



A Facility For Evaluating Satellite-Based Positioning Systems

The Forest Service has established a test course at Lubrecht Experimental Forest to evaluate the characteristics of Global Positioning System (GPS) receiver equipment in forest environments and to acquaint personnel with use of satellite-based navigation for field work. Tests conducted on the course will influence manufacturers in developing new equipment for forest and range applications. A series of field training seminars have been conducted by the University of Montana and the Missoula Technology and Development Center at the site to allow potential users field experience with common forest-related positioning tasks.

Recently developed satellite-based position and navigation systems appear to hold outstanding potential for performing

land management tasks. However, these systems have not been tested in forest settings. Improvements in position and navigation instruments have been rapid and dramatic, but topography and vegetation on national forests may restrict their performance. Lubrecht Forest was chosen as a test and evaluation site because of its physical characteristics and because of its extensive ground control network and vegetation mapping system.

Lubrecht contains about 30,000 acres dedicated to forestry research and education. It is centrally located in the northern Rocky Mountains with its headquarters camp facility and research center located 33 miles east of Missoula, Montana (Figure 1). The topography is moderate with

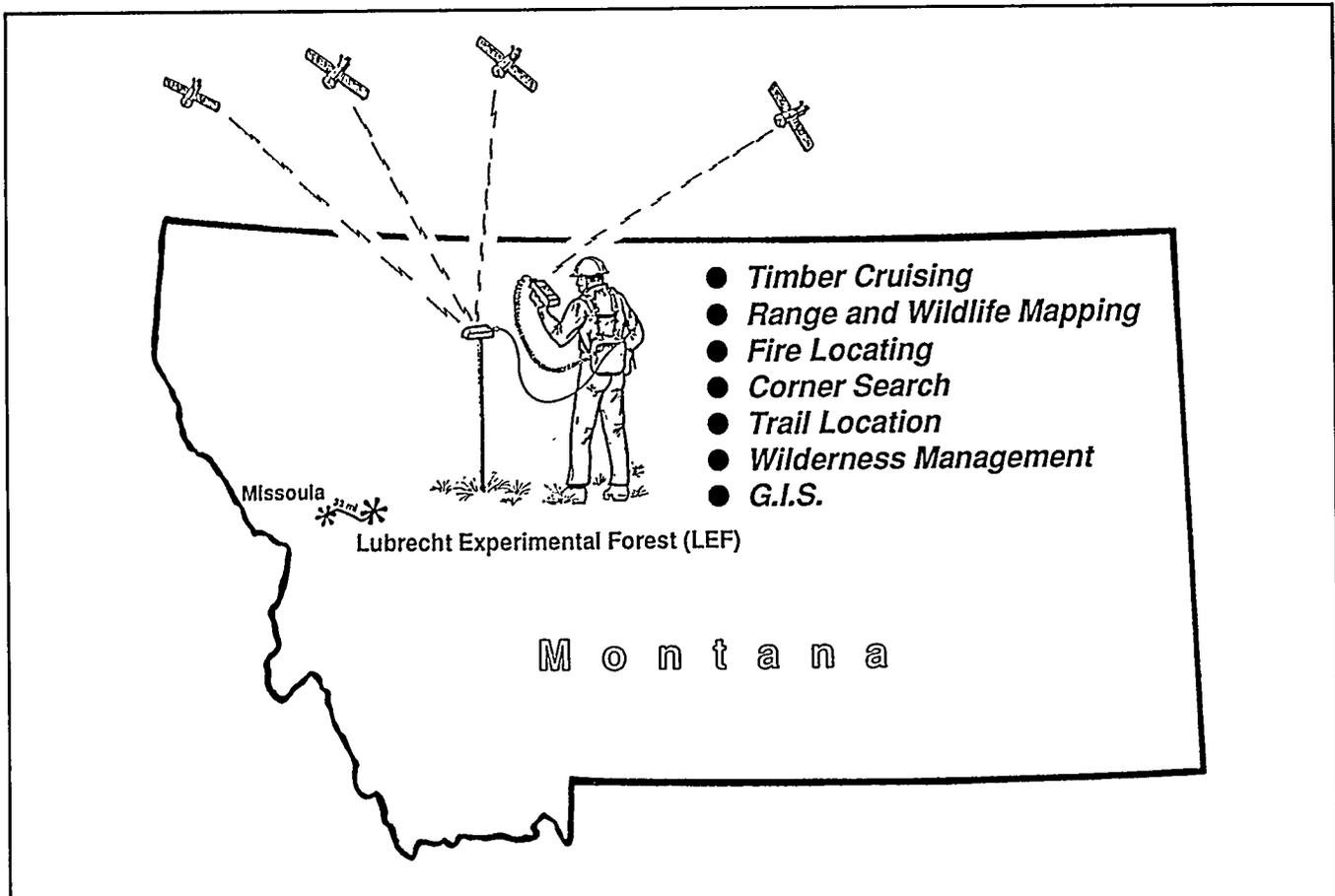


Figure 1.—Schematic location of Lubrecht Experimental Forest.

elevations from 3,600 feet to 6,500 feet. The forest vegetation is principally ponderosa pine, Douglas fir, lodgepole pine, western larch, alpine fir, and Engelmann spruce, with hardwood stands of aspen and cottonwood.

Some 1,200 forest stands have been delineated and mapped using the Environmental Data Collection System (EDCCS) to control the photogrammetric mapping. The data from EDCCS and the forest stand mapping are available in computer files for analyses. For example, many different cover type, slope, aspect, and elevation combinations can be selected for establishing position and navigation test courses.

Nine evaluation courses (Figure 2) have been selected to evaluate recently developed satellite-based position and navigation system receivers. GPS may soon be routinely used to perform tasks like establishing timber sale boundaries, locating roads and trails, mapping insect and disease areas, guiding aircraft, soil surveys, and smokechasing.

Course A (Figure) is in a clearcut area and Course B is a thinned area of young lodgepole pine. The courses were designed to be similar except for the cover and possible masking or signal blocking forest conditions. Each station in course "A1" has 15 degrees of vertical angle clearance in

all directions (360 degrees). The course "A2" stations are at the edge of the clearcut and therefore are clear for only 180 degrees at each station. Stations "A31" and "A32" were located outside the clearcut in dense forest cover. Courses A and B are both located on nearly flat or gently rolling terrain. Course B is also divided into an inner and outer traverse in what was a very dense (100 percent canopy cover) lodgepole pine stand that has been thinned to four spacing levels (10 x 10, 14 x 14, 20 x 20 ft and control). The stations are located in each of the tree spacing levels and are designated "B1" and "B2".

Course C is located in mixed coniferous (ponderosa pine, Douglas fir, and western larch) stands of all ages. Tree size varies from reproduction size to 30-inch dbh and over 100 feet in height. The terrain is gently rolling. The stations were located with respect to potential signal blocking trees or canopy conditions.

Courses A, B, and C are intended to determine if tree cover, tree spacing, tree size, and general stand conditions significantly affect accuracy, ease of operation, or operating efficiency of field coordinate locator instruments in these forest situations.

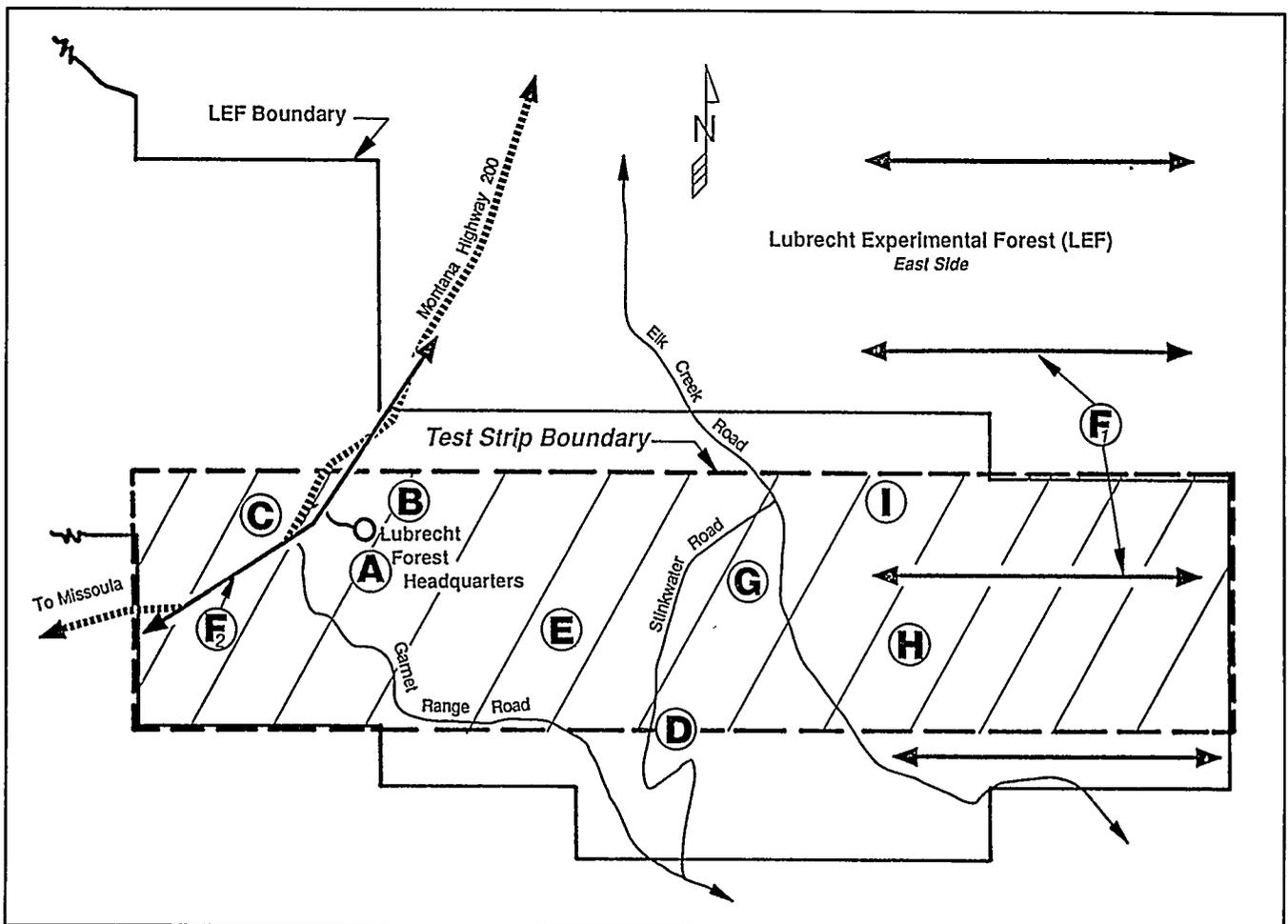


Figure 2.—Schematic of Evaluation Site locations.

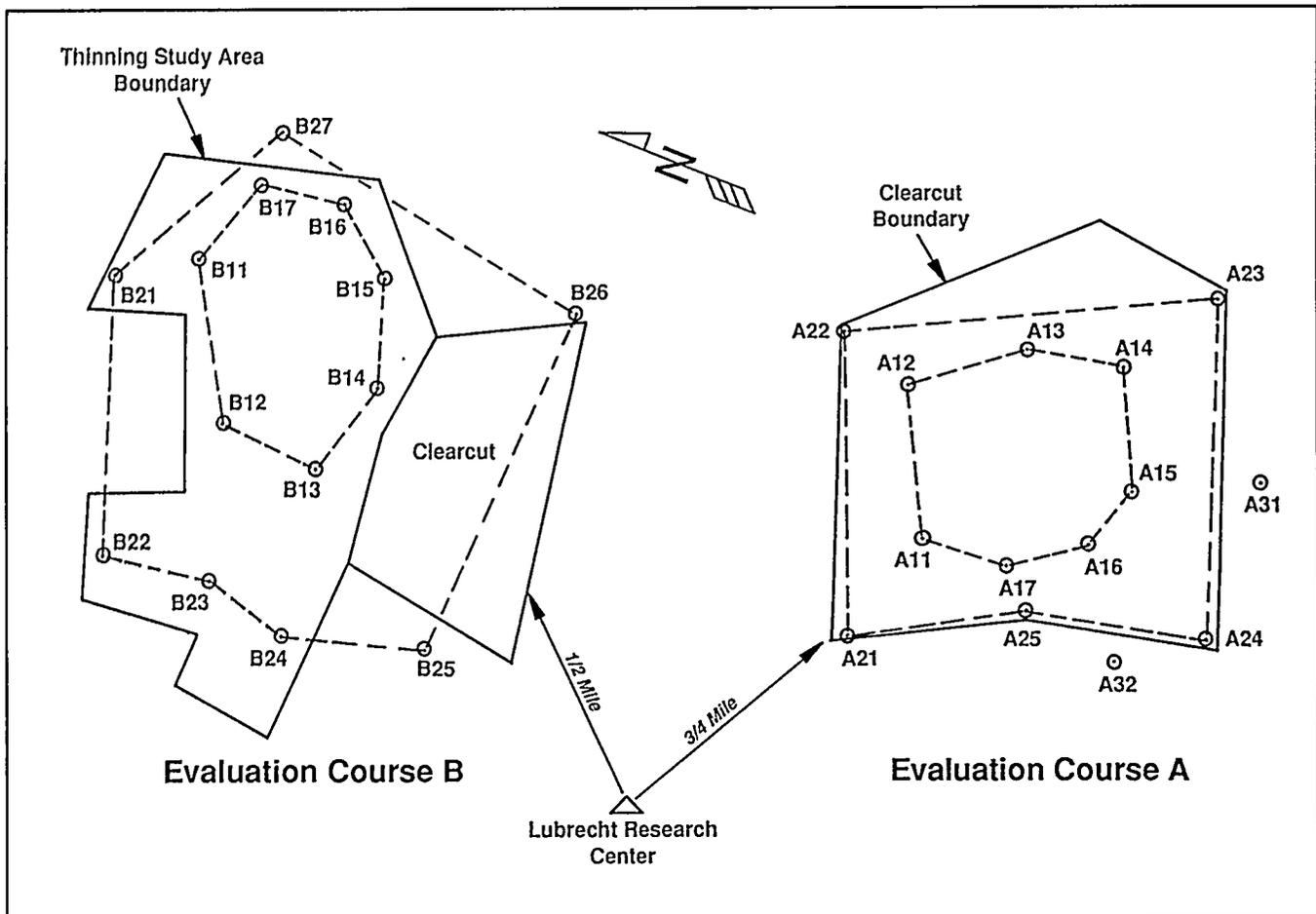


Figure 3.—Schematic of Evaluation Courses A & B.

Course D encloses about 37 acres of moderate to very steep topography and varying forest conditions. The course will evaluate receivers in very rough conditions over relatively short distances. The primary purpose of the course is to test the slope profiling capability of the instruments. This information is essential for laying out cableways for aerial logging.

The A, B, C, and D courses are intended to evaluate portable receivers where the entire instrument, including power supply, will be carried by one person. The E, F, G, and H courses will evaluate applications in a vehicle or mounted on aircraft.

The E course follows two roads. The first is a major forest access road beginning and ending at established control points. The second is a primitive forest road heavily grown over by trees for considerable distances. Portions of these roads were never adequately mapped, and therefore, truly represent the problem of map revision in resource management. The course is designed to compare the satellite-based navigation systems' map revision capabilities with conventional field and photogrammetric methods.

An aircraft-mounted instrument is required for the F course. Four flight lines were planned to cover Lubrecht, with one line to duplicate coverage of the test

strip. The course affords an opportunity to compare results of accuracy and efficiency of navigation as well as the accuracy of photographing route strips with results obtained from conventional methods.

The G course provides for airborne coordinate reporting, dispatch, and ground recovery evaluation. Tests at Lubrecht will compare the efficiency of satellite-based navigation system guidance to conventional reporting and recovery procedures.

The H course is similar to the G course and could be used in the same evaluations. The site has lower topographic and forest features, and is more easily accessible than positions in the G course. The main purpose of testing on the H course is to determine the efficiency of the satellite-based navigation systems in a difficult orienteering problem. Given a map position (coordinates), the satellite-based system will be used to direct an air or ground crew to the position. The problem is typical of air or ground searches for lost aircraft, hunters, or ground crews, and in the subsequent rescue operations.

The last course, I, was established for evaluating instruments mounted on all-terrain vehicles or snowmobiles. The course is located on a ridge (elevation 5,000 ft). The stations form a traverse on several miles of road or trail as

well as off-road conditions. All stations are accessible by all-terrain vehicles or snowmobiles. The course is usually snow-covered from November through March. Road conditions in April and May during spring breakup are usually difficult for normal vehicle travel. The 1 course evaluations will determine the ease of transporting satellite-based navigation systems on special purpose vehicles.

The Lubrecht facility has the capability of evaluating a wide spectrum of coordinate location receivers under a variety of field conditions. The evaluation sites typify the field conditions found in forest, range, and wildland management. The evaluation courses exemplify actual field problems. The established field positions provide a reliable

base for studies of satellite-based position and navigation systems data. The Lubrecht test strip (EDCCS) provides for developing new evaluation situations including research opportunities.

For more information on the Lubrecht facility or on the GPS evaluations, contact:

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