the Natural Heritage Inventory data, the ACP project crosses a historic occurrence of this newly-listed species. FWS Virginia is currently working on a procedure for how to address this species, and may request surveys in select areas.

ACTION ITEMS

ACTION REQUIRED:	BY WHOM:
Comments on October 20th BA draft by December 9th	FWS
Provide list of the 12-digit HUCs in North Carolina where sensitive species warrant additional E&S controls by December 5th	FWS NC
Provide list of sensitive waterbodies in Virginia for additional E&S controls	FWS VA
Eagle permits to Sarah Nystrom for review prior to submission to migratory bird office	ERM
Provide list of counties where eagle observers are recommended	FWS
Link to the website containing a list of conservation measures for migratory birds	FWS
Provide karst survey data, including the ERI survey results at Cochran's Cave	ERM
Provide written comments to the karst plan in December	FWS

Attachments:

cc: Project Files

Steve Holden

From:	Sara Throndson
Sent:	Thursday, March 23, 2017 11:16 AM
To:	elizabeth_stout@fws.gov; Ellis, John; Sumalee Hoskin; troy_andersen@fws.gov; sarah_mcrae@fws.gov; Glenn Smith
Cc:	Pat Robblee; Steve Holden; Tracy Brunner; Wade Hammer; Spencer Trichell (spencer.trichell@dom.com); Richard B Gangle (Services - 6); Robert M Bisha (Services - 6); Jennifer C Broush (Services - 6)
Subject:	ACP - Updated Master Waterbody Crossing Table
Attachments:	170323 Revised Master WB Table to FWS.xls

FWS Field Offices,

On behalf of the Atlantic Coast Pipeline (ACP) Project please find the attached updated Master Waterbody Table.

This table is being filed with FERC in response to Staff Recommendation 54 of the DEIS.

The update to the draft Biological Assessment for the Projects, which Atlantic and DTI filed with FERC and provided to the FWS on January 27, 2017 (FERC Accession Number 20170127-5203), identified waterbodies where the presence of Roanoke logperch is known or assumed and described conservation measures for the species. Atlantic subsequently incorporated information regarding Roanoke logperch, including conservation measures, into a revised master waterbody table.

Atlantic looks forward to continued coordination with you on this project. Please contact Mr. Richard Gangle at (804) 273-2814 or richard.b.gangle@dom.com, or Ms. Sara Throndson at (612) 347-7113 or sara.throndson@erm.com if there are questions.

Thank you, Sara

Sara Throndson
Senior Scientist
ERM
1000 IDS Center, 80 S. 8th Street I Minneapolis I MN I 55402
Office 612-347-7113 I Cell 612-716-7812
sara.throndson@erm.com I www.erm.com

ERM The business of sustainability

State/Commonwealth Agencies

West Virginia Agencies

West Virginia Division of Natural Resources, West Virginia Division of Forestry

ATLANTIC COAST PIPELINE
PROJECT MEETING MINUTES

MEETING WITH (COMPANY/AGENCY):
Seneca Park Superintendent, Forestry and West Virginia Scenic Trails Association

DATE:	LOCATION:
October 5, 2016	Seneca State Forest, Dunmore, WV

ATTENDEES AND THEIR AFFILIATION:
Jeffrey Layfield, Seneca Park Superintendent
Eric Judy, John Netor, Div. of Forestry
Doug Wood, West Virginia Scenic Trails Association (WVSTA)
Brittany Moody, Dominion
Bob Orndorff, Dominion
Rick Weeks – Dominion
Rodney Bartgis, The Conservation Fund

PREPARED BY:
Rick Weeks

MEETING MINUTES:

Discussion

- The meeting was arranged to discuss the possibility of moving the Allegheny Trail within the Seneca Sate Forest. The Route and the Trail meet at the Hiker Shelter, a former CCC shelter, at milepost 78.1. The Trail and the Route run together from milepost 78.1 to milepost 78.8. Doug Wood has proposed a route that would cross the Route at the shelter and reconnect to the existing trail at Laurel Run Road. The current trail runs in the Laurel Run Road for a distance. The proposed Trail route may be able to eliminate this stretch in the road and improve safety. The new Trail would need to meet hiking and mountain biking standards, and would be approximately 2 miles long.

- Everyone was in agreement on the value of moving the Trail and doing so prior to the start of construction. Both the State and WVSTA requested that ACP handle the contractual work. Doug recommended the use of companies that specialize in design and constructing trails and that they should be used, specifically the Tri-state Company. This company can do a turnkey operation including planning, location, design and construction. Jeff Layfield was favorably inclined to use this company.

- Moving the Trail would require the approval of West Virginia's Parks and DNR Directors.

Follow-up

- Brittany will provide a kmz file based on the drawing that Doug provided.

- Brittany with contact Tri-State to request a proposal.

- ACP needs to decide how to approach the project including discussions with FERC.

cc: Project Files

ATLANTIC COAST PIPELINE
PROJECT MEETING MINUTES

MEETING WITH (COMPANY/AGENCY):
Seneca Park Superintendent, State Parks, Forestry and the Division of Natural Resources

DATE:	LOCATION:
March 1, 2017	Seneca State Forest, Dunmore, WV

ATTENDEES AND THEIR AFFILIATION:
Stephen McDaniel, DNR Director
Sam England, Director of West Virginia Parks
Gary Foster, Assistant Wildlife Director, DNR
Matt Yeager, Area Director WV Parks
Reps from Forestry
Brittany Moody, Dominion
Greg Park, Dominion
Bob Orndorff, Dominion
Rick Weeks – Dominion
Rodney Bartgis, The Conservation Fund

PREPARED BY:
Rick Weeks

MEETING MINUTES:

Discussion

- The meeting was arranged to review the proposed reroute of the Allegheny Trail to avoid a stretch where the ACP route and the Trail would run together within the Seneca State Forest, the location of the ACP crossing of the Trail, and the ACP crossing of the Greenbrier Rail to Trails.

- The ACP Route crosses the Allegheny Trail near the Hiker Shelter, a former CCC shelter, at milepost 78.1. The Trail and the Route run together from milepost 78.1 to milepost 78.8. Doug Wood, with West Virginia Scenic Trails, had proposed a Trail route that would leave the current Trail route at the Shelter and reconnect to the existing Trail at Laurel Run Road. Dominion provided maps showing the proposed reroute which was surveyed by Tri-State, Inc. Both WV Parks and Forestry supported the proposed route. They also support the moving the Trail prior to ACP construction.

- Forestry indicated that they would want to do the timbering of the ACP right-of-way prior to the start of construction and would like conduct a timber sale that was larger than that needed for the ACP construction right-of-way.

- The first site visit was to the Hiker Shelter. WV indicated that they would likely clear more trees at this location than required for the ACP right-of-way to open a vista of nearby mountains. WV also wanted improvements to the existing road that passes in front of the Shelter. Dominion indicated that the road would be graded and graveled. Dominion discussed the planned crossing of the Trail near the Shelter to allow the Trail to remain open except for a short period during construction, to which WV was agreeable.

- The next site visit was to the location where the Trail would cross Laurel Run Road. This crossing would eliminate stretch of the Trail that runs in Laurel Run Road for a distance. During this site visit WV and Dominion walked back to a stream crossing where a bridge would be built as part of the Trail reroute.

- The next site visit was to the Greenbrier River Trail crossing. Dominion indicated that they would temporarily detour the Trail to a nearby road and would provide signage to protect trail users from the traffic. Dominion indicated that the Trail would be detoured for a few days and would be scheduled to occur on weekdays, likely in June 2019. WV was satisfied with his approach and indicated that weekdays in summer are low usage times for the Trail.

cc: Project Files

West Virginia Department of Environmental Protection

Dominion Resources Services, Inc.
5000 Dominion Boulevard, Glen Allen, VA 23060

Web Address: www.dom.com

Dominion

March 16, 2017

BY: OVERNIGHT MAIL

Mr. Joseph Kessler
Division of Air Quality
West Virginia Department of Environmental Protection
601 57th Street, SE
Charleston, West Virginia, 25304

RE: Atlantic Coast Pipeline, L.L.C. (ACP)
Marts Compressor Station Permit No. R13-3271
Class II Administrative Update Application

Dear Mr. Kessler:

Enclosed is an administrative update application pursuant of WV 45 CSR 13 for changes to the Marts Compressor Station in Lewis County, West Virginia. ACP requests the following changes with this submittal:

- Removal of the Caterpillar Emergency Generator (EG-1) rated at 2,098 hp;
- Installation of two Caterpillar Emergency Generators (EG-1 and EG-2) each rated at 1,114 hp;
- Modification of the Pipeline Liquids Tank (TK-1) from 2,500 gallons to 3,000 gallon capacity;
- Modification of the Aqueous Ammonia Tank (TK-3) from 8,000 gallons to 13,000 gallons; and

A legal advertisement will be published in the next few days and proof of publication will be forwarded as soon as it is received.

Additionally, enclosed is a check in the amount of $1,300.

Should you have any questions or need additional information, please feel free to contact Laurence Labrie at (804) 273-3075 or via email at laurence.a.labrie@dom.com.

Sincerely,

Robert M. Bisha

Robert Bisha, Technical Advisor
Atlantic Coast Pipeline
Dominion Environmental Services

West Virginia Division of Culture and History

Dominion Resources Services, Inc.
5000 Dominion Boulevard,
Glen Allen, VA 23060

Dominion

March 24, 2017

Ms. Susan M. Pierce
Deputy State Historic Preservation Officer
West Virginia Division of Culture and History
1900 Kanawha Boulevard, East
Charleston, West Virginia 25305-0300

Subject: Section 106 Review – Phase I Historic Architectural Survey Report Addendum 5
Atlantic Coast Pipeline, LLC, Atlantic Coast Pipeline Project
FR#: 14-928-Multi

Dear Ms. Pierce:

Atlantic Coast Pipeline, LLC (Atlantic) is requesting review and comment on the enclosed addendum architectural survey report on investigations conducted for the proposed Atlantic Coast Pipeline (ACP). The Federal Energy Regulatory Commission (FERC) is the lead Federal agency for this Project. Atlantic's consultant, ERM, conducted the survey and prepared the enclosed report pursuant to the requirements of Section 106 of the National Historic Preservation Act of 1966, as amended.

Atlantic would appreciate your comments on the attached addendum architectural survey report, and we look forward to continuing to work with you on this Project. If you have any questions regarding the enclosed report, please contact Richard B. Gangle at (804) 273-2814 or Richard.B.Gangle@dom.com, or by letter at:

Richard B. Gangle
Dominion Resources Services, Inc.
5000 Dominion Boulevard
Glen Allen, Virginia 23060

Respectfully submitted,

Robert M. Bisha

Robert M. Bisha
Technical Advisor, Atlantic Coast Pipeline

cc: Richard Gangle (Dominion)
Enclosure: **Phase I Historic Architectural Survey Report Addendum 5**

City of Buckhannon

Dominion Resources Services, Inc.
5000 Dominion Boulevard,
Glen Allen, VA 23060

March 13, 2017

BY ELECTRONIC MAIL

Mr. James (Jay) Hollen, III, PE
City of Buckhannon
70 East Main Street
Buckhannon, WV 26201

Re: **Atlantic Coast Pipeline, LLC, Atlantic Coast Pipeline**
Buckhannon River Crossing and City of Buckhannon Water Supply Response

Dear Mr. Hollen:

Atlantic Coast Pipeline (Atlantic) is submitting the following information for the Atlantic Coast Pipeline (ACP) in response to the requests for additional information pertaining to the following items discussed during a meeting on February 7, 2017.

Bold text below restates requests for information or questions outlined by Mr. Jay Hollen during the February 7, 2017 meeting. Dominion responses to each statement or question follow the bold text heading.

- **Request for map of zone of peripheral concern (ZPC) and zone of critical concern (ZCC); confirm definitions of ZCC and ZPCs.**
  - Included with this letter is a map that illustrates the ZCC and ZPC data provided by the West Virginia Department of Health and Human Resources (WVDHHR) for the City of Buckhannon surface water source on the Buckhannon River. Atlantic requested the ZCC and ZPC data within a three mile buffer from the proposed route, so WVDHHR clipped the ZCC and ZPC data based on a 3 mile buffer from the proposed centerline submitted with the request for the GIS data. This explains why the map only illustrates a portion of the ZCC and ZPC, but the map illustrates the data provided to Atlantic by WVDHHR on March 11, 2016.
  - Resource Report 2, Water Use and Quality, for the ACP submitted to the Federal Energy Regulatory Commission states the following regarding how the WVDHHR determines the extent of the ZCCs and ZPCs:

    "The ZCC is based on a protection zone of five hours above the water intake... The ZPC is based on a protection zone of ten hours above the water intake."

- **Provide a narrative description of how the cofferdam construction across the Buckhannon River will occur.**

  The cofferdam method for crossing waterbodies during pipeline construction involves use of a temporary diversion structure that is installed from the bank around half the width of the crossing to isolate that section of the stream from the rest of the waterbody. Once the temporary diversion structure is installed, water is pumped from the isolated section to allow excavation of the pipe trench from the bed of the waterbody in the dry. After the pipe is installed in the trench in the isolated section of stream, the temporary diversion structure is disassembled and reinstalled from the opposite bank of the crossing and the process is repeated. The cofferdam method allows waterbodies to be crossed in the dry in discrete sections while water flows unimpeded around the temporary diversion structure. The method is sometimes favored for wide, relatively shallow waterbodies or waterbodies containing sensitive fisheries or aquatic resources because it allows water and fish to pass around the temporary diversion structure.

  For waterbodies crossed using the cofferdam method, sections of steel frame for the temporary diversion structure will be assembled in an upland area adjacent to the crossing. Depending on size, the frame sections will be placed in the waterbody either manually or by crane. The frame sections will be positioned around a predetermined perimeter in the waterbody extending from one of the banks based on the waterbody bed substrate, but not to exceed the limits of disturbance. The spacing of frame sections will be based on the depth of the water, but a typical spacing will be 15 to 30 inches. The frame sections may be reinforced, as necessary, with steel poles or other supports to increase stability of the structure, especially in waterbodies with soft substrate. Fabric sheets will then be attached to the top of the frame and unrolled down and out onto the bed of the waterbody on the exterior side of the frame. The fabric sheets will create a liner around the frame with a seal on the bed of the waterbody. The fabric may be covered in soft sediments or sandbags to help create the seal.

  After the temporary diversion structure is installed, one or more pumps will be used to dewater the area within the temporary diversion structure. The pump intakes will be appropriately screened to prevent entrainment of aquatic species. Water will be discharged to the waterbody outside the structure through an energy-dissipating device to prevent scouring of the bed at locations of discharge.

  Once dewatering is complete, any fish trapped in the temporary diversion structure will be removed and returned to the flowing waterbody. Construction equipment will enter the isolated section of the waterbody from the adjacent bank. This construction equipment will be used to excavate the trench, install a pre-assembled section of pipe, backfill the trench, and restore the bed as near as practicable to pre-construction contours. The equipment will be removed from the temporary diversion structure via the adjacent bank.

  After the section of pipeline is installed, the enclosed area within the temporary diversion structure will be flooded. Then the fabric sheets and steel frame sections will be disassembled. The structure will be reinstalled from the opposite bank, with enough overlap of the initial excavation area so that the installed section is accessible for tie-in to the next section of pipe. The dewatering and construction process is then repeated from the opposite bank, to complete the crossing of the waterbody.

Please contact Ms. Moody at (304) 627-3432 or Brittany.D.Moody@dom.com, if there are addition questions regarding the ACP.

Please direct written responses to:

Brittany Moody
Dominion Transmission, Inc.
445 West Main Street
Clarksburg, WV 26301

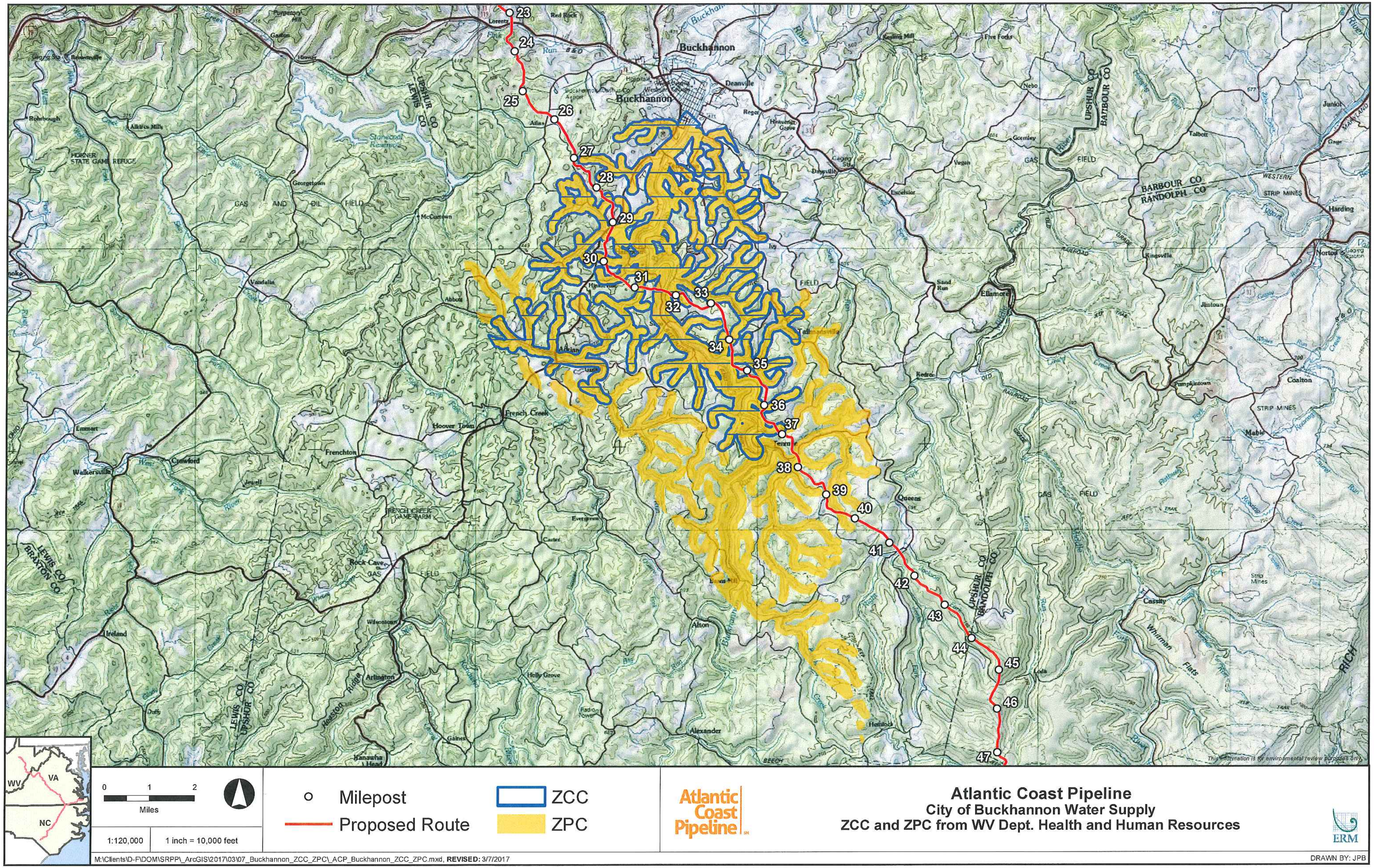
Sincerely,

Brittany Moody

Brittany Moody
Manager Engineering Projects
Dominion Transmission, Inc.

cc: Bob Bisha, Bob Orndorff, Richard Gangle

Enclosures: Map of ZCC and ZPC for the City of Buckhannon Water Supply



0 1 2
Miles

1:120,000 | 1 inch = 10,000 feet

Milepost
Proposed Route
ZCC
ZPC

Atlantic Coast Pipeline

Atlantic Coast Pipeline
City of Buckhannon Water Supply
ZCC and ZPC from WV Dept. Health and Human Resources

ERM

M:\Clients\D-F\DOM\SRPP_ArcGIS\2017\03\07_Buckhannon_ZCC_ZPC_ACP_Buckhannon_ZCC_ZPC.mxd, REVISED: 3/7/2017

DRAWN BY: JPB

Virginia Agencies

Virginia Department of Conservation and Recreation

Steve Holden

From:	Ludwig, Chris (DCR) <Chris.Ludwig@dcr.virginia.gov>
Sent:	Monday, February 27, 2017 4:43 PM
To:	Richard F Weeks (Services - 6)
Cc:	Meader, Tyler (DCR)
Subject:	[External] RE: Pollinator Seed Mixes
Attachments:	Pollinator Habitat Recommended Seed Mixes_022717.docx

Hello Richard – just a few species that we would not recommend. They are in the attached.

C.

From: Richard F Weeks (Services - 6) [mailto:Richard.F.Weeks@dom.com]
Sent: Monday, February 27, 2017 3:46 PM
To: Ludwig, Chris (DCR) <Chris.Ludwig@dcr.virginia.gov>
Cc: Ewing, Amy (DGIF) <Amy.Ewing@dgif.virginia.gov>; Hypes, Rene (DCR) <Rene.Hypes@dcr.virginia.gov>; Molly P Plautz (Services - 6) <molly.p.plautz@dom.com>; Herbert Pirela <Herbert.Pirela@erm.com>; Matt Overton (Services - 6) <matt.overton@dom.com>; Meader, Tyler (DCR) <Tyler.Meader@dcr.virginia.gov>; Puckett, Marc (DGIF) <Marc.Puckett@dgif.virginia.gov>
Subject: RE: Pollinator Seed Mixes

Chris,

Attached is an update to the "Recommended Seed Mixes for Pollinator Habitat in Virginia and North Carolina." We removed all of the grasses and forbs that you recommended be removed and have replaced them with recommendations provided by Bob Glennon. Additionally, we checked with a native seed vender to be sure that the seeds are available commercially.

Thanks again for your review of our seed mixes.

Rick

From: Ludwig, Chris (DCR) [mailto:Chris.Ludwig@dcr.virginia.gov]
Sent: Wednesday, January 25, 2017 3:00 PM
To: Richard F Weeks (Services - 6); Puckett, Marc (DGIF)
Cc: Ewing, Amy (DGIF); Hypes, Rene (DCR); Molly P Plautz (Services - 6); Herbert Pirela; Matt Overton (Services - 6); Meader, Tyler (DCR)
Subject: [External] RE: Pollinator Seed Mixes

Hello Rick – as you may know, Natural Heritage is reviewing all of the documents coming out of the ACP permitting process, among them the draft EIS. Part of that EIS was the attached Restoration and Rehabilitation plan that was filed on 1/10/17. Check on me on this, but I believe that all of the seed mixes that you just sent me are in the attached plan.

Two of my colleagues, Darren Loomis and Ryan Klopf, and I reviewed seed mixes in the Restoration and Rehabilitation Plan. I commented on the seed mixes below and I have attached the comments from Ryan and Darren. Below in black are the comments that I made for all but the seed mix lists specific to North Carolina. We will be sending these comments to FERC when we comment on the draft EIS (Table numbers correspond to the document attached):

Table 5.7.5-1
Remove Sporobolus compositus: rare in WV and not viable on most substrates

5.7.5-2
Remove Coreopsis lanceolata: questionably native to WV
5.7.5-3
Remove Andropogon ternarius: rare in mountain region and probably not viable (Andropgon virginicus or Sorghastrum nutans would be a substitute)

5.7.5-4
Remove Coreopsis tinctoria: not native to WV
Remove Coreopsis lanceolata: questionably native to WV
Remove Helianthus maximilianii: not native to WV
Remove Echinacea purpurea: not native to WV

5.7.5-6
Remove Asclepias tuberosa: cannot tolerate poorly drained sites
Remove Pycnanthemum incanum: cannot tolerate poorly drained sites
Remove Bidens aristosa: questionably native to WV
Remove Lupinus perennis: cannot tolerate poorly drained sites

5.7.5-8
Remove Coreopsis tinctoria: not native to VA
Remove Eryngium yuccifolium: rare in VA and probably not viable in poorly-drained soils
Remove Helianthus angustifolius: rare in mountain region and probably not viable

5.7.5-10
Remove Coreopsis tinctoria: not native to VA
Remove Coreopsis lanceolata: questionably native to VA
Remove Helianthus maximilianii: not native to VA
Remove Echinacea purpurea: not native to VA
Remove Gaillardia pulchella: not native to VA

5.7.5-11
Remove Sporobolus compositus: rare in VA and not viable on most substrates

5.7.5-14
Remove Coreopsis tinctoria: not native to VA
Remove Eryngium yuccifolium: rare in VA and probably not viable in poorly-drained soils

2.2.1-1
Use mixes 8, 10, and 11 if possible, all native species

2.2.1-2
Use mixes 103,105,106,109 if possible, all native species

2.2.1-6
Remove Andropogon ternarius: rare in mountain region and probably not viable (Andropgon virginicus or Sorghastrum nutans would be a substitute)

2.2.1-7
Remove Coreopsis tinctoria: not native to VA
Remove Coreopsis lanceolata: questionably native to VA
Remove Helianthus maximilianii: not native to VA
Remove Echinacea purpurea: not native to VA

2.2.1-8
Remove Coreopsis tinctoria: not native to VA
Remove Eryngium yuccifolium: rare in VA and probably not viable in poorly-drained soils

2.2.1-9
Remove Koeleria macrantha: not native to VA

2.2.1-10
Remove Sporobolus compositus: rare in VA and not viable on most substrates
Remove Coreopsis tinctoria: not native to VA
Remove Dalea purpurea: not native to VA
Remove Desmanthus illinoisensis: not native to VA
Remove Helianthus maximilianii: not native to VA

2.2.1-11
Remove Bouteloua curtipendula: not viable on most substrates
Remove Lotus corniculatus: not native to North America
Remove Desmanthus illinoisensis: not native to VA
Remove Helianthus maximilianii: not native to VA
Remove Coreopsis lanceolata: questionably native to VA
Remove Bidens aristosa: questionably native to WV
Remove Pycnanthemum pilosum: not native to VA (P. incanum is – did they mean that?)
(Supplimentary species listed: Buckwheat, Millet, Korean Lespedeza, etc. – DO NOT USE.)

2.2.4-2
Remove Coreopsis tinctoria: not native to VA
Remove Coreopsis lanceolata: questionably native to VA
Remove Helianthus maximilianii: not native to VA
Remove Echinacea purpurea: not native to VA
Remove Gaillardia pulchella: not native to VA

2.2.4-3
Remove Coreopsis tinctoria: not native to VA
Remove Eryngium yuccifolium: rare in region and probably not viable in poorly-drained soils

Thanks Rick for the opportunity to comment and you all will be seeing these again when the FERC EIS review comes out.

Chris

From: Richard F Weeks (Services - 6) [mailto:Richard.F.Weeks@dom.com]
Sent: Wednesday, January 25, 2017 1:24 PM
To: Ludwig, Chris (DCR) <Chris.Ludwig@dcr.virginia.gov>; Puckett, Marc (DGIF) <Marc.Puckett@dgif.virginia.gov>
Cc: Ewing, Amy (DGIF) <Amy.Ewing@dgif.virginia.gov>; Hypes, Rene (DCR) <Rene.Hypes@dcr.virginia.gov>; Molly P Plautz (Services - 6) <molly.p.plautz@dom.com>; Herbert Pirela <Herbert.Pirela@erm.com>; Matt Overton (Services - 6) <matt.overton@dom.com>
Subject: Pollinator Seed Mixes

Chris, Marc,

Attached are two documents, the first is a table that summarizes locations and parcels on the Atlantic Coastal Pipeline route identified as potential areas for the establishment of pollinator habitat. The table identifies locations with at least a mile of contiguous or nearly contiguous potential pollinator habitat. Also summarized on the table is the number of parcels. Using the one mile criteria, there are a total of 71 miles in Virginia with 18 miles on the ACP 3 lateral and 53 miles on ACP 1 that could be suitable

Using the following link to the Dom.com web site and clicking on Maps by County you can view the mileposts and parcels:

https://www.dom.com/about-us/news-center/natural-gas-projects-and-initiatives/atlantic-coast-pipeline/maps

The second attachment provides recommended pollinator seed mixes on pages 2 through 4 for Virginia. There is a set of recommendations for the Counties of Brunswick, Buckingham and Prince Edward for well drained soils and for poorly drained soils. There is another set of recommendations for the Counties of Dinwiddie, Greensville, and Southampton, and the City of Suffolk, again for well drained soils and for poorly drained soils.

We would greatly appreciate your input on these seed mixes and application rates.

On January 10, 2017 Dominion submitted an updated Restoration and Rehabilitation Plan to FERC: **https://www.dom.com/about-us/news-center/natural-gas-projects-and-initiatives/atlantic-coast-pipeline/library/636352af6ce343348f00246ecb48c5ef.ashx**

Starting on page 8 there are two new sections 5.7.2.1 Pollinator Habitat Planting and 5.7.2.2 Pollinator Habitat Maintenance that briefly describe our Pollinator Initiative. There are seed mix recommendations for the entire pipeline route in the body of the document and the appendices. Please feel free to comment on any of these seed mix recommendations. This document still contains recommended pollinator seed mixes for mountainous areas which we no longer plan to include in our Pollinator Initiative.

Thanks

Rick

CONFIDENTIALITY NOTICE: This electronic message contains information which may be legally confidential and or privileged and does not in any case represent a firm ENERGY COMMODITY bid or offer relating thereto which binds the sender without an additional express written confirmation to that effect. The information is intended solely for the individual or entity named above and access by anyone else is unauthorized. If you are not the intended recipient, any disclosure, copying, distribution, or use of the contents of this information is prohibited and may be unlawful. If you have received this electronic transmission in error, please reply immediately to the sender that you have received the message in error, and delete it. Thank you.

CONFIDENTIALITY NOTICE: This electronic message contains information which may be legally confidential and or privileged and does not in any case represent a firm ENERGY COMMODITY bid or offer relating thereto which binds the sender without an additional express written confirmation to that effect. The information is intended solely for the individual or entity named above and access by anyone else is unauthorized. If you are not the intended recipient, any disclosure, copying, distribution, or use of the contents of this information is prohibited and may be unlawful. If you have received this electronic transmission in error, please reply immediately to the sender that you have received the message in error, and delete it. Thank you.

Recommended Seed Mixes for Pollinator Habitat

In Virginia and North Carolina

Prepared by

February 2017

TABLE OF CONTENTS

1.1 VIRGINIA

1.1.1 Brunswick, Buckingham, and Prince Edward Counties (Southern Piedmont)

Recommended Native Grasses and Pollinator Seed mixtures by Drainage Class

Seed Mix 1.1.1-1: Recommended
Grass Seed Mixture and Application Rates for Excessively to Moderately Well Drained Sites in the Southern Piedmont of Virginia

Common Name	Scientific Name	Cultivar or Germplasm	Drilled Seeding Rate [a] (weight of pure live seed (PLS) per acre)	Seeds per Square Foot
Little Bluestem	*Schizachyrium scoparium*	Cimarron (OK) or Suther Germplasm (NC)	8 ounces	3
Broomsedge	*Andropogon virginicus*	—	8 ounces	3
Purple Top	*Tridens flavus*	North Carolina or Kentucky Ecotype	3 ounces	3

Source: Glennon, 2017; Roundstone Native Seed, 2017.
[a] If the broadcast method is more feasible, increase the perennial grasses in the mixture by 50 percent.

Seed Mix 1.1.1-2:
Recommended Forbs Seed Mixture and Application Rates for Excessively to Moderately Well Drained Sites in the Southern Piedmont of Virginia

Common Name [a]	Scientific Name	Flowering Season	Drilled Seeding Rate [b] (ounces/acre - weight of pure live seed (PLS) per acre)	Seeds per Square Foot
Showy Tickseed	*Bidens aristosa*	Late Summer	11	3
Pea, Partridge (A)	*Chamaecrista fasciculata*	Mid-Summer	32	3
Susan, Black-eyed (B)	*Rudbeckia hirta*	Early Summer	2	3
Bergamot, Spotted (P)	*Monarda punctata*	Summer	2	3
Bergamot, Wild (P)	*Monarda fistulosa*	Summer	2	3
Beardtongue, Eastern Smooth (P)	*Penstemon laevigatus*	Late Spring	7	3
Penstemon, Talus Slope (P)	*Penstemon digitalis*	Late Spring	5	3
Slender Mountain Mint (P)	*Pycnanthemum tenuifolium*	Late Summer	1	3
New England Aster	*Aster novae-angliae*	Late Summer	2	3
Total	—	—	**64.0 ounces/acre (4.0 lbs/acre)**	**27**

Source: Glennon, 2017; Roundstone Native Seed, 2017.
[a] Forb types include (A) for annual flowers, (B) for biennial flowers, and (P) for perennial flowers.
[b] If the broadcast method is more feasible, increase the perennial grasses in the mixture by 50 percent.

Seed Mix 1.1.1-3: Recommended Grass Seed Mixture and Application Rates for Somewhat Poorly to Very Poorly Drained Sites in the Southern Piedmont of Virginia				
Common Name	Scientific Name	Cultivar or Germplasm	Drilled Seeding Rate [a] (weight of pure live seed (PLS) per acre)	Seeds per Square Foot
Beaked Panicum	*Panicum anceps*	SC or MD Ecotype	4 ounces	3
Redtop Panicum	*Panicum rigidulum*	NC Ecotype	3 ounces	3
Slender Rush	*Juncus tenuis*	—	1 ounce	3

Source: Glennon, 2015.

[a] If the broadcast method is more feasible, increase the perennial grasses in the mixture by 50 percent.

Seed Mix 1.1.1-4: Recommended Forbs Seed Mixture and Application Rates for Somewhat Poorly to Very Poorly Drained Sites in the Southern Piedmont of Virginia				
Common Name [a]	Scientific Name	Flowering Season	Drilled Seeding Rate [b] (ounces/acre - weight of pure live seed (PLS) per acre)	Seeds per Square Foot
New England Aster	*Symphyotrichum puniceum*	Fall	3	3
Large Coreopsis	*Coreopsis major*	Summer	8	3
Bergamot, Wild (P)	*Monarda fistulosa*	Summer	1	3
Ironweed, New York (P)	*Vernonia novaboracensis*	Late Summer	7	3
Rough Goldenrod	*Solidago rugosa*	Late Summer	3	3
Joe Pye Weed, Spotted (P)	*Eupatoriadelphus fistulosus*	Late Summer	2	3
Pea, Partridge (A)	*Chamaecrista fasciculata*	Mid-Summer	32	3
Rosemallow (P)	*Hibiscus moscheutos*	Summer	2	3
Showy Tickseed	*Bidens aristosa*	Late Summer	11	3
Total	—	—	**69.0 ounces/ acre (4.3 lbs/acre)**	**27**

Source: Glennon, 2017; Roundstone Native Seed, 2017.

[a] Forb types include (A) for annual flowers, (B) for biennial flowers, and (P) for perennial flowers.

[b] If the broadcast method is more feasible, increase the perennial grasses in the mixture by 50 percent.

Comment [LC(1]: This is a species of dry soil and is not native to this area of Virginia.

1.1.2 Dinwiddie, Greensville, and Southampton Counties, and Suffolk City (Coastal Plain)

Recommended Native Grasses and Pollinator Seed Mixtures Drainage Class

Seed Mix 1.1.2-1: Recommended Grass Seed Mixture and Application Rates for Excessively to Moderately Well Drained Sites on the Coastal Plain of Virginia				
Common Name	Scientific Name	Cultivar or Germplasm	Drilled Seeding Rate [a] (weight of pure live seed (PLS) per acre)	Seeds per Square Foot
Little Bluestem	*Schizachyrium scoparium*	'Cimarron' (OK) or Suther Germplasm (NC)	8 ounces	3
Splitbeard Bluestem	*Andropogon ternarius*	Missouri or Kentucky Ecotype	8 ounces	3

Source: Glennon, 2017; Roundstone Native Seed, 2017.

[a] If the broadcast method is more feasible, increase the perennial grasses in the mixture by 50 percent.

Seed Mix 1.1.2-2: Recommended Forbs Seed Mixture and Application Rates for Excessively to Moderately Well Drained Soils on the Coastal Plain of Virginia				
Common Name [a]	Scientific Name	Flowering Season	Drilled Seeding Rate [b] (ounces/acre - weight of pure live seed (PLS) per acre)	Seeds per Square Foot
Mountain Mint, Narrowleaf (P)	*Pycnanthemum tenuifolium*	Late Summer	1	3
Large Coreopsis	*Coreopsis major*	Summer	8	3
Showy Tickseed	*Bidens aristosa*	Late Summer	11	3
Pea, Partridge (A)	*Chamaecrista fasciculata*	Mid-Summer	32	3
Susan, Black-eyed (B)	*Rudbeckia hirta*	Early Summer	2	3
Bergamot, Spotted (P)	*Monarda punctata*	Summer	2	3
Beardtongue, Eastern Smooth (P)	*Penstemon laevigatus*	Late Spring	7	3
Penstemon, Talus Slope (P)	*Penstemon digitalis*	Late Spring	5	3
Bergamot, Wild (P)	*Monarda fistulosa*	Summer	2	3
Total	—	—	**70.0 ounces/acre (4.4 lbs/acre)**	**27**

Source: Glennon, 2015; Roundstone Native Seed, 2017.

[a] Forb types include (A) for annual flowers, (B) for biennial flowers, and (P) for perennial flowers.

[b] If the broadcast method is more feasible, increase the perennial grasses in the mixture by 50 percent.

Comment [LC(2]: This species is not native to this region.

Seed Mix 1.1.2-3: Recommended Grass Seed Mixture and Application Rates for Somewhat Poorly to Very Poorly Soils on the Coastal Plain of Virginia				
Common Name	Scientific Name	Cultivar or Germplasm	Drilled Seeding Rate [a] (weight of pure live seed (PLS) per acre)	Seeds per Square Foot
Panicum, Beaked	*Panicum anceps*	SC or MD Ecotype	4 ounces	3
Panicum, Redtop	*Panicum rigidulum*	NC Ecotype	3 ounces	3

Source: Glennon, 2015.

[a] If the broadcast method is more feasible, increase the perennial grasses in the mixture by 50 percent.

Seed Mix 1.1.2-4: Recommended Forbs Seed Mixture and Application Rates for Somewhat Poorly to Very Poorly Drained Soils on the Coastal Plain of Virginia				
Common Name [a]	Scientific Name	Flowering Season	Drilled Seeding Rate [b] (ounces/acre - weight of pure live seed (PLS) per acre)	Seeds per Square Foot
New England Aster	*Aster novae-angliae*	Fall	3	3
Sneezeweed, Common (P)	*Helenium autumnale*	Fall	2	3
Showy Tickseed	*Bidens aristosa*	Late Summer	11	3
New York Ironweed (P)	*Vernonia nova boracensis*	Late Summer	7	3
Goldenrod, Wrinkleleaf (P)	*Solidago rugosa*	Late Summer	2	3
Joe Pye Weed, Spotted (P)	*Eupatoriadelphus fistulosus*	Late Summer	2	3

Seed Mix 1.1.2-4: Recommended Forbs Seed Mixture and Application Rates for Somewhat Poorly to Very Poorly Drained Soils on the Coastal Plain of Virginia				
Common Name [a]	Scientific Name	Flowering Season	Drilled Seeding Rate [b] (ounces/acre - weight of pure live seed (PLS) per acre)	Seeds per Square Foot
Partridge Pea (A)	*Chamaecrista fasciculata*	Mid-Summer	32	3
Rosemallow (P)	*Hibiscus moscheutos*	Summer	2	3
Narrowleaf Sunflower (P)	*Helianthus angustifolius*	Late Summer	4	3
Total Grass and Forbs	—	—	**65.0 ounces/acre (4.1 lbs/acre**	**27**

Source: Glennon, 2015; Roundstone Native Seed, 2017.

[a] Forb types include (A) for annual flowers, (B) for biennial flowers, and (P) for perennial flowers.

[b] If the broadcast method is more feasible, increase the perennial grasses in the mixture by 50 percent.

1.2 NORTH CAROLINA

Recommended Native Grass and Pollinator Seed Mixtures by Drainage Class

Seed Mix 1.2.1-1: Recommended Grass Seed Mixture and Application Rates for Excessively to Moderately Well Drained Sites in North Carolina [a]				
Common Name	Scientific Name	Height (Inches)	Sun Exposure	Drilled Seed Mix Rate (lbs/acre/PLS)[b]
Little Bluestem	*Schizachyrium scoparium*	2- 4	Full Sun	0.250
Virginia Wild Rye	*Elymus virginicus*	2 - 4	Full Sun	0.250
Tall Dropseed	*Sporobolus compositus*	2 - 3	Full Sun	0.050
Purple Top	*Tridens flavus*	3 - 5	Part Shade	0.058
Indian Grass	*Sorghastrum nutans*	3 - 6	Full Sun	0.167
Switchgrass	*Panicum virgatum*	3 - 7	Full Sun	0.183
Fall Panicum	*Panicum anceps*	2 - 4	Part Shade	0.042
Total	—	—	—	**1.0**

Sources: Roundstone Native Seed, 2017; Glennon, 2017.

[a] Recommended seeding application rate is 8 to 18 pounds per acre.

[b] lbs/acre/PLS = pounds per acre of pure live seed.

Seed Mix 1.2.1-2: Recommended Forbs Seed Mixture and Application Rates for Excessively to Moderately Well Drained Sites in North Carolina				
Common Name	Scientific Name	Color	Bloom Period	Drilled Seed Application Rate (lbs/acre/PLS)[b]
Lance Leaved Coreopsis	*Coreopsis lanceolata*	Yellow	Spring, Summer	0.266
Spotted Beebalm	*Monarda punctata*	Pink	Spring, Summer	0.124
Common Milkweed	*Asclepias syriaca*	Pink	Spring, Summer	0.107
Smooth Beardtongue	*Penstemon digitalis*	White	Spring	0.107
Bergamot	*Monarda fistulosa*	Lavender	Summer	0.124
Partridge Pea	*Cassia fasciculata*	Yellow	Summer	0.621
Spiked Blazing Star	*Liatris spicata*	Pink	Summer	0.222
Lupine	*Lupinus perennis*	Blue	Summer	0.497
Early Goldenrod	*Solidago juncea*	Yellow	Summer	0.160
Starry Silphium	*Silphium asteriscus*	Yellow	Summer, Fall	0.178
Iron Weed	*Vernonia altissima*	Purple	Summer, Fall	0.222
Sneezeweed	*Helenium autumnale*	Yellow	Summer, Fall	0.124
Hairy Mountain Mint	*Pycnanthemum pilosum*	White	Summer, Fall	0.089
Total	—	—	—	**2.84**

Sources: Roundstone Native Seed, 2017; Glennon, 2017.
[a] lbs/acre/PLS = pounds per acre of pure live seed

Comment [LC(3]: I think this is a wetland plant – How about Vernonia glauca instead?

Comment [LC(4]: A Midwestern taxon.

Seed Mix 1.2.1-3: Recommended Grass Seed Mixture and Application Rates for Somewhat Poorly to Very Poorly Drained Sites in North Carolina [a]				
Common Name	Scientific Name	Height (Inches)	Sun Exposure	Seed Mix Rate (lbs/acre/PLS)[b]
Switchgrass	*Panicum virgatum*	3 - 7	Full Sun	0.233
Red Top Panicum	*Panicum rigidulum*	2 - 4	Full Sun	0.017
Fowl Manna Grass	*Glyceria striata*	3 - 5	Part Shade	0.008
Virginia Wild Rye	*Elymus virginicus*	2 - 4	Full Sun	0.217
Canada Wild Rye	*Elymus canadensis*	2 - 5	Part Shade	0.167
Deer Tongue Grass	*Panicum clandestinum*	2 - 4	Full Sun	0.058
Big Bluestem	*Andropogon gerardii*	4 - 10	Full Sun	0.167
Frank's Sedge	*Carex frankii*	1 - 2	Part Shade	0.042
Fox Sedge	*Carex vulpinoidea*	2 - 3	Part Shade	0.025
Fall Panicum	*Panicum anceps*	2 - 4	Part Shade	0.067
Total	—	—	—	**1.0**

Sources: Roundstone Native Seed, 2017; Glennon, 2017.
[a] Recommended seeding application rate is 8 to 18 pounds per acre.
[b] lbs/acre/PLS = pounds per acre of pure live seed.

Comment [LC(5]: Extremely rare in NC.

Seed Mix 1.2.1-4: Recommended Forbs Seed Mixture and Application Rates for Somewhat Poorly to Very Poorly Drained Sites in North Carolina				
Common Name	Scientific Name	Color	Bloom Period	Seed Application Rate (lbs/acre/PLS)[a]
Smooth Beardtongue	*Penstemon digitalis*	White	Spring	0.169
Butterfly Milkweed	*Asclepias tuberosa*	Orange	Spring, Summer	0.056
Ohio Spiderwort	*Tradescantia ohiensis*	Blue	Spring, Summer	0.084
Blackeyed Susan	*Rudbeckia hirta*	Yellow	Spring, Summer	0.180
Spiked Blazing Star	*Liatris spicata*	Pink	Summer	0.264
Hoary Mountain Mint	*Pycnanthemum incanum*	White	Summer	0.034
Early Goldenrod	*Solidago juncea*	Yellow	Summer	0.113
Bergamot	*Monarda fistulosa*	Lavender	Summer	0.169
Showy Tickseed	*Bidens aristosa*	Yellow	Summer, Fall	0.366
Starry Silphium	*Silphium asteriscus*	Yellow	Summer, Fall	0.113
Narrow-Leaved Sunflower	*Helianthus angustifolius*	Yellow	Summer, Fall	0.113
Joe-Pye Weed	*Eupatorium fistulosum*	Pink	Summer, Fall	0.141
Total	—	—	—	**1.80**

Sources: Roundstone Native Seed, 2017; Glennon, 2017.
[a] lbs/acre/PLS = pounds per acre of pure live seed

2.0 REFERENCES

Glennon, Robert. 2017. Personal communication with Herbert Pirela of Environmental Resources Management, Inc. Private Lands Biologist.

Roundstone Native Seed. 2017. Jeremy Hamlington, personal communication with Herbert Pirela of Environmental Resources Management, Inc. Horticulturist.

Steve Holden

From:	Hypes, Rene (DCR) <Rene.Hypes@dcr.virginia.gov>
Sent:	Monday, March 06, 2017 12:14 PM
To:	Richard F Weeks (Services - 6)
Cc:	Meader, Tyler (DCR)
Subject:	[External] RE: Pollinator Seed Mixes

Thanks Rick for the update and your continued coordination with DCR in regards to pollinator seed mixes.

Rene'

S. Rene' Hypes
Project Review Coordinator
Department of Conservation and Recreation
Division of Natural Heritage
600 East Main Street, 24th Floor
Richmond, Virginia 23219
804-371-2708 (phone)
804-371-2674 (fax)
rene.hypes@dcr.virginia.gov

Conserving VA's Biodiversity through
Inventory, Protection and Stewardship
http://www.dcr.virginia.gov/natural-heritage/

From: Richard F Weeks (Services - 6) [mailto:Richard.F.Weeks@dom.com]
Sent: Monday, March 06, 2017 11:42 AM
To: Hypes, Rene (DCR) <Rene.Hypes@dcr.virginia.gov>
Cc: Meader, Tyler (DCR) <Tyler.Meader@dcr.virginia.gov>
Subject: RE: Pollinator Seed Mixes

Hi Renee,

We will submit the updated seed mixes to FERC later this month. Chris asked for a couple more changes that I would like to resolve before we submit.

Thanks

Rick

From: Hypes, Rene (DCR) [mailto:Rene.Hypes@dcr.virginia.gov]
Sent: Wednesday, March 01, 2017 12:35 PM
To: Richard F Weeks (Services - 6)
Cc: Meader, Tyler (DCR)
Subject: [External] RE: Pollinator Seed Mixes

Hi Rick,

I hope all is well.

Thank you for the opportunity to provide input on the updated "Recommended Seed Mixes for Pollinator Habitat in Virginia and North Carolina." Is Dominion planning to file an updated list of the pollinator seed mixes with FERC as supplemental information to what is currently included in the DEIS?

Thanks,

Rene'

S. Rene' Hypes
Project Review Coordinator
Department of Conservation and Recreation
Division of Natural Heritage
600 East Main Street, 24th Floor
Richmond, Virginia 23219
804-371-2708 (phone)
804-371-2674 (fax)
rene.hypes@dcr.virginia.gov

Conserving VA's Biodiversity through
Inventory, Protection and Stewardship
http://www.dcr.virginia.gov/natural-heritage/

Virginia Department of Game and Inland Fisheries

ATLANTIC COAST PIPELINE

PROJECT CALL LOG

CALL TO/FROM WHOM:	PHONE NO.:
Brian Moyer	804-367-4370
COMPANY: Virginia Department of Game and Inland Fisheries	
PROJECT CONTACT: Rick Weeks	PHONE NO.: 804-771-3623
DATE: July 6, 2016	TIME OF CONVERSATION: PM
RE: Virginia Birding and Wildlife Trails	

LOG OF CONVERSATION:

- ACP representative, Rick Weeks, spoke with Brian Moyer with the Virginia Department of Game and Inland Fisheries, who manages the Virginia Birding and Wildlife Trails (VBWTs). Here is the link to WBWT web site https://www.dgif.virginia.gov/vbwt/.

- Mr. Moyer indicated that the VBWTs are not trails, but rather they are public roads connecting multiple discrete sites where birds and wildlife can be observed.

- He indicated that DGIF's only concern would be if we crossed one of these discrete sites for observing birds and wildlife.

  Further he indicated that most of these sites are privately owned and are not DGIF properties. He said if we do cross one of these properties we should contact the owners directly and he would provide us the contact information.

ACTION ITEMS	
ACTION REQUIRED:	BY WHOM:
N/A	N/A

cc: Project Files

Steve Holden

From: Puckett, Marc (DGIF) <Marc.Puckett@dgif.virginia.gov>
Sent: Thursday, January 26, 2017 8:33 AM
To: Ludwig, Chris (DCR); Richard F Weeks (Services - 6)
Cc: Ewing, Amy (DGIF); Hypes, Rene (DCR); Molly P Plautz (Services - 6); Herbert Pirela; Matt Overton (Services - 6); Meader, Tyler (DCR)
Subject: [External] RE: Pollinator Seed Mixes

Friends, I cannot offer anything beyond what Chris' team has offered. I am happy to evaluate habitats for early-succession species as they develop at any time. I appreciate the chance to have been a part of this and I feel everything is in great hands with the DCR Natural heritage Team involved.

Virginia Department of Environmental Quality

COMMONWEALTH of VIRGINIA

DEPARTMENT OF ENVIRONMENTAL QUALITY
Street address: 629 East Main Street, Richmond, Virginia 23219
Mailing address: P.O. Box 1105, Richmond, Virginia 23218
www.deq.virginia.gov

Molly Joseph Ward
Secretary of Natural Resources

David K. Paylor
Director

(804) 698-4000
1-800-592-5482

March 9, 2017

Spencer Trichell
Environmental Consultant - Atlantic Coast Pipeline
Dominion Resources Services, Inc.
5000 Dominion Boulevard
Glen Allen, Virginia 23060

RE: 90-Day Federal Consistency Certification Status: Atlantic Coast Pipeline, DEQ Project No. 15-161F

Dear Mr. Trichell,

The Department of Environmental Quality (DEQ) is responsible for coordinating the review of Federal Consistency Certifications (FCCs) and responding to appropriate agencies on behalf of the Commonwealth. Pursuant to the Coastal Zone Management Act of 1972 (CZMA), as amended, all activities located within Virginia's designated coastal management area requiring a federal permit, license or approval must be consistent with the Virginia Coastal Zone Management (CZM) Program. The Virginia CZM Program is comprised of a network of environmental policies administered by several agencies of the Commonwealth. DEQ is coordinating the review of the portions of the Atlantic Coast Pipeline (ACP) project within the cities of Suffolk and Chesapeake, which are within the coastal zone, with agencies administering the enforceable policies of the Virginia CZM Program. Atlantic Coast Pipeline, LLC (Atlantic) is seeing authorization from the Federal Energy Regulatory Commission for construction and operation of the pipeline.

In accordance with the provision of CZMA federal consistency regulation § 930.62(a), at the earliest practicable time, DEQ shall notify the federal agency and the applicant whether the state concurs with or objects to a consistency certification. If DEQ has not issued a decision within three months following commencement of the review, it shall notify the applicant and the federal agency of the status of the matter and the basis for further delay (§ 930.62(b)). This letter constitutes the 90-day notification of the status of the consistency review of the proposed project.

As you know, the DEQ Office of Environmental Impact Review (OEIR) initiated its review of the FCC on October 6, 2015. This started the original six month review period. However on November 13, 2015, the Federal Energy Regulatory Commission (FERC) issued a request for additional comments on proposed route changes including changes in Virginia's coast management zone resulting in a stay of the federal consistency review starting on December 9, 2015. Since that time, Dominion and DEQ have agreed to eight additional stays, the last through February 13, 2017. The 90-day date is March 10, 2107, and the six-month due date is June 8, 2017.

Upon receipt of the updated FCC, detailing the route and project changes that have occurred since 2015, DEQ OEIR distributed the document the affected state agencies, localities and the planning district commission for review. In accordance with 15 CFR §930.2 and §930.61, the public comment period for the project is March 5 through April 4. After the public comment period, DEQ will consider all comments it received and will respond to the FCC on or before June 8, 2017.

If you have questions, please call me at (804) 698-4204.

Sincerely,

Bettina Sullivan, Manager
Office of Environmental Impact Review

ec: Kevin Bowman, FERC
Spencer Trichell, Dominion
Julia Wellman, DEQ

Virginia Department of Historic Resources

Dominion Resources Services, Inc.
5000 Dominion Boulevard,
Glen Allen, VA 23060

Dominion

March 24, 2017

Mr. Roger Kirchen, Director
Review and Compliance Division
Virginia Department of Historic Resources
2801 Kensington Ave.
Richmond, VA 23221

**Subject: Section 106 Review –Architectural Survey Report Addendum 5
Atlantic Coast Pipeline, LLC, Atlantic Coast Pipeline Project
DHR File No. 2014-0710**

Dear Mr. Kirchen:

Atlantic Coast Pipeline, LLC (Atlantic) is requesting review and comment on the enclosed addendum architectural survey report on investigations conducted for the proposed Atlantic Coast Pipeline (ACP). The Federal Energy Regulatory Commission (FERC) is the lead Federal agency for this Project. Atlantic's consultant, ERM, conducted the survey and prepared the enclosed report pursuant to the requirements of Section 106 of the National Historic Preservation Act of 1966, as amended.

Atlantic would appreciate your comments on the attached addendum architectural survey report, and we look forward to continuing to work with you on this Project. If you have any questions regarding the enclosed report, please contact Richard B. Gangle at (804) 273-2814 or Richard.B.Gangle@dom.com, or by letter at:

> Richard B. Gangle
> Dominion Resources Services, Inc.
> 5000 Dominion Boulevard
> Glen Allen, Virginia 23060

Respectfully submitted,

Robert M. Bisha

Robert M. Bisha
Technical Advisor, Atlantic Coast Pipeline

cc: Richard Gangle (Dominion)
Enclosure: **Architectural Survey Report Addendum**

Dominion Resources Services, Inc.
5000 Dominion Boulevard,
Glen Allen, VA 23060

Dominion

March 24, 2017

Mr. Roger Kirchen, Director
Review and Compliance Division
Virginia Department of Historic Resources
2801 Kensington Ave.
Richmond, VA 23221

Subject: **Section 106 Review –Phase II Investigations, Sites 44GV0386 and 44SN0308**
Atlantic Coast Pipeline, LLC, Atlantic Coast Pipeline Project
DHR File No. 2014-0710

Dear Mr. Kirchen:

Atlantic Coast Pipeline, LLC (Atlantic) is requesting review and comment on the enclosed Phase II Report on investigations conducted for the proposed Atlantic Coast Pipeline (ACP) in September 2015 and November 2016. The Federal Energy Regulatory Commission (FERC) is the lead Federal agency for this Project. Atlantic's consultant, ERM, conducted the survey and prepared the enclosed report pursuant to the requirements of Section 106 of the National Historic Preservation Act of 1966, as amended.

Atlantic would appreciate your comments on the attached Phase II report, and we look forward to continuing to work with you on this Project. If you have any questions regarding the enclosed report, please contact Richard B. Gangle at (804) 273-2814 or Richard.B.Gangle@dom.com, or by letter at:

Richard B. Gangle
Dominion Resources Services, Inc.
5000 Dominion Boulevard
Glen Allen, Virginia 23060

Respectfully submitted,

Robert M. Bisha

Robert M. Bisha
Technical Advisor, Atlantic Coast Pipeline

cc: Richard Gangle (Dominion)
Enclosure: **Phase II Investigations, Sites 44GV0386 and 44SN0308**

North Carolina Agencies

North Carolina Department of Agriculture & Consumer Services

Steve Holden

From: Yarborough, Bill <bill.yarborough@ncagr.gov>
Sent: Friday, January 27, 2017 3:52 PM
To: Richard F Weeks (Services - 6)
Cc: Hedgecock, Zane; McGinnis, Michelle S
Subject: [External] RE: ACP Pollinator Ininiative

Richard,

Thanks for the opportunity to review your seed mixes for pollinators on your pipeline plans.

This is good work. I have reviewed the mixes and feel the species and seeding rates are within what we have had success with. Of course soil fertility is something you may want to consider with the use of soil tests.

I would like to take the opportunity to suggest some area resources that may be of assistance with agronomic recommendations as you work on this project. The NCDA&CS Agronomic Division have regional agronomists familiar with their regions. They understand the regional variables of soils and fertility levels. In looking at your maps, below are the regional agronomists available by county.

Northampton – Mike Wilder (919) 495-7495
Halifax – Mike Wilder (919) 495-7495
Nash – Mike Wilder (919) 495-7495
Wilson – Don Nicholson (919) 499-8708
Johnston – Don Nicholson (919) 499-8708
Sampson – Don Nicholson (919) 499-8708 (just a sliver of proposed pipeline in Sampson, so Don can be the contact)
Cumberland – Georgia Love (910) 690-0270
Roberson – Georgia Love (910) 690-0270

Again, thanks for the reaching out and if we can be of additional assistance, please let us know. If this is not sufficient for your needs or additional detail is required for your purpose, please let me know.

Best regards,

Bill

Bill Yarborough
Special Assistant to the Commissioner of Agriculture
NCDA & CS
828 507 2273

From: Richard F Weeks (Services - 6) [mailto:Richard.F.Weeks@dom.com]
Sent: Wednesday, January 25, 2017 2:56 PM
To: Yarborough, Bill <bill.yarborough@ncagr.gov>
Cc: Molly P Plautz (Services - 6) <molly.p.plautz@dom.com>; Herbert Pirela <Herbert.Pirela@erm.com>
Subject: ACP Pollinator Ininiative

Bill,

It was good to speak with you today and we appreciate North Carolina's support of pollinator habitat. The Atlantic Coast Pipeline's Pollinator Initiative focuses on the ACP right-of-way with slopes less than 15 percent so North Carolina is attractive for our Initiative. We are also focusing on areas that are currently forested.

Attached are two documents. The first is a table that summarizes locations and parcels on the route identified as potential areas for the establishment of pollinator habitat. The table identifies locations with at least a mile of contiguous or nearly contiguous potential pollinator habitat. Also summarized on the table is the number of parcels. Using the one mile criteria, there are a total of 56 miles in North Carolina that could be suitable.

The following link to the Dom.com web site, will take you to Maps by County where you can view the mileposts and parcels: https://www.dom.com/about-us/news-center/natural-gas-projects-and-initiatives/atlantic-coast-pipeline/maps

The second attachment provides recommended pollinator seed mixes on pages 5 and 6 for North Carolina. There is a set of recommendations for well drained soils and for poorly drained soils.

We would greatly appreciate your input on these seed mixes and application rates.

On January 10, 2017 Dominion submitted an updated Restoration and Rehabilitation Plan to FERC: **https://www.dom.com/about-us/news-center/natural-gas-projects-and-initiatives/atlantic-coast-pipeline/library/636352af6ce343348f00246ecb48c5ef.ashx**

Starting on page 8 there are two new sections 5.7.2.1 Pollinator Habitat Planting and 5.7.2.2 Pollinator Habitat Maintenance that briefly describe our Pollinator Initiative.

We would be happy to meet with the appropriate individuals on our initiative and would appreciate anything you can do to help promote the program.

Thanks

Rick

Rick Weeks
O (804) 771-3623
C (804) 347-0623

CONFIDENTIALITY NOTICE: This electronic message contains information which may be legally confidential and or privileged and does not in any case represent a firm ENERGY COMMODITY bid or offer relating thereto which binds the sender without an additional express written confirmation to that effect. The information is intended solely for the individual or entity named above and access by anyone else is unauthorized. If you are not the intended recipient, any disclosure, copying, distribution, or use of the contents of this information is prohibited and may be unlawful. If you have received this electronic transmission in error, please reply immediately to the sender that you have received the message in error, and delete it. Thank you.

North Carolina Wildlife Resources Commission

Jaclyn Martin

From:	Stancil, Vann F <vann.stancil@ncwildlife.org>
Sent:	Wednesday, March 01, 2017 2:03 PM
To:	Sara Throndson; Garrison, Gabriela; Ellis, John; sarah_mcrae@fws.gov
Cc:	Laurid Broughton; Pat Robblee; Steve Holden; Spencer Trichell (spencer.trichell@dom.com); Jennifer C Broush (Services - 6); Richard B Gangle (Services - 6); Black, Tyler R
Subject:	RE: ACP - NC Neuse River Mussel Addendum Report
Follow Up Flag:	Follow up
Flag Status:	Flagged

Sara,

Thank you for the ACP Neuse River Mussel Addendum Report. We have reviewed the report and compared the recent effort with that done in June 2016 at the proposed crossing location. The Dec 2016 survey effort is sufficient to address our request for additional information on freshwater mussels in the Neuse River near the proposed ACP crossing location.

Thanks,
Vann

From: Sara Throndson [mailto:Sara.Throndson@erm.com]
Sent: Friday, February 17, 2017 5:08 PM
To: Stancil, Vann F <vann.stancil@ncwildlife.org>; Garrison, Gabriela <gabriela.garrison@ncwildlife.org>; Ellis, John <john_ellis@fws.gov>; sarah_mcrae@fws.gov
Cc: Laurid Broughton <Laurid.Broughton@erm.com>; Pat Robblee <Pat.Robblee@erm.com>; Steve Holden <Steve.Holden@erm.com>; Spencer Trichell (spencer.trichell@dom.com) <spencer.trichell@dom.com>; Jennifer C Broush (Services - 6) <jennifer.c.broush@dom.com>; Richard B Gangle (Services - 6) <richard.b.gangle@dom.com>
Subject: ACP - NC Neuse River Mussel Addendum Report

Vann, Gabriela, and John,

On behalf of the Atlantic Coast Pipeline Project please find the attached ACP Neuse River Mussel Report. This survey was requested determine the extent of the mussel assemblage observed during initial surveys. This report will be filed with FERC later this week.

Atlantic looks forward to continued coordination with you on this project. Please contact Mr. Richard Gangle at (804) 273-2814 or richard.b.gangle@dom.com, or Ms. Sara Throndson at (612) 347-7113 or sara.throndson@erm.com if there are questions.

Thank you, Sara

Sara Throndson
Senior Scientist
ERM
1000 IDS Center, 80 S. 8th Street l Minneapolis l MN l 55402
Office 612-347-7113 l Cell 612-716-7812
sara.throndson@erm.com l www.erm.com

ERM *The business of sustainability*

North Carolina Department of Natural and Cultural Resources

North Carolina Department of Natural and Cultural Resources

State Historic Preservation Office

Ramona M. Bartos, Administrator

Governor Roy Cooper
Secretary Susi H. Hamilton

Office of Archives and History
Deputy Secretary Kevin Cherry

March 17, 2017

Richard Gangle
Dominion Resources Services, Inc.
5000 Dominion Boulevard
Glen Allen, VA 23060
Richard.B.Gangle@dom.com

Re: Phase II Investigations at Sites 31NP391, 31NP392, 31NS147, 31NS169, and 31RB534;
Atlantic Coast Pipeline Project, Multi County; ER 14-1475

Dear Mr. Gangle:

We have received Mr. Robert M. Bisha's letter of January 9, 2017, providing copies of ERM's report of Phase II investigations at the five referenced sites.

For purposes of compliance with Section 106 of the National Historic Preservation Act, we concur that the following properties are eligible for the National Register of Historic places under the criterion cited: 31NP391 and 31NP392, both under Criterion D, for their respective abilities to yield information on regional developments during the Middle Woodland and Woodland periods.

If 31NP391 and 31NP392 cannot be avoided by the proposed pipeline and associated construction activities, we will need to enter into consultation under Section 106 to address the adverse effect. One method to mitigate these effects might be data recovery. Please contact us as soon as possible once it is known if the sites will be affected.

The following properties are determined not eligible for listing in the National Register of Historic Places: 31NS147, 31NS169, and 31RB534, because they lack integrity and are unlikely to contribute further to an understanding of the region's prehistory or history. We recommend no further archaeological investigations in connection with these sites; construction may be allowed to proceed in their locations.

The above comments are made pursuant to Section 106 of the National Historic Preservation Act and the Advisory Council on Historic Preservation's Regulations for Compliance with Section 106 codified at 36 CFR Part 800.

Thank you for your cooperation and consideration. If you have questions concerning the above comment, contact Renee Gledhill-Earley, environmental review coordinator, at 919-807-6579 or environmental.review@ncdcr.gov. In all future communication concerning this project, please cite the above referenced tracking number.

Sincerely,

Renee Gledhill-Earley

for Ramona M. Bartos

Location: 109 East Jones Street, Raleigh NC 27601 **Mailing Address**: 4617 Mail Service Center, Raleigh NC 27699-4617 **Telephone/Fax**: (919) 807-6570/807-6599

North Carolina Department of Natural and Cultural Resources
State Historic Preservation Office
Ramona M. Bartos, Administrator

Governor Roy Cooper
Secretary Susi H. Hamilton

Office of Archives and History
Deputy Secretary Kevin Cherry

March 20, 2017

Richard Gangle
Dominion Resources Services, Inc.
5000 Dominion Boulevard
Glen Allen, VA 23060
Richard.B.Gangle@dom.com

Re: Historic Cemetery Delineation Report, Atlantic Coast Pipeline Project, Multi County, ER 14-1475

Dear Mr. Gangle:

We have received Mr. Robert M. Bisha's letter of January 9, 2017, providing copies of ERM's report of the delineations of seven historic-period cemeteries identified during archaeological survey for the Atlantic Coast Pipeline Project.

Cemeteries revisited with the goal of determining if graves are present beyond the originally recorded boundaries are: 31CD2091, 31JT452, 31JT461, 31JT485, 31NS162, 31NS171, 31NS173, and 31RB572. Measures employed in this process included visual examination and probing.

ERM found no evidence of unmarked graves beyond the currently defined boundaries of the cemeteries. Though access was denied to 31JT485, ERM concluded its current fenced enclosure and its siting made it unlikely that additional burials exist outside its perimeter as defined.

We understand that all eight cemeteries will be avoided during not only project construction but also throughout ongoing use and maintenance of the pipeline corridor. Further, prior to any construction activities, temporary fencing will be placed around all cemeteries lacking intact boundary fences. These are: 31CD2091, 31JT452, 31JT461, 31NS171, and 31NS173. We support these measures.

Though all eight sites are recommended as not eligible for the National Register of Historic Places under any criterion, they are protected under the auspices of NCGS 65 and NCGS 14-148 and 14-149.

We note the proximity of 31NS173, the Hunter Cemetery, just to the west of the planned corridor in the vicinity of 31NS136, and to the southwest of 31NS173. If the alignment of the corridor should shift to the west, we recommend that 31NS173 too be delineated in the manner of the other cemeteries.

Thank you for your cooperation and consideration. If you have questions concerning the above comment, contact Renee Gledhill-Earley, environmental review coordinator, at 919-807-6579 or environmental.review@ncdcr.gov. In all future communication concerning this project, please cite the above referenced tracking number.

Sincerely,

Renee Gledhill-Earley

for Ramona M. Bartos

cc: State Clearinghouse

Dominion Resources Services, Inc.
5000 Dominion Boulevard,
Glen Allen, VA 23060

Dominion

March 24, 2017

Renee Gledhill-Earley
State Historic Preservation Office
109 East Jones Street, Room 258
Raleigh, NC 27601

Subject: Section 106 Review –Phase I Historic Architectural Survey Report Addendum 4
Atlantic Coast Pipeline, LLC, Atlantic Coast Pipeline Project
File No. Multi-County ER 14-1475

Dear Ms. Gledhill-Earley:

Atlantic Coast Pipeline, LLC (Atlantic) is requesting review and comment on the enclosed addendum architecture survey report, which reports on investigations conducted for the proposed Atlantic Coast Pipeline (ACP). The Federal Energy Regulatory Commission (FERC) is the lead Federal agency for this Project. Atlantic's consultant, ERM, conducted the survey and prepared the enclosed report pursuant to the requirements of Section 106 of the National Historic Preservation Act of 1966, as amended.

Atlantic would appreciate your comments on the attached addendum architecture survey report, and we look forward to continuing to work with you on this Project. If you have any questions regarding the enclosed report, please contact Richard B. Gangle at (804) 273-2814 or Richard.B.Gangle@dom.com, or by letter at:

Richard B. Gangle
Dominion Resources Services, Inc.
5000 Dominion Boulevard
Glen Allen, Virginia 23060

Respectfully submitted,

Robert M. Bisha

Robert M. Bisha
Technical Advisor, Atlantic Coast Pipeline

cc: Richard Gangle (Dominion)
Enclosure: **Phase I Historic Architectural Survey Report Addendum 4**

Dominion Resources Services, Inc.
5000 Dominion Boulevard,
Glen Allen, VA 23060

Dominion

March 24, 2017

Renee Gledhill-Earley
State Historic Preservation Office
109 East Jones Street, Room 258
Raleigh, NC 27601

Subject: **Section 106 Review –Phase II Investigations Sites 31CD2018, 31CD2055, 31CD2093, 31CD2099, and 31CD2109**
Atlantic Coast Pipeline, LLC, Atlantic Coast Pipeline Project
File No. Multi-County ER 14-1475

Dear Ms. Gledhill-Earley:

Atlantic Coast Pipeline, LLC (Atlantic) is requesting review and comment on the enclosed Phase II report on investigations conducted for the proposed Atlantic Coast Pipeline (ACP) from October 2015 through November 2016. The Federal Energy Regulatory Commission (FERC) is the lead Federal agency for this Project. Atlantic's consultant, ERM, conducted the survey and prepared the enclosed report pursuant to the requirements of Section 106 of the National Historic Preservation Act of 1966, as amended.

Atlantic would appreciate your comments on the attached Phase II testing report, and we look forward to continuing to work with you on this Project. If you have any questions regarding the enclosed report, please contact Richard B. Gangle at (804) 273-2814 or Richard.B.Gangle@dom.com, or by letter at:

Richard B. Gangle
Dominion Resources Services, Inc.
5000 Dominion Boulevard
Glen Allen, Virginia 23060

Respectfully submitted,

Robert M. Bisha

Robert M. Bisha
Technical Advisor, Atlantic Coast Pipeline

cc: Richard Gangle (Dominion)
Enclosure: **Phase II Investigations Sites 31CD2018, 31CD2055, 31CD2093, 31CD2099, and 31CD2109**