

Surveyors



Occupational Brief Title Codes:

- D.O.T.: 018.167-018
- G.O.E.: 05.01.06
- S.O.C.: 17-1022
- O*NET™: 17-1022.00
- N.A.I.C.S.: 541360, 541370
- H.O.C.: IEA

Occupational Subtitles:

- Cartographers
- Geodetic Surveyors
- Geophysical Prospecting Surveyors
- Photogrammetrists
- Survey Technicians

Work Classification Based Related

D.O.T. Occupations:

- Cartographic Drafters
- Map Editors
- Mapping Supervisors
- Mosaicists
- Photogrammetric Engineers

Interests Based Related

G.O.E. Occupations:

- Clerical Methods Analysts
- Cost Analysis Engineers
- Forest Engineers
- Logistics Engineers
- Tool Programmers
- Utilization Engineers

Skills Based Related

O*NET Occupations:

- Appraisers, Real Estate
- Cartographers and Photogrammetrists
- Commercial and Industrial Designers
- Electrical Drafters
- Geological Data Technicians
- Landscape Architects
- Mapping Technicians
- Range Managers

Surveyors (sur`vey-ors) establish official land, air space, and water boundaries. They write descriptions of land for deeds, leases, and other legal documents, define air space for airports, and measure construction and mineral sites. Surveyors provide data relevant to the shape, contour, location, elevation, or dimension of land or land features.

For as long as humans have lived together, they have felt the need to set boundary lines marking ownership of land. Early tribes set up group ownership of lands and laid down borders. Nations also laid out and recorded their holdings along with trade routes and roads. The Romans surveyed and mapped the roads of their empire. When the early settlers in the United States traveled West, they marked their routes, surveyed the lands, and filed claims.

Precise and accurate land measurements are required to build a house or a skyscraper on a given piece of land, to lay out a trail or a superhighway, or to chart plans for telephone lines or water systems.

Work Performed

Surveyors set official land and water boundaries. They write detailed reports about land for inclusion in deeds, leases, and other legal documents. They define air space for airports. They also measure mineral sites and construction projects. Surveyors plan the fieldwork. They select the survey reference points, and determine the exact location of all the important features of the survey area.

With measurements from the field, surveyors prepare data or information in a form clients can use. They may prepare maps, plans, or reports. Among clients may be an engineer who will use the data in engineering designs, a contractor planning a construction project, or a real estate evaluator trying to resolve an ownership dispute.

Surveyors conduct research into legal records to look for evidence of previous boundaries. They may examine courthouse records for opinions on legal property lines. They establish township, property, and other boundary lines on tracts of land. When the crew completes a survey, surveyors record the results and verify the accuracy of the data.

Survey technicians serve as assistants to surveyors and usually work under their direct instruction. Survey technicians adjust and operate surveying instruments such as the theodolite, which measures horizontal and vertical angles, and electronic distance-measuring equipment. Survey technicians hold the vertical rods the theodolite operator sights on in order to measure angles, distances, or elevations. Survey technicians take notes, make sketches, and enter readings from the instruments into a computer. These notes are the record of the survey.

Surveyors direct one or more survey parties. These groups work in the field where they measure distances, directions, and angles between points and elevations of the points, lines, and contours on the surface of the earth.

The survey parties who collect the information for the land surveyors consist of a **party chief** and several survey technicians. The party chief may be either a surveyor or an experienced survey technician. This person leads the crew in

collecting and recording field observations. Party chiefs review all the notes and check the survey for accuracy. They see that all the required measurements are taken and are referenced to the correct control points.

New technology is changing the work of surveyors and survey technicians. On large surveying projects, surveyors are using Global Positioning Systems (GPS) to determine global positions and locate points on the earth. GPS technology, operated by the U.S. Department of Defense, uses a constellation of about twenty-four orbiting satellites. To use GPS, a surveyor places a satellite receiver about the size of a backpack or smaller on a desired point. The receiver collects information simultaneously from several satellites in different positions to determine the exact position of the point. Usually two receivers are operated together, one at a known point and the other at the unknown point. A receiver can also be placed in a vehicle to trace out road systems or for other uses.

Surveyors today have electronic equipment to measure, record, and store data. Equipment called "Total Station" couples an electronic theodolite with an electronic distance measuring device to measure horizontal and vertical angles as well as distances. An electronic data recorder plugs directly into the Total Station and automatically stores data. Surveyors also use computer graphics and automated plotting equipment to process data, including that from satellite-based GPS.

Other mapping scientists, like surveyors, measure, map, and chart the surface of the earth, but they usually cover much larger areas. Among these workers are *cartographers*. They prepare maps using information from geodetic surveys, aerial photographs, and satellite data. Cartographers compile geographic, political, and cultural information and prepare maps of large areas.

Photogrammetrists prepare maps and drawings by measuring and interpreting aerial photographs. In their work they use analytical processes and mathematical formulas. This work is important because it outlines and gives details on land or water areas that are inaccessible or difficult to survey by other methods.

Geophysical prospecting surveyors mark sites on the surface where they will take geophysical measurements in order to determine the geology of the earth below. Usually the purpose of this work is petroleum-related. They may use sonic, electronic, or nuclear measuring instruments to gauge the earth formations in boreholes in order to evaluate the potential for oil or gas deposits.

Geodetic surveyors measure such large masses of land, sea, or space that they must take into account the curvature of the earth when surveying them. The results of this work are helpful in setting points of reference for smaller land surveys, for setting national boundaries, and in making maps. Using geodetic computers, these surveyors calculate latitude, longitude, angles, and other data required

for making maps. They work from field notes made by survey parties.

Working Conditions

The work of surveyors is usually active and sometimes strenuous. They work outdoors in all kinds of weather. Surveyors stand for long periods, walk, and climb hills with a heavy pack of instruments and equipment. They may commute long distances to the job site.

Surveyors also spend considerable time in an office. They plan surveys and prepare reports, charts, and maps. They do most drafting and computational work on a computer. Some survey technicians may spend all their time in the office computing and drafting with the aid of a computer.

Hours and Earnings

The hours of surveyors depend on the kind of work the firm does and in what stages of the work the surveyors are occupied. Although a normal week is eight hours a day, five days a week, surveyors may work longer hours to finish a large project or to meet a deadline. Surveyors may work longer hours in summer when the construction industry is active, and when the weather is more conducive to outdoor work.

According to the Bureau of Labor Statistics, in 2003, surveyors earned an average of \$40,860 a year. Wages ranged from a high of more than \$69,500 a year to a low of less than \$22,820 a year. Earnings vary depending on geographic location, employer, and years of experience.

Most workers with federal, state, and local governments, and with private firms as well, get medical, pension, and insurance benefits.

Education and Training

The best preparation for this career is a bachelor's degree combined with on-the-job training. An increasing number of states require a bachelor's degree in surveying or in a closely related field such as civil engineering or forestry, with courses in surveying. Those planning a career in a special branch of surveying such as geodesy should have a bachelor's degree in engineering or one of the physical sciences. Specific courses for this career may include techniques in measurement, advanced mathematics, computer science, geodesy, law, photogrammetry, remote sensing, land management, and land economics. Cartographers and photogrammetrists usually have a bachelor's degree in engineering or a physical science. To work with Global Positioning Systems and other advanced technologies, these scientists need solid computer skills.

Those interested in becoming technicians may enroll in a one-year, two-year, or three-year program in surveying or surveying technology at a community college or

technical school. On-the-job training will round out this preparation for work as a survey technician.

High school students should take mathematics including algebra, geometry, and trigonometry. They should also take physics, mechanical drawing, and other courses in science and drafting.

Licensing, Certification, and Professional Societies

All fifty states require that surveyors making property and boundary surveys be licensed or registered. Requirements for licensure vary with states, but in general, candidates must be college graduates with two to four years of experience, have at least six years of experience and pass an examination in land surveying, or have ten to twelve years of experience. Those who would like to work for the federal government must pass a civil service examination and meet the requirements on education and training for the position in which they are interested.

The American Society for Photogrammetry and Remote Sensing (ASPRS) has certification programs for photogrammetrists and mapping scientists who meet experience standards and pass an examination. The American Congress on Surveying and Mapping (ACSM) is made up of four other member organizations including The National Society of Professional Surveyors (NSPS). It has a certification program for surveying technicians. Although not required for state licensure, certification is required by many employers as a condition of promotion to jobs with greater responsibilities.

Personal Qualifications

Surveyors should work with precision and accuracy. Surveying is often a team effort that calls for communications skills and leadership qualities. The ability to visualize and understand objects in two or three dimensions as well as the ability to discriminate between them is helpful. Since surveyors spend a great deal of time in the field, they should like working outdoors.

Occupations can be adapted for workers with disabilities. Persons should contact their school or employment counselors, their state office of vocational rehabilitation, or their state department of labor to explore fully their individual needs and requirements as well as the requirements of the occupation.

Where Employed

According to the Bureau of Labor Statistics, about 51,500 surveyors are at work throughout the United States. Engineering and architectural services firms employ most of these workers. Federal, State, and local governmental agencies also employ a small percentage. The principal federal employers are the U.S. Geological Survey, the Bureau of Land Management, the Army Corps of Engineers, the Forest Service, the National

Oceanic and Atmospheric Administration, and the Defense Mapping Agency. Most surveyors in state and local governments work for highway departments, regional planning commissions, and environmental protection agencies. Construction firms, mining and oil and gas extraction companies, and public utilities also employ surveyors.

Employment Outlook

Overall employment of surveyors is expected to grow about as fast as the national average for all jobs through the year 2012. The widespread use of GPS and remote sensing technologies is increasing the exactness and productivity of surveyors. Opportunities will be best for surveyors and mapping scientists with a bachelor's degree and the skills to use these new technologies.

Construction projects through the year 2012 will call for surveyors to lay out streets, shopping malls, housing projects, factories, and other structures. Road and highway construction may require surveyors, but the demand may fluctuate from year to year. Budget cutbacks are expected to tighten up hiring in the federal government and in private firms.

Entry Methods

College placement services keep college graduates informed of job openings. Many professional journals and trade journals list jobs for surveyors. Professional organizations may list job openings on the Internet.

Graduates interested in working in a certain geographic region might check the Yellow Pages of telephone books for the names of companies who might have openings. Major newspapers also advertise for surveyors. Those interested in working with the federal government should write or call the nearest regional branch of the Office of Personnel Management for details.

Advancement

Advancement for surveyors depends on their education and on their initiative in keeping up with technological developments in the field. Survey technicians may advance to become party chiefs and surveyors.

In the federal government advancement is by grade and earnings. Higher GS ratings may require more education as well as more experience.

For Further Research

American Congress on Surveying and Mapping, 6 Montgomery Village Avenue, Suite 403, Gaithersburg, MD 20879. Web site: www.acsm.net

Careers in Cartography, Geodesy, and Surveying. Free.

Careers in Surveying and Mapping: Cooperative Education Benefits for Students and Employers. Free.
Cartography and Geographic Information Systems: A Career Guide. 20 pages. Free.

American Society for Photogrammetry and Remote Sensing, 5410 Grosvenor Lane, Suite 210, Bethesda, MD 20814-2160. Web site: www.asprs.org

National Society of Professional Surveyors, 6 Montgomery Village Avenue, Suite 403, Gaithersburg, MD 20879. Web site: www.nspsmo.org

Acknowledgments

Chronicle Guidance Publications appreciates the cooperation of the individuals who reviewed the information in this brief.

Noteworthy Quote

"I have been surveying for 36 years. I still find it to be an interesting and challenging mix of physical labor and puzzle solving. The intricacies of deed customs, laws, and rules often challenge the best puzzle solvers. Surveying in central New York, with its often steep terrain, provides plenty of aerobic exercise. In addition, the profession requires an artistry in the form of clear and complete mapping to detail either the boundary information of the site or the details for the design. Even after 36 years, I greatly enjoy my profession. It's my job, career, and avocation."

—Jim Stockwin, Stockwin Surveying, Homer, New York.

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