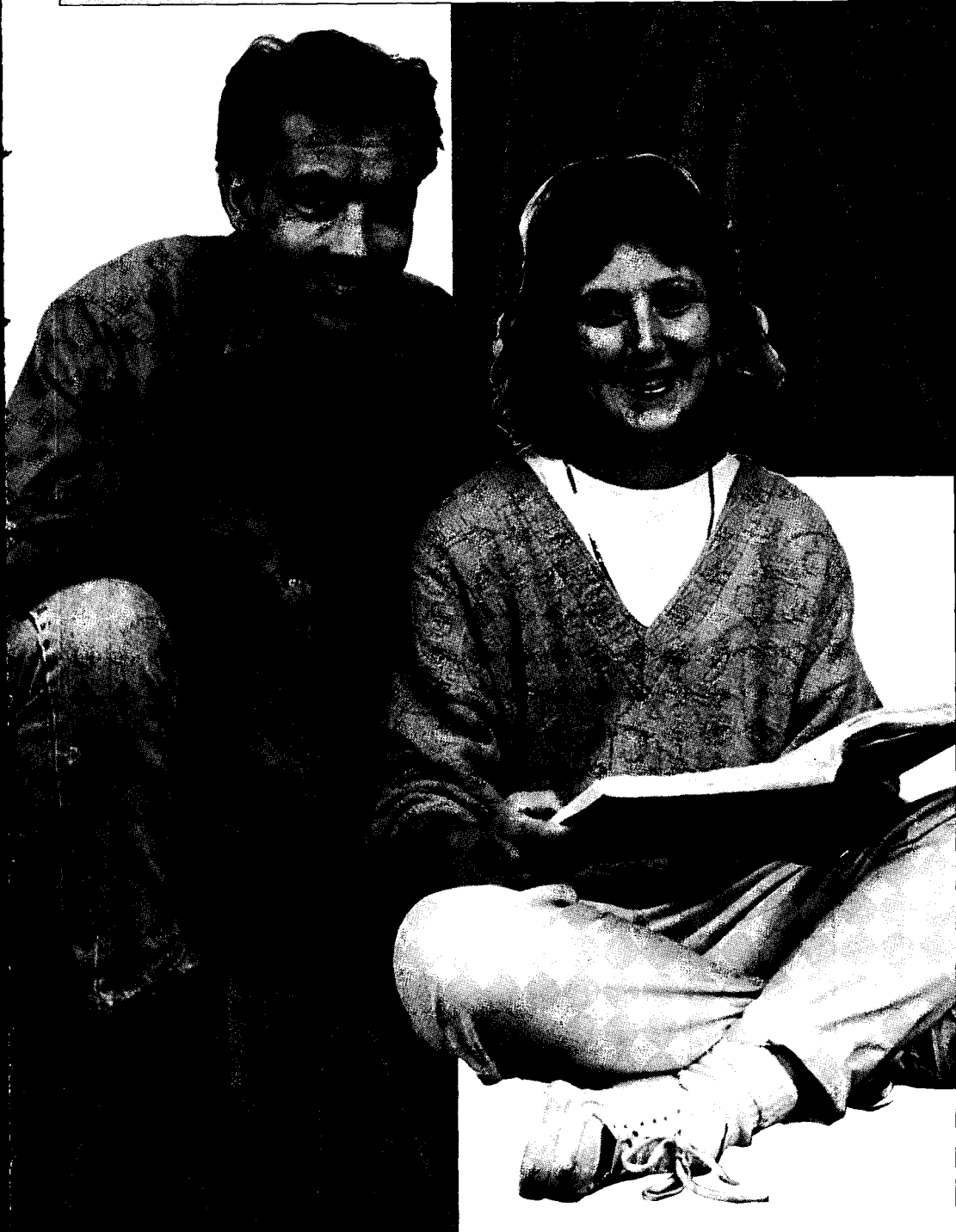
College of Natural Resources

UNIVERSITY OF MINNESOTA

BULLETIN 1992-1994



On the cover:

Mary Jackson, a first-year Forest Resources graduate student, co-chairs the membership committee of the student chapter of the Society of American Foresters.

Jeff Korte, a Natural Resources and Environmental Studies senior, is a student representative to the Natural Resources Alumni Society board of directors and CNR's yearbook photographer.

The College of Natural Resources is dedicated to educating academically capable students interested in managing, protecting, and using our renewable natural resources.

College of Natural Resources

Introduction

Policies

Bulletin Use—The contents of this bulletin and other University bulletins, publications, or announcements are subject to change without notice. University offices can provide current information about possible changes.

Equal Opportunity—The University of Minnesota is committed to the policy that all persons shall have equal access to its programs, facilities, and employment without regard to race, color, creed, religion, national origin, sex, age, marital status, disability, public assistance status, veteran status, or sexual orientation. In adhering to this policy, the University abides by the Minnesota Human Rights Act, Minnesota Statute Ch. 363; by the Federal Civil Rights Act, 420 S.C. 2000e; by the requirements of Title IX of the Education Amendments of 1972; by Sections 503 and 504 of the Rehabilitation Act of 1973; by Executive Order 11246, as amended; by 38 U.S.C. 2012, the Vietnam Era Veterans Readjustment Assistance Act of 1972, as amended; and by other applicable statutes and regulations relating to equality of opportunity.

Inquiries regarding compliance may be directed to Patricia A. Mullen, Director, Office of Equal Opportunity and Affirmative Action, University of Minnesota, 419 Morrill Hall, 100 Church Street S.E., Minneapolis, MN 55455 (612/624-9547).

Access to Student Educational Records—In accordance with regents' policy on access to student records, information about a student generally may not be released to a third party without the student's permission. (Exceptions under the law include state and federal educational and financial aid institutions.) The policy also permits students to review their educational records and to challenge the contents of those records.

Some student information—name, address, telephone number, dates of enrollment and enrollment termination, college and class, major, adviser, academic awards and honors received, and degrees earned—is considered public or directory information. Students may prevent the release of public information only during their terms of enrollment. To do so, they must notify the records office on their campus.

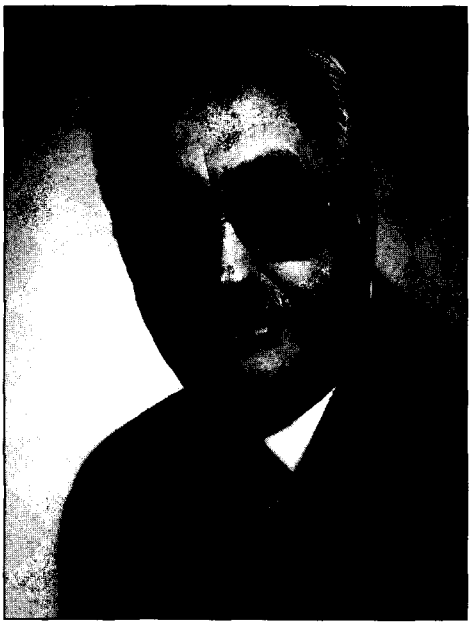
Students have the right to review their educational records. The regents' policy, including a directory of student records, is available for review at the Williamson Hall Information Center, Minneapolis, and at records offices on other campuses of the University. Questions may be directed to the Office of the Registrar, 150 Williamson Hall (612/625-5333).

Immunization—Students born after 1956 who take more than one University class are required under Minnesota law to submit an Immunization Record form.

The form, which is sent along with the official University admission letter, must be filled out and returned to Boynton Health Service within 45 days of the first term of enrollment in order for students to continue registering for classes at the University. Complete instructions accompany the form.

Extracurricular Events—No extracurricular events requiring student participation may be scheduled from the beginning of study day to the end of finals week. Exceptions to this policy may be granted by the Senate Committee on Educational Policy. The Senate advises all faculty that any exemption granted pursuant to this policy shall be honored and that students who are unable to complete course requirements during finals week shall be provided an alternative and timely opportunity to do so.

Letter From the Dean



The educational opportunities you will find described in this bulletin were developed for students who have a strong interest in the study and understanding of renewable natural resources and the associated environment. The uses, management, and protection of forest, fish, and wildlife resources are the focus of curricula in Forest Products, Forest Resources, Recreation Resource Management, Urban Forestry, and Fisheries and Wildlife. The newer program in Natural Resources and Environmental Studies is for the student with a general interest in how these various resources relate to serving human needs and our ability to deal with our environment. These curricula help students integrate scientific knowledge with the management and communication skills necessary for professional success.

Forests, recreation resources, fisheries, and wildlife play important roles in the lives of people worldwide. As a source of firewood or food, physical challenge or psychological reward, these resources touch on the economic, environmental, social, and cultural well-being of each of us. If you would like to help make the most of these renewable resources and to prepare yourself to address the associated environmental issues, I am sure you will find this bulletin presents interesting opportunities.

The College of Natural Resources is recognized nationally for its excellence. It has been accredited continuously since 1935, when forestry program accreditation was first offered. Graduates have played leadership roles in industry, public agencies, research, and education. Our strength is in the quality of our faculty, students, and staff and in the richness of the University as an educational, scientific, and cultural resource.

Richard A. Skok
Dean, College of Natural Resources

Career Opportunities

Some College of Natural Resources programs offer excellent employment opportunities. Forest Products majors, particularly those pursuing a degree in Paper Science and Engineering, find the job market very strong. Starting salaries for these graduates range upward from $35,000 per year.

Forest Resources graduates have recently found an improved job market, partially due to fewer graduates nationwide. Starting salaries for these graduates typically range from $18,000 to $23,000 per year. Natural Resources and Environmental Studies is a new curriculum offering. Graduates are expected to experience relatively good job opportunities. Potential employers include federal, state, and local government agencies, environmental consulting firms, industry, and non-profit organizations.

Fisheries and Wildlife graduates face a more competitive job market. Graduates from this curriculum should (1) be flexible in choosing where to work, (2) maintain above average academic records, (3) gain related work experience before graduation, and (4) earn a master's degree. Starting salaries for Fisheries and Wildlife graduates typically range from $17,000 to $25,000 per year.

The College of Natural Resources offers assistance and advice to students seeking summer jobs and internships in fisheries and wildlife, forestry, forest products industries, and the environment as well as permanent employment after graduation. Job search assistance for all students except Forest Products majors is provided by the career opportunities coordinator in 135 Natural Resources Administration Building. Students in the Forest Products paper science and engineering specialization receive assistance in 206 Kaufert Lab; all other Forest Products students, in 240 Kaufert Lab. Faculty advise students on job searches, publicize openings, help arrange interviews, and periodically hold information meetings.

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General Information

Mission

The College of Natural Resources—through its departments of Forest Resources, Forest Products, and Fisheries and Wildlife—seeks to increase the economic, social, and environmental benefits of our most important renewable natural resources. The only institution of higher learning in the state offering B.S., M.S., and Ph.D. programs in these natural resource disciplines, it is engaged in undergraduate and graduate education, basic and applied research, extension, continuing education, and public service. Programs of the College reflect and contribute to state, national and international professional and scientific endeavors in carrying out this mission.

Facilities

The College of Natural Resources is based in four buildings on the St. Paul campus: the Natural Resources Administration Building (NRAB), Green Hall, the Kaufert Laboratory of Forest Products and Wood Science, and Hodson Hall.

The Dean's Office, Office for Student Affairs, Graduate Studies in Forestry Office, Cold Weather Climate Housing Information Center, Forestry Library, and the College of Natural Resources computer laboratory are located in the Natural Resources Administration Building. The Forest Resources Department, Remote Sensing Laboratory, and some Department of Fisheries and Wildlife faculty and graduate student offices are located in Green Hall.

The Forest Products Department is in the Kaufert Laboratory, which has well equipped laboratories for teaching and research in wood products manufacturing, wood chemistry, mechanical testing, biodeterioration, and wood drying. The Department of Fisheries and Wildlife office, library, lecture, laboratory, and faculty facilities are in Hodson Hall. Also on the St. Paul campus, adjacent to college facilities, is the regional headquarters of the North Central Forest Experiment Station of the U.S. Forest Service.

The College of Natural Resources uses several field centers for its programs: The University's *Lake Itasca Forestry and Biological Station* is located in Itasca State Park in north central Minnesota. Minnesota's largest state park embraces 50 square miles of virgin and second-growth forest, bogs, streams, and lakes, including Lake Itasca, the source of the Mississippi River. The station offers housing, dining, library, and laboratory facilities. Fisheries and Wildlife, Forest Resources, and Urban Forestry majors spend a 3½-week summer term at the station studying botany, ecology, fisheries and wildlife techniques, and forest measurement.

The college's *Cloquet Forestry Center* includes more than 3,700 acres of virgin and second-growth timber in a major forest products manufacturing area of northeastern Minnesota. Forest Resources seniors spend their fall quarter at the center taking 18 credits of field-oriented instruction. Students interact with representatives of local industries and nearby state and federal resource agencies. The center has housing, dining, classroom, laboratory, and library facilities.

The 300-acre *John H. Allison Forest,* about 10 miles from the St. Paul campus, is available for field laboratory work throughout the year.

Other field experiences—such as the industrial forest lands of the southern United States, and the Lake States' forest products mills and factories—are also available to students.

Degrees Offered

Baccalaureate Degrees—The bachelor of science (B.S.) degree is awarded to College of Natural Resources students who satisfactorily complete 192 required and elective credits in one of five major programs: Fisheries and Wildlife, Forest Products, Forest Resources, Recreation Resource Management, or Urban Forestry. The B.S. degree is awarded to College of Natural Resources students who satisfactorily complete 180 required and elective credits in the Natural Resources and Environmental Studies program. Curricular requirements are fully explained in the Baccalaureate Programs section of this bulletin. The degree may be earned "with distinction" or "with high distinction."

Graduate Degrees—The master of science (M.S.) and the doctor of philosophy (Ph.D.) in Forestry, Fisheries, or Wildlife Conservation, and the master of forestry (M.F.) degrees are offered through the Graduate School in cooperation with the College of Natural Resources. For detailed information, contact the appropriate Director of Graduate Studies (235 NRAB, 612/624-2774, for Forestry; 200 Hodson Hall, 612/624-3600, for Fisheries and Wildlife) or the *Graduate School Bulletin.* Interested students should apply for admission through the Graduate School, 306 Johnston Hall, 101 Pleasant Street S.E., Minneapolis, MN 55455 (612/625-3014).

Administration

Undergraduate curricula of the College of Natural Resources are organized within three departments: Fisheries and Wildlife (200 Hodson Hall); Forest Products (203 Kaufert Laboratory); and Forest Resources (115C Green Hall), which includes the Recreation Resource Management and Urban Forestry programs. The College also offers the Natural Resources and Environmental Studies curriculum. The chief administrator of each department is the department head.

Each department has a Student Scholastic Standing Committee, composed of faculty members, that is responsible for interpreting and administering college policies and requirements regarding admission, transfer of credit, curricula, academic standards, student credit loads, and other academic matters.

The College's Office for Student Affairs, 135 NRAB, provides admission, registration, advising, placement, and other assistance to all undergraduates.

Admission

Undergraduates seeking admission to the College of Natural Resources should apply through the Office of Admissions, 240 Williamson Hall, 231 Pillsbury Drive S.E., Minneapolis, MN 55455 (612/625-2008 or 1-800-752-1000). A $25 nonrefundable application fee is required.

Admission with Advanced Standing— Appropriate credits earned at other accredited colleges and universities or within other units of the University may be applied toward College of Natural Resources programs. Most students find they must transfer before their junior year to meet residence and upper-level course requirements of the College of Natural Resources.

Credits earned through special examination or Continuing Education and Extension may transfer to the College of Natural Resources.

Adult Special Admission—Students may be admitted, after college approval, as adult specials. Such students are not degree candidates, but complete courses to satisfy individual needs.

Freshman Admission

High school graduates from Minnesota, North Dakota, South Dakota, and Wisconsin must submit scores from the American College Test (ACT) along with their high school rank percentile (HSR). Students from other states must submit either scores from the Scholastic Aptitude Test (SAT) or ACT scores, along with their HSR.

The College of Natural Resources uses the following admission criteria:

Formula	*Minimum Score*
HSR Percentile + (SAT Verbal divided by 10) + SAT Math divided by 10)	150
HSR Percentile + (2 x ACT Composite Score)	110

Students seeking admission for fall quarter 1992 or later, or as transfer students (39 or more quarter credits) fall quarter 1993 or later, will be expected to have completed at least the following courses while in high school (grades 9-12):

1) FOUR YEARS OF ENGLISH with emphasis on writing, including instruction in reading and speaking skills and in literary understanding and appreciation;

2) TWO YEARS OF SOCIAL STUDIES, including U.S. history;

3) THREE YEARS OF MATHEMATICS, including one year each of elementary algebra, geometry, and intermediate algebra;

4) THREE YEARS OF SCIENCE, including one year each of biological and physical science;

5) TWO YEARS OF A SINGLE SECOND LANGUAGE.

Applicants who attain at least the minimum score and meet course requirements will be admitted routinely. Others will be considered on an individual basis, taking into account factors such as high school performance and educational objectives.

English Proficiency—If English is not your native language, you may be required to take the Test of English as a Foreign Language (TOEFL) or the Michigan English Language Assessment Battery (MELAB). To register for the TOEFL, contact the agency that handles TOEFL registration in your country or write to the Educational Testing Service (Box 899, Princeton, NJ 08540 USA) at least 10 weeks before any scheduled test date. If you are already in the Twin Cities area, you may register for the MELAB with the Minnesota English Center, 320 16th Ave. S.E., University of Minnesota, Minneapolis, MN 55455, or call (612) 624-1503. To register for the MELAB outside the Twin Cities area, contact the English Language Institute, Testing and Certification Division, University of Michigan, Ann Arbor, MI 48109 USA, or call (313) 764-2416.

Financial Aid

Scholarships, grants, loans, and work-study programs available University-wide to eligible students are administered through the Office of Student Financial Aid (210 Fraser Hall, 106 Pleasant Street S.E., Minneapolis, MN 55455, or 197 Coffey Hall, 1420 Eckles Avenue, St. Paul, MN 55108, 612/624-1665). Application forms are available from either of these student financial aid offices and from most Minnesota high school guidance offices. Students should apply as soon after January 1 as possible. The ACT Family Financial Statement is the official need analysis document used in selecting financial aid recipients.

Scholarships and awards available only to College of Natural Resources students are listed below. These awards are administered by the college's scholarship committees. *Awards may vary each year depending on earnings and availability of funds.* Those available to incoming freshmen and/or transfer students are normally awarded the spring before the academic year of their use. Contact the College's Office for Student Affairs for application information.

College of Natural Resources Scholarships and Awards

Mary Dwight Akers Loan—Sponsor anonymous. Limited loans as needed. Approved by the dean. Up to $1,000 each.

John H. Allison Scholarship—Sponsored by former members of the Beta Chapter, Tau Phi Delta. For students with special interests in forest economics, forest management, and related areas. One $500 award annually.

Andersen Corporation Scholarships—Sponsored by Andersen Corporation, Bayport, Minnesota. For Forest Products juniors and seniors in the marketing and production management specializations on the basis of academic achievement and professional promise. Three $1,500 awards annually.

Robert C. Bernard Memorial Scholarship—Sponsored by Mrs. Lori Bernard and family and Georgia Pacific Corporation. Established to financially assist a deserving College of Natural Resources student. One $1,000 award annually.

Boise Cascade Corporation Scholarship—Sponsored by Boise Cascade Corporation. For upper division Forest Resources students on the basis of professional promise, good character, and academic aptitude. Two $750 awards annually.

R.M. Brown Scholarship—Sponsored by donations to the College of Natural Resources. For a Forest Resources or Natural Resources and Environmental Studies senior with a special interest in mensuration or statistics. One $500 award annually.

Carolind Scholarships—Sponsored by the late Dr. Ralph M. Lindgren. For deserving and outstanding undergraduates. Number per year varies. $300 to $400 each.

E.G. Cheyney Memorial Scholarships—Sponsored by the Minnesota Forestry Alumni Association. For juniors or seniors who have demonstrated outstanding ability and improvement in creative writing and speaking skills. One $300 award annually.

Caleb Dorr Scholarships—Sponsored by the Caleb D. Dorr Fund. For the student in each class with the highest grade point average. Four $500 awards annually.

Edward A. Everett Memorial Scholarship—Sponsored by the late Edward A. Everett. For upper division forestry students on the basis of financial need, acceptable scholarship, and professional promise. Number per year varies. $500 each.

Federated Garden Clubs of Minnesota Scholarships—Sponsored by the Federated Garden Clubs of Minnesota. For forestry students on the basis of special interest in Urban Forestry, academic aptitude, and personal attributes. Number per year varies. $200 each.

Forest Products Marketing Scholarships—Sponsored by the Forest Industry Fraternity of Minneapolis and St. Paul. For deserving and promising Forest Products juniors or seniors in the marketing specialization. One or two $1,000 awards annually.

Thomas W. French Memorial Scholarship—Sponsored by Dr. David and Audrey French. For a junior or senior. Recipient must have strong interest in urban forestry and a high degree of professional promise. One $500 award annually. (Amount may vary each year.)

Robert L. Goudy Memorial Scholarships—Sponsored by Mr. and Mrs. F.X. Corbett, Georgetown, Colorado. For outstanding incoming Forest Resources transfer students on the basis of academic ability, vocational promise, extracurricular activities, personality, and financial need. Two $300 awards annually.

Samuel B. Green Scholarship Medal—Sponsored by the late Mrs. Samuel B. Green in memory of her husband. For the senior with the highest grade point average at the end of fall quarter. One honorary medal annually.

Dayton Kirkham Scholarship—Sponsored by the late Mr. Dayton Kirkham. For entering high school seniors and transfer students on the basis of outstanding academic ability and strong desire to pursue careers in natural resource management. Two $750 awards ($4,500 total for four years) are available to entering freshmen and three $1,250 awards ($2,750 total for two years) are available for transfer students.

Timothy B. Knopp Memorial Scholarship—Sponsored by the Timothy Knopp family and friends for a junior or senior on the basis of demonstrated environmental awareness and interest in the ethics of conservation and a high degree of professional promise and scholarship. One $500 award annually.

Oscar L. Mather Scholarship—Sponsored by the Minnesota Federation of Women's Clubs and Mrs. Oscar L. Mather, Madison Lakes, Minnesota, in memory of her husband. Book awarded to a forestry student displaying outstanding scholarship, leadership, and character.

Ken Merriam Scholarship—Sponsored by Dr. Lawrence Merriam. For a physically handicapped and/or Recreation Resource Management junior or senior. Professional promise emphasized. One $500 award annually.

William R. Miles Scholarship—Sponsored by the William R. Miles Fund. For a Forest Resources junior on the basis of professional promise, character and integrity, academic aptitude, and leadership. One $500 award annually.

C.J. Mulrooney Endowed Memorial Scholarships—Sponsored by WCCO AM and FM Radio and Television. For Forest Products juniors and seniors with a specialization in marketing or production management. One award of $2,500 annually.

Leiton Nelson Scholarship—Sponsored by L.E. Nelson Endowment. For a Forest Resources or Forest Products senior demonstrating outstanding academic ability and strong professional promise. One $1,200 award available alternate years. (Available to qualified graduate student for interim year.)

Charles Lathrop Pack Awards in Forestry—Sponsored by the Charles Lathrop Pack Foundation. For regularly enrolled undergraduates who write the best essays on current forestry or conservation subjects. Three awards annually of $300, $200, and $100.

Paper Science and Engineering Scholarships—Sponsored by manufacturing and supply companies representing the pulp, paper, and allied support industries, and by Paper Science and Engineering alumni. Administered by the University of Minnesota Paper Science and Engineering Council and the Department of Forest Products. For Paper Science and Engineering students on the basis of academic performance and professional promise. $600 for freshmen, $1,200 for sophomores, $1,800 for juniors, and $2,400 for seniors—total of $6,000. Current sponsors include Appleton Papers; Betz Laboratories, Inc.; Blandin Paper Company; Boise Cascade Corporation; Buckman Laboratories, Inc.; Consolidated Papers Foundation, Inc.; Diversey Wyandotte; H.B. Fuller Company Foundation; Henkel Chemical Company; Jefferson Smurfit; Lake Superior Paper Industries; Minnesota Forestry Association; Minnesota Section, Technical Association of the Pulp and Paper Industry (TAPPI); Nekoosa Packaging; North Central Division, Paper Industry Management Association (PIMA); Potlatch Foundation for Higher Education; Nalco Chemical Company; Waldorf Corporation; and alumni and personal contributors.

Robert D. Peterson Writing Skill Award—Sponsored by the Robert D. Peterson Award Fund. Open to all sophomores, juniors, and seniors. Recognizes outstanding effort and ability related to communication skills. One $1,000 award annually.

Pheasants Forever, McLeod County Chapter Scholarship—Sponsored by the McLeod County, Minnesota, Chapter of Pheasants Forever. For seniors in Fisheries and Wildlife on the basis of academic achievement and professional promise. One $1,000 award annually.

A.G. Roan Scholarship—Sponsored by Mrs. A.G. Roan and family. Available to a junior or senior demonstrating a strong conservation ethic. One $500-$1,000 award annually.

Henry Schmitz Forest Products Engineering Scholarship—Sponsored by Dr. Stanley J. and Mertie W. Buckman, Memphis, Tennessee. For a Forest Products junior or senior on the basis of academic achievement and professional promise. One $1,000 award annually.

Henry Schmitz Student Leadership Awards—Sponsored by Dr. Stanley J. and Mertie W. Buckman, Memphis, Tennessee. For juniors or seniors on the basis of demonstrated leadership and acceptable scholarship. Up to four $300 awards annually.

Augustus L. Searle Scholarship—Sponsored by Augustus L. Searle. For women in the college with preference given to Minnesota residents. Number per year varies. $500 each.

J. Donald Smith Award—Sponsored by J. Donald Smith Memorial Fund. Book awarded to a senior in Fisheries and Wildlife on the basis of academic achievement and professional promise.

K.E. Winsness Scholarship—Sponsored by family and friends of the late Professor Winsness. For a junior or senior in the College of Natural Resources who is pursuing a degree while coping with unusual hardships. One $500 award annually.

Helen A. Young Memorial Scholarship—Sponsored by John Young, Rochester, Minnesota. To help qualified, competent, and needy students start and complete their forestry education. One $200 award annually.

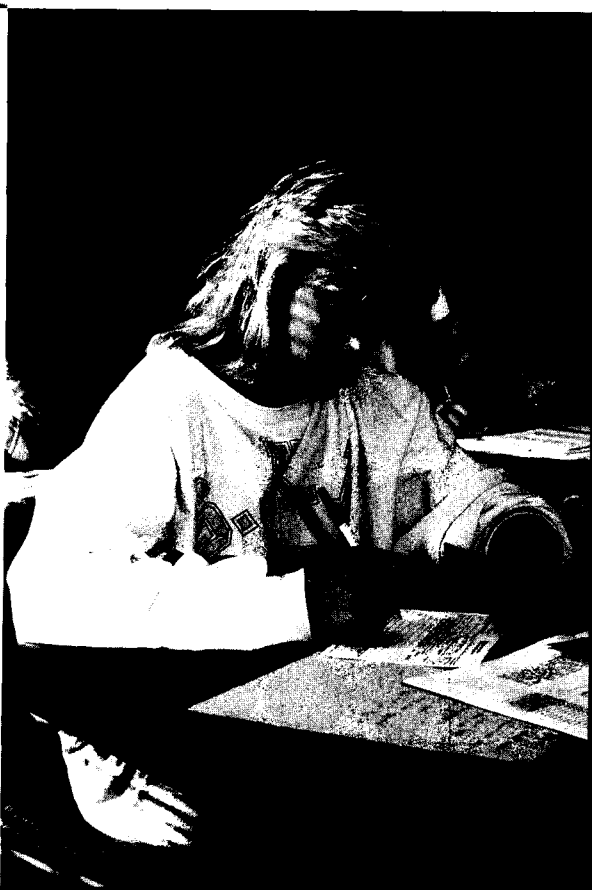
Student Activities

Governance—Students may participate in governance activities at the department, college, and campus levels. Within each department, several committees (including curriculum committees) have student representatives. Students also serve on College of Natural Resources committees and on the College's Student-Faculty Board, which advises the dean on student problems and concerns. Students also participate in the St. Paul Campus Board of Colleges, which directs student activities and acts as a liaison between the student body and administration, and on the Student Center Board of Governors, which establishes programs, operation policies, and budgets for the St. Paul Student Center.

Clubs—Student clubs in the College include the Environmental Studies Club, Forestry Club, student chapter of the Society of American Foresters, Recreation Resource Management Club, Forest Products Research Society, Technical Association of the Pulp and Paper Industry (TAPPI), Paper Industry Management Association (PIMA), and Fisheries and Wildlife Club (with an affiliated student chapter of the Wildlife Society). Through these clubs, students hold an annual Forester's Day, support a scholarship fund by selling Christmas trees, attend events such as the Midwest Fish and Wildlife Conclave and the Midwestern Foresters Conclave, and produce and market wood identification kits. Xi Sigma Pi Honor Society holds an annual banquet and administers a student speakers bureau. College of Natural Resources students also produce the last remaining University yearbook, the *Gopher Peavey*.

College of Natural Resources

Baccalaureate Programs



Six Major Curricula

The College of Natural Resources offers six major curricula leading to the bachelor of science (B.S.) degree: (1) Fisheries and Wildlife; (2) Forest Products (with specializations in marketing, production management, paper science and engineering, and wood science); (3) Forest Resources; (4) Natural Resources and Environmental Studies; (5) Recreation Resource Management; and (6) Urban Forestry. Because the first year of coursework is somewhat similar, students may transfer between curricula at the end of their freshman year with little loss of credit.

Academic Policies

Adviser—Each student, with adviser assistance, is responsible for learning curricular and graduation requirements and developing a course program and timetable to meet them. Freshmen and first-year transfer students in the Forest Resources, Fisheries and Wildlife, Natural Resources and Environmental Studies, Recreation Resource Management, and Urban Forestry curricula are assigned an adviser in the college's Office for Student Affairs. Forest Products students are assigned a faculty adviser within that department.

Credit Load—The typical course load for each quarter is 14 to 18 credits, but may vary according to individual ability and circumstances. A credit requires an average of three hours of work per week, including class, laboratory, and preparation time. To carry more than 21 credits, a student must have at least a B average the previous quarter and permission from the department Student Scholastic Standing Committee.

Repeating Courses—Students may repeat a course even if a passing grade was received. The grade received for the course the second time becomes the permanent grade. The original grade and credits are not included in the student's cumulative number of completed credits or grade point average (GPA). It is the student's responsibility to report any repeated courses to the Office for Student Affairs.

Auditing—Students who audit a course pay regular tuition and fees, but do not take examinations or earn grades or credits.

Extra Credit—Students may register for one to three extra credits in some courses with the instructor's approval. The extra work is mutually agreed upon and conducted independently of class. Contact the Office for Student Affairs for more information.

Independent Study—With the instructor's approval, students may take regularly offered courses through independent study without attending class. Contact the Office for Student Affairs for more information.

Class Attendance—When students willfully miss class, instructors are under no obligation to help them make up work. However, the following reasons justify absences and make-up requests: (a) illness certified by the University Health Service or another physician; (b) death or serious illness in the immediate family; (c) participation, certified by the Office of Student Affairs (190 Coffey Hall), in University-approved cocurricular activities; and (d) approval of the absence by the department Student Scholastic Standing Committee, which becomes involved only in emergencies or as an appeal agency.

Class Standing—Students are classified according to the number of credits they have completed: freshmen—45 credits or fewer, sophomores—46 to 90 credits, juniors—91 to 135 credits, seniors—136 credits or more. Freshmen and sophomores are considered lower division; juniors and seniors, upper division.

Registration—The quarterly *Class Schedule* contains general registration information.

Forest Resources and Forest Products juniors and seniors and Fisheries and Wildlife majors may sign their own course request forms. All other students in the college, regardless of class standing, must have their advisers sign their registration materials.

Students who find it necessary to cancel or add courses after registering for the quarter should contact the Office for Student Affairs for instructions and forms.

During the first week of the quarter, a course may be added to a student's schedule without any approval required (if the course is open). During the second through the sixth week, the instructor's permission is required and after the sixth week the approval of both the adviser and the department Student Scholastic Standing Committee is required.

During the first six weeks of a quarter, no approval is required to cancel a course with a W (withdrawal). During the third through the sixth week, the instructor's permission is required. After the sixth week the approval of the adviser, instructor, and the department Student Scholastic Standing Committee is required. A student doing passing work may be permitted to cancel a course after the sixth week with a W; if the student is doing failing work, an F (no credit) will be reported.

If a student withdraws from the college at any time, all classes should be officially cancelled. Cancellation through the first three weeks entitles the student to a refund (a 100% refund through the first week, 75% through the second week, and 50% through the third week).

Grading—Two grading options, A-B-C-D-F and S-N, are offered, although use of the S-N option is limited. A grading option is chosen for each course at the time of registration. The following restrictions on the use of the S-N option apply to College of Natural Resources students:

1. A maximum of 25% of the residence credits presented for the baccalaureate degree may be in courses in which a grade of S was received.

2. All required courses must be taken under the A-F option. Prerequisites for required courses and courses in the major must also be taken A-F unless an exception is made.

University grading policies and letter definitions are explained in the quarterly *Class Schedule*.

Honor System—Under an honor system adopted on the St. Paul campus, students accept responsibility for the supervision of student behavior during examinations and pledge not to give or receive aid. A student or faculty member who observes an act of dishonesty may report the incident to the college Honor Case Commission, a committee of the Student-Faculty Board. For more information about how the honor system works, contact the Office for Student Affairs.

Satisfactory Progress—Students in the College of Natural Resources are expected to meet certain minimum academic standards. Students not meeting these standards are subject to probation and suspension actions by their department Student Scholastic Standing Committee. The following chart details conditions under which these actions will be taken:

Probation	Cumulative GPA after first two quarters in college below 1.90 (freshman) or 2.00 (sophomore, junior, senior) *or* Any combination of three D and N or F grades in any one quarter
Suspension	Cumulative GPA after first two quarters in college below 1.60 (freshman) or 1.90 (sophomore, junior, senior) *or* Any combination of four D and N or F grades in three consecutive quarters *or* Two consecutive quarters of probation

The Student Scholastic Standing Committee puts a student on probation and informs him or her that repeated low academic performance will lead to a suspension. A suspension action lasts two academic quarters, and reinstatement in the program requires a petition to the department Student Scholastic Standing Committee. Students placed on probation or suspension may appeal the action.

The Itasca session for Fisheries and Wildlife and Forest Resources students is not counted as a separate quarter. Itasca grades are included with the fall quarter grades.

Students who are performing poorly academically should contact their adviser as soon as possible to correct the problem. Probation and suspension actions are rarely waived.

To appeal a suspension action, the student must obtain a "Petition for Reinstatement" from the Office for Student Affairs. The petition must be completed and turned in to the chair of the department Student Scholastic Standing Committee, along with any supporting documents. The final decision rests with the department Student Scholastic Standing Committee which will act on the petition and inform the student in writing.

Policy Waivers—Occasionally it may be to the educational advantage of both the student and the department to waive an academic policy or curricular requirement, provided the basic spirit of the regulation is maintained. A student may petition for a departure from normal procedure. If approved by the adviser, the petition is routed to the department Student Scholastic Standing Committee for a final decision. Contact the Office for Student Affairs for more information.

Graduation Requirements

To receive the bachelor of science (B.S.) degree, College of Natural Resources students must meet the following requirements:

1. Complete a minimum of 192 credits (180 for Natural Resources and Environmental Studies), including required and elective courses in the chosen curriculum. No more than 9 credits in physical education may be applied toward the degree. No more than 9 credits in music may be applied as elective credits toward the degree.

2. Achieve a GPA of 2.00 or higher with no more than 5 credits of D in required Forest Resources, Forest Products, Natural Resources and Environmental Studies or Fisheries and Wildlife designator courses and 5 credits of D in other required courses.

3. Satisfy liberal education requirements (see below).

4. Satisfy residence and other general University requirements for graduation.

Graduation with Honors—The B.S. degree may be earned "with distinction" or "with high distinction." Students who achieve a GPA of at least 3.85 may be recommended to the faculty for graduation with high distinction. The recommendation is made on the basis of scholarship and other evidence of satisfactory achievement in the curriculum. Students who achieve a GPA between 3.35 and 3.85 may be recommended for graduation with distinction.

Transfer students who have completed less than half the credits required for graduation while in residence in the College of Natural Resources are not eligible to graduate with honors.

Quality Credits—The number of free elective credits required for graduation may be decreased by one for every five grade points in excess of those required to reach a GPA of 3.35. Free electives may be chosen without regard to curricular or college requirements. No more than one-twelfth of the total number of credits required for graduation may be gained through quality credits.

Special Examinations for Credit—Currently enrolled students who believe their knowledge of a subject is equal to that required to complete a particular course may request to take an examination for credit. If the Student Scholastic Standing Committee and the department approve, arrangements can be made with an appropriate instructor to take an examination. Usually no grade is assigned. A $30 fee is assessed for each examination. Credit by special examination is not granted for language or mathematics courses taken in high school.

College Level Examination Program (CLEP)—Students may earn credit for the CLEP social science and humanities examinations prepared by the College Entrance Examination Board. CLEP also offers a number of subject examinations for credit. Information may be obtained from the Office for Student Affairs.

Liberal Education Requirements—The University of Minnesota believes that all students, regardless of their area of specialization or vocational goals, should have a broad liberal education. Therefore, in addition to its own curricular requirements, the College of Natural Resources requires coursework in each of four liberal education categories. The minimum number of credits required in each category and a partial list of courses follow. Note that individual College of Natural Resources curricula may require more credits in any of the four categories and place restrictions on which courses to complete and when. Students in doubt about the use of specific courses should consult the Office for Student Affairs.

All College of Natural Resources students must take Rhet 1101, 1104, 1151, 1222, 3562 (except that Recreation Resource Management majors may substitute 3551 for 3562). Students who pass an English proficiency examination, administered by the Rhetoric Department, may be exempted from Rhet 1101. Students with above average writing skills may also take exemption examinations, administered once each quarter by the Rhetoric Department, for Rhet 3562. Note that advanced composition courses taken at other institutions can be used to satisfy the Rhet 3562 requirement.

The College of Natural Resources accepts CLEP scores at the 75th percentile or higher for exemption from up to 8 credits in Category D and, in special cases by petition, in Category C.

Computer Competency—Computer skills are necessary for today's student. As a student in the College of Natural Resources, you will use computer applications in your coursework regardless of the major you choose. You will be expected to have basic computer competency in word processing, spreadsheets, database management, and telecommunications. Your level of computer competency will be assessed in the advising process. If you lack needed skills, you will be given advice on which courses you will be required to take in order to learn those skills.

A. Communication, Language, Symbolic Systems—26 credits minimum

This category is automatically fulfilled by core curriculum required courses in all CNR majors.

1. *English and Foreign Language Communication Skills*
   Comp 1011, 1012, 1013, 1027
   Rhet 1101, 1104, 1151, 1222, 3254, 3266, 3562
   Spch 1101, 1102, 3605
2. *Logic, and Philosophic Analysis*
   Clas 1048
   Phil 1001, 1005, 5105, 5201
3. *Mathematics*
   Math—all courses except 1005-1006, 5703
   Stat 3011, 3091, 5021

B. Physical, Biological, and Analytical Sciences—25 credits minimum

This category is automatically fulfilled by core curriculum required courses in all CNR majors.

1. *The Physical Universe*
   Ast 1011, 1021
   BioC 3001-3031
   Chem 1001-1002, 1003, 1051-1052
   Geo 1001, 1002, 1111
   Phys 1041, 1042, 1045, 1046, 1251, 1252, 1253
   Soil 1020, 3125
2. *The Biological Universe*
   Biol 1008, 1009, 1103, 1106
   PBio 1009, 1012
   Ent 1005
   GCB 3022
   Phsl 1002

C. The Individual and Society—8-22 credits minimum, depending on curriculum (with no more than 6 credits in any one discipline)

The following courses are suggested; students are not limited to this list. Consult the quarterly *Class Schedule* or your adviser for additional courses in Category C.

1. *Analysis of Human Behavior and Institutions*
   Afro 1025, 3055, 3061-3062, 3072, 3091
   AgEc 1101, 1102
   Anth 1102
   Econ 1001-1002, 1004-1005, 3001-3002
   FR 1201 (except Fisheries and Wildlife)
   FSoS 1001, 1025
   Geog 1301, 1401
   Pol 1001, 1025, 1026, 1027
   Psy 1001, 1004-1005
   Rhet 5165
   Soc 1001, 1002, 3101
   Spch 3401

2. *Development of Civilization: Historical and Philosophical Studies*
   Afro 1015, 1025, 1441
   Clas 1001, 1002, 1003, 1004, 1005, 1006, 1042, 3071, 3072, 3073
   Fren 3501, 3502
   Hist—all courses through 1954
   Ital 3501, 3502
   Jour 5601
   Phil 1002, 3001, 3002, 3003, 3004
   Pol 1041
   Rhet 1310, 1311, 3375
   Span 3501, 3502

D. Literature, Humanities, and Fine Arts—8 credits minimum

1. *Literature*
   Engl—all literature courses
   Foreign languages—all literature courses
   Rhet—all literature and humanities courses
2. *The Arts*
   Afro 1301, 3105, 3301
   Arch 1021, 1022, 1023
   ArtH—all courses except 5521, 5950, 5960, 5970, 5990, 5991
   ArtS—all courses except 3530, 3970, 3980, 5530, 5970
   Dsgn 1501, 1521
   Mus—all courses except 1052, 1053, 1340, 1351, 1602, 3970, 3980, 5253, 5330, 5340, 5364, 5365, 5540, 5667, 5950
   Th—all courses except 3412, 3980, 5321, 5540, 5950, 5970

Itasca Session—Forest Resources, Urban Forestry, and Fisheries and Wildlife majors are required to complete a 3½-week Lake Itasca Forestry and Biological Station summer term between their freshman and sophomore or sophomore and junior years. To attend, students must have completed 40 credits and attained a minimum cumulative GPA of 2.00. Forest Resources and Urban Forestry students must also have completed the following courses with a grade of C or better: Biol 1103, Chem 1001 or 1051, and Math 1008 (students with a C or better in high school trigonometry are exempt from Math 1008). Fisheries and Wildlife students must have completed the following courses with a grade of C or better: Biol 1009, 1103, 1106, and FW 3052. The session is also open to students who are not enrolled in the College of Natural Resources.

All transfer students must provide the Office for Student Affairs with transcripts of all coursework and an application by July 15 before the start of the Itasca session they wish to attend.

Cloquet Session—Students in Forest Resources are required to complete the Cloquet Forestry Session in the fall of their senior year. To attend, students must have attained a minimum cumulative GPA of 2.00 at the end of the preceding quarter and completed the Itasca Session and FR 1100, 3103, 3300, 5100, 5114, 5200, 5212, 5215, 5232, Soils 1020, and FW 3052.

Minnesota-Idaho Student Exchange—Forest Resources students at the University of Minnesota who are pursuing a management or biological sciences emphasis may study timber harvesting in Idaho during their senior year under an exchange agreement with the University of Idaho. Minnesota students return from this study in Idaho to be awarded their baccalaureate degree from the department of Forest Resources. In turn, Idaho students take coursework in paper science and engineering at the University of Minnesota.

Forest Products Cooperative Education Program—Students in this program alternate periods of employment in their career fields with periods of academic study. The program leads to a B.S. in Forest Products, with a specialization in paper science and engineering, production management, marketing, or wood science. Full-time students who have declared a major in Forest Products and who have a 2.70 GPA may apply.

Students must complete at least two quarters of academic study before their first quarter of work. At the end of each work quarter, students must submit a written report on their work assignments and learning experiences to a faculty member. Successful reports are graded "S" (satisfactory) and 1 credit is awarded for completing a work quarter. Continuation of the program is based on indication of normal progress

toward the degree, a 2.50 cumulative GPA, and satisfactory work progress. For more information, contact Dr. James Bowyer, Forest Products Department Head, 209 Kaufert Laboratory (612/624-4292).

Fisheries and Wildlife Field Trip— Fisheries and Wildlife majors are eligible to participate in a field trip during spring break of their senior year. Selection for participation is competitive, based on previous academic performance. Students travel with a faculty member or graduate student(s) to different regions of the United States to observe and discuss ongoing wildlife management activities. Local agency personnel provide on-site information. Selected students will register for one credit of FW 5398—Special Problems in Wildlife, either during winter or spring quarters.

Fisheries and Wildlife

This curriculum offers basic education in the biological and physical sciences and related nonscience disciplines to provide the broad background necessary for professional careers in fisheries and wildlife, natural resources, and other biological sciences. The program emphasizes basic principles and quantitative approaches to fisheries and wildlife conservation. Undergraduate-level study will satisfy only minimum requirements for professional employment; graduate-level study will enhance career opportunities. (The master's degree is required for many management, administrative, and research positions. The doctorate may be required for some positions and for college teaching.)

All students take the core curriculum of 169-181 credits, including six credits at the Itasca Session and three credits of a senior project, completed as a group activity with classmates over two quarters. The 11-13 elective credits may be used for concentration in a specific field of interest or spread among different disciplines. Electives are chosen in consultation with the student's adviser.

Freshman and Sophomore Years—91-94 credits

A. Communication, Language, and Symbolic Systems 29-32 required credits
Rhet 1101—Writing to Inform and Persuade (4)
Rhet 1104—Library Research Methods (1)
Rhet 1151—Writing in Your Major (4)
Rhet 1222—Public Speaking (4)
Rhet 3266—Communication, Discussion, in Small Group Decision Making (4)
Choose one of the following groups:
Math 1251, 1252—Differential, Integral Calculus (4,4)
and Math 1261—Algebra and Geometry of Euclidean Space (4)
or Phil 1001—Introduction to Logic (5)
or Math 1142, 1131, Phil 1001—Short Calculus, Finite Mathematics, Introduction to Logic (5,5,5)

B. Physical, Biological, and Analytical Sciences—41 required credits
Biol 1009—General Biology (5)
Biol 1103—General Botany (5)
Biol 1106—General Zoology (5)
Biol 5041—Ecology (4)
Bio 3201—Introductory Taxonomy (4)
or PBio 1009—Minnesota Plant Life (4)
Chem 1051—Chemical Principles I (4)
Chem 1052—Chemical Principles II (4)
FR 1201—Conservation of Natural Resources (3)
FW 1001—Orientation in Fisheries and Wildlife (1)
FW 1101—Ethics and Values in Resource Management (3)
FW 3052—Introduction to Fisheries and Wildlife (3)

C. The Individual and Society—13 required credits
AgEc 1102—Principles of Macroeconomics (4)
Pol 1001—American Government and Politics (5)
Mgmt 3001—Fundamentals of Management (4)
or Mgmt 3002—Psychology in Management (4)
or IR 3010—The Individual in the Organization (4)

D. Literature, Humanities, and Fine Arts—8 required credits
See the Liberal Education Requirements section of this bulletin for additional Category D suggestions.

Junior and Senior Years—78-87 credits

Itasca Session—6 credits
FW 3600—Fisheries and Wildlife Field Techniques (5)
FR 3106—Important Plants in Fisheries and Wildlife Habitats (1)

Required Courses—72-81 credits
Geo 1111—Introductory Physical Geology (5)
or Geo 1001—Introduction to Geology (4)
and Geo 1021—Introduction to Geology Lab: Geology of Minnesota (1)
GCB 3022—Genetics (4)
EEB 5608—Ecosystems: Form and Function (3)
or EEB 5014 Ecology of Plant Communities (5)
EEB 5156—Comparative Animal Physiology (5)
or AnSci 3301—Systemic Physiology (6)
EEB 5044—Evolution (4)
EEB 5601—Limnology (4)
or Geo 1601—Oceanography (4)
EEB 5136—Ichthyology (4)
or EEB 5606—Ecology of Fishes (3)

FW 5129—Mammalogy (5)
or EEB 5134—Introduction to Ornithology (5)
FW 5601—Assessment and Management of Vertebrate Populations (5)
FW 5603—Ecology and Management of Fish and Wildlife Habitats (4)
FW 5604—Fishery and Wildlife Management (4)
FW 5701, 5702—Senior Project (1,2)
BioC 3001—Elementary Biological Chemistry (4)
or Chem 3301, 3305—Elementary Organic Chemistry I and Lab (4,2)
PubH 5450—Biostatistics I (4) and PubH 5415—Biostatistical Methods II (4)
or Stat 3011-3012—Statistical Analysis (4,4)
or Stat 5021—Statistical Analysis (5)
Rhet 3562—Writing in Your Profession (4)
Phys 1041-1042—Introductory Physics (4,4) and Physics 1045-1046—Introductory Physics Laboratory (1,1)
or Phys 1104 and 1105—General Physics (4,4) and Physics 1107 and 1108—General Physics Laboratory (1,1)
(For students considering graduate school the 1104/1105 series plus Phys 1106 and 1108 are recommended.)

Suggested Electives—11-22 credits
Choose from this list. Unlisted courses may be taken after consultation with your adviser.
EEB 3111—Introduction to Animal Behavior (4)
EEB 5052—Theoretical Population Ecology (4)
EEB 5116—Introduction to Animal Parasitology (5)
Ent 5360—Aquatic Entomology (2)
FR 5100—Silviculture (4)
FR 5200—Aerial Photo Interpretation (3)
FR 5212—Natural Resources Inventory (4)
FR 5231—Range Management (3)
FR 5240—Natural Resource Policy and Administration (3)
FR 5262—Remote Sensing of Natural Resources (4)
FW 5455—Aquaculture (3)
FW 5460—Pollution Impacts on Aquatic Systems (3)
FW 5461—The Behavior of Fishes (2)
FW 5570—Avian Conservation (4)
FW 5620—Geographical Information Systems (GIS) for Fisheries, Wildlife, and Biological Conservation (4)
NRES 3060—Water Quality in Natural Resource Management (3)
FW 5459—Fish Physiology (4)
PA 5721—Environmental Policy I (3)

Total Graduation Requirements—192 credits.
Required courses listed above (169-181) and electives (11-23 credits).

Fisheries and Wildlife Minor

This minor enables students in the natural resource areas or other fields such as communications and education to develop a secondary concentration in fisheries and wildlife. An overview of fish and wildlife natural history and the general principles applied to managing their populations and habitats is provided. Open to students who have completed the required background courses or their equivalent; the minor is declared after minor core and optional courses are completed.

Required Background Courses—18-20 credits
Biol 1103—General Botany (5)
Biol 1106—General Zoology (5)
Biol 5041—Ecology (4)
FW 1001—Orientation in Fisheries and Wildlife (1)
One vertebrate biology course from the following:
EEB 5114—Vertebrate Biology (4)
FW 5129—Mammalogy (5)
EEB 5134—Introduction to Ornithology (5)
EEB 5834—Field Ornithology (5) (Itasca)
EEB 5136—Ichthyology (4)
EEB 5606—Ecology of Fishes (3)

Minor Core Courses—14 credits
FW 1101—Ethics and Values in Resource Management (3)
FW 3052—Introduction to Fisheries and Wildlife (3)
FW 5603—Ecology and Management of Fish and Wildlife Habitats (4)
FW 5604—Fishery and Wildlife Management (4)

Optional Courses—Choose one course
FW 5459—Fish Physiology (4)
FW 5455—Aquaculture (3)
FW 5601—Assessment and Management of Vertebrate Populations (5)
FW 5570—Avian Conservation (4)

Total Graduation Requirements—192 credits
Required courses, including 8 credits in Category D, (170-181 credits), and suggested electives (1-22 credits)

Forest Products

This curriculum is for students interested in careers in the development, production, marketing, and use of the thousands of products that flow from forests—from paper, wood-based panels, and furniture to chemicals from wood. Courses emphasize the chemical, physical, and mechanical properties of wood and the newest technologies for converting this raw material into its many final forms.

Marketing—This specialization is for students interested in the marketing, sales, and distribution of forest products. Technical emphasis is on the physical-mechanical nature of wood-based building materials including lumber, plywood, fiberboard, particleboard, and newer composite products. In addition, coursework focuses on marketing principles and analysis, manage-

ment science, computer applications, and economics. Career opportunities include purchasing and selling of all types of forest products at the wholesale and retail levels, technical sales, product promotion, and specialized marketing research.

Freshman and Sophomore Years—79 required credits plus electives.

A. Communication, Language, and Symbolic Systems—22 required credits
Rhet 1101—Writing to Inform and Persuade (4)
Rhet 1104—Library Research Methods (1)
Rhet 1151—Writing in Your Major (4)
Rhet 1222—Public Speaking (4)
Math 1142—Short Calculus (5)
Stat 3011—Statistical Analysis (4)

B. Physical, Biological, and Analytical Sciences—34 required credits
Biol 1009—General Biology (5)
Chem 1001—General Principles of Chemistry (4)
Chem 1002—Elementary Organic Chemistry (4)
ForP 1001—Forest Products Orientation (1)
ForP 1301—Wood as a Raw Material (4)
ForP 1303—Wood Structure and Identification (2)
FR 1100—Dendrology (4)
Phys 1041—Introductory Physics (4)
Phys 1042—Introductory Physics (4)
Phys 1045—Introductory Physics Laboratory (1)
Phys 1046—Introductory Physics Laboratory (1)

C. The Individual And Society—15 required credits
AgEc 1101—Principles of Microeconomics (4)
AgEc 1102—Principles of Macroeconomics (4)
Jour 1001—Introduction to Mass Communication (2)
Psy 1001—Introduction to Psychology (5)

D. Literature, Humanities, and Fine Arts—8 required credits
See the Liberal Education Requirements section of this bulletin for additional Category D suggestions.

Junior Year—47 required credits
Acct 1050—Introduction to Financial Reporting (4)
BLaw 3058—Introduction to Law, the Law of Contracts and Sales Contracts (4)
CSci 3101—A FORTRAN Introduction to Computer Programming (4)
or CSci 3102—Introduction to Pascal Programming (4)
or CSCI 3113—Introduction to Programming in C (4)
or AgET 3030—Introduction to Problem Solving With Computers (4)
ForP 3300—Wood Industry Tours (2)
ForP 3303—Forest Products Marketing (3)
ForP 3312—Building Materials Estimating (2)
ForP 5300—Wood-Fluid Relationships (3)
ForP 5301—Mechanical Properties (3)
ForP 5303—Wood Deterioration (4)
ForP 5331—Undergraduate Seminar (2)
Mgmt 3001—Fundamentals of Management (4)
Mktg 3000—Principles of Marketing (4)
Mktg 3010—Buyer Behavior and Marketing Analysis (4)
Mktg 3020—Marketing Operations Management (4)
Electives and liberal education requirements

Senior Year—40-41 required credits
Acct 3001—Introduction to Management Accounting (4)
ForP 5304—Wood Drying and Preservation Processes (4)
ForP 5307—Wood-Base Panel Technology (4)
ForP 5355—Mechanics and Structural Design With Wood Products (4)
ForP 5356—Advanced Forest Products Marketing (3)
FR 5240—Natural Resource Policy and Administration (3)
or FR 5250—Role of Renewable Natural Resources in Developing Countries (2)
BME 5260—Professional Sales Education (3)
BFin 3000—Finance Fundamentals (4)
Jour 5251—Psychology of Advertising (4)
Mktg 3030—Sales and Distribution Management (4)
Rhet 3562—Writing in Your Profession (4)
Electives and liberal education requirements

Directed Electives—at least two courses
Acct 3160—Financial Statement Analysis (4)
Jour 3159—Public Relations (4)
Jour 5721—Mass Media in a Dynamic Society (4)
Mgmt 3002—Psychology in Management (4)
Mktg 3050—Marketing Communications (4)
Mktg 3065—Retail Management (4)
LM 3000—Introduction to Logistics (4)
LM 5020—Advanced Logistics Management (4)

Total Graduation Requirements—192 credits. Required courses and directed electives listed above (174-175 credits), and electives (17-18 credits).

Production Management—This specialization is for students interested in production management, product development, and industrial engineering careers in industries that manufacture lumber, plywood, particleboard, furniture, and other wood products. In addition to a strong wood science background, students gain knowledge in industrial engineering, labor management, and economics.

Freshman and Sophomore Years—84 credits required plus electives

A. Communication, Language, and Symbolic Systems—25 required credits
Math 1251—Differential Calculus (4)
Math 1252—Integral Calculus (4)
Rhet 1101—Writing to Inform and Persuade (4)
Rhet 1104—Library Research Methods (1)
Rhet 1151—Writing in Your Major (4)
Rhet 1222—Public Speaking (4)
Stat 3091—Probability and Statistics (4)

B. Physical, Biological, and Analytical Sciences—38 required credits
Biol 1009—General Biology (5)
BioC 3001—Elementary Biological Chemistry I (4)
Chem 1051—General Principles of Chemistry I (4)
Chem 1052—General Principles of Chemistry II (4)
ForP 1001—Forest Products Orientation (1)
ForP 1301—Wood as a Raw Material (4)
ForP 1303—Wood Structure and Identification (2)

FR 1100—Dendrology (4)
Phys 1041—Introductory Physics (4)
Phys 1042—Introductory Physics (4)
Phys 1045—Introductory Physics Laboratory (1)
Phys 1046—Introductory Physics Laboratory (1)

C. The Individual and Society—13 required credits
AgEc 1101—Principles of Microeconomics (4)
AgEc 1102—Principles of Macroeconomics (4)
Psy 1001—Introduction to Psychology (5)

D. Literature, Humanities, and Fine Arts—8 required credits
Rhet 1301—Modern Thought and the Enlightenment (4)
Rhet 1302—Modern Thought and the Industrial Revolution (4)
Rhet 1303—Modern Thought and the Impact of Evolution (4)
Rhet 1310—Humanities: The Land in American Experience (4)
See the Liberal Education Requirements section of this bulletin for additional Category D suggestions.

Junior Year—43 required credits
CSci 3101—A FORTRAN Introduction to Computer Programming (4)
or CSci 3102—Introduction to Pascal Programming and Problem Solving (4)
or CSci 3113—Introduction to Programming in C (4)
or AgEt 3030—Introduction to Programming (4)
ForP 3300—Wood Industry Tours (2)
ForP 3303—Forest Products Marketing (3)
ForP 3361—Introduction to Adhesives (3)
ForP 5300—Wood-Fluid Relationships (3)
ForP 5301—Mechanical Properties of Wood (3)
ForP 5303—Wood Deterioration (3)
ForP 5331—Undergraduate Seminar (2)
ForP 5355—Mechanics and Structural Design With Wood Products (4)
IEOR—Introduction to Industrial Engineering Analysis (4)
IEOR—Quality Control and Reliability (4)
IEOR—Introduction to Operations Research (4)
IR 3002—Personnel and Industrial Relations (4)
Electives

Senior Year—37 required credits
ForP 5304—Wood Drying and Preservation Processes (4)
ForP 5305—Pulp and Paper Technology (2)
ForP 5306—Analysis of Production Systems (3)
ForP 5307—Wood-Base Panel Technology (4)
FR 5240—Natural Resource Policy and Administration (3)
or FR 5250—Role of Renewable Natural Resources in Developing Countries (2)
IEOR 5010—Introduction to Work Analysis (4)
IEOR 5020—Engineering cost Accounting (4)
IEOR 5311—Management for Engineers (4)
IEOR 5361—Inventory and Production Control (4)
IR 3007—Collective Bargaining and Modern Labor Relations (4)
Rhet 3562—Writing in Your Profession (4)

Electives
Acct 1050—Introduction to Financial Reporting (4)
ForP 5356—Advanced Forest Products Marketing (3)
IEOR 5180—Applied Industrial Engineering (3-5)
IEOR 5221—Industrial Plants (3-5)
IEOR 5321—Industrial Safety (4)
IEOR 5351—Analysis of Production Processes (4)
IR 3010—The Individual and the Organization (4)
LM 3000—Introduction to Logistics Management (4)
Mktg 3000—Principles of Marketing (4)
Mktg 3090—Marketing Topics: Industrial Marketing (4)
Rhet 3254 Advanced Public Speaking (4)
Rhet 3266—Communication, discussion in Small Group Decision Making (4)

Total Graduation Requirements—192 credits. Required courses listed above (166-167 credits), and electives (25-26 credits).

Paper Science and Engineering—This specialization provides in-depth training in mathematics, physics, chemistry, engineering, and wood and fiber science and technology. It also includes specialized pulp and paper and related engineering courses on the technology of the pulping and papermaking processes. Graduates find careers in process engineering, manufacturing operations, technical services, marketing, plant management, and research and development.[1]

Freshman and Sophomore Years—72 credits required plus electives and liberal education requirements in categories C (4 cr) and D (8 cr).

A. Communication, Language, and Symbolic Systems—33 required credits
Math 1251—Differential Calculus (4)
Math 1252—Integral Calculus (4)
Math 1261—Algebra and Geometry of Euclidean Space (4)
Math 3261—Differential Equations with Linear Algebra (4)
Rhet 1101—Writing to Inform and Persuade (4)
Rhet 1104—Library Research Methods (1)
Rhet 1151—Writing in Your Major (4)
Rhet 1222—Public Speaking (4)
CSci 3101—A FORTRAN Introduction to Computer Programming (4)
or CSci 3102—Introduction to Pascal Programming (4)
or CSci 3113—Introduction to Programming in C (4)
or AgET 3030—Introduction to Problem Solving With Computers (4)

B. Physical, Biological, and Analytical Sciences—35 required credits
Chem 1051—Chemical Principles I (4)

[1]*Detailed plans of study are available from the Director of Paper Science and Engineering.*

Chem 1052—Chemical Principles II (4)
Chem 3301—Elementary Organic Chemistry I (4)
Chem 3302—Elementary Organic Chemistry II (4)
Chem 3305—Elementary Organic Chemistry Laboratory I (2)
Chem 3306—Elementary Organic Chemistry Laboratory II (2)
ForP 1001—Forest Products Orientation (1)
ForP 5331—Undergraduate Seminar (2)
Phys 1251—General Physics I (4)
Phys 1252—General Physics II (4)
Phys 1253—General Physics III (4)

C. The Individual and Society—8 required credits
AgEc 1102—Principles of Macroeconomics (4)
See the Liberal Education Requirements section of this bulletin for additional Category C suggestions.

D. Literature, Humanities, and Fine Arts—8 required credits
See the Liberal Education Requirements section of this bulletin for additional Category D suggestions.

Junior Year—50 required credits
CE 3400—Fluid Mechanics (4)
ForP 1301—Wood as a Raw Material (4)
ForP 1303—Wood Structure and Identification (2)
ForP 3300—Wood Industry Tours (2)
ForP 3301—Industrial Internship (2)
ForP 5302—Wood Chemistry I (3)
ForP 5305—Pulp and Paper Technology (2)
ForP 5306—Analysis of Production Systems (3)
ForP 5310—Pulp and Paper Process Laboratory (3)
ForP 5311—Pulp and Paper Process Engineering Calculations I (4)
ForP 5312—Pulp and Paper Process Engineering Calculations II (4)
ForP 5315—Paper Engineering Laboratory (2)
ForP 5353—Wood Chemistry II (3)
ForP 5361—Adhesion and Adhesives (3)
ME 3301—Thermodynamics (4)
Stat 5021—Statistical Analysis (5)
Electives and liberal education requirements

Senior Year—35-36 required credits
Chem 5520—Elementary Physical Chemistry (3)
ForP 5313—Pulp and Paper Process Operations (4)
ForP 5314—Pulp and Paper Process Operations II: Paper Machine Operations, Finishing, and Converting (3)
ForP 5316—Coated Product Development (2)
ForP 5318—Pulp and Paper Process Dynamics and Control (3)
ForP 5320—Biological and Environmental Science of Pulp and Paper (3)
ForP 5321—Material Science of Paper [Paper and Fiber Physics and Properties] (4)
ForP 5359—Surface and Colloid Chemistry of Papermaking (3)
FR 5240—Natural Resource Policy and Administration (3)
or FR 5250—Role of Renewable Natural Resources in Developing Countries (2)
ME 5342—Heat Transfer (4)
Rhet 3562—Writing in Your Profession (4)
Electives and liberal education requirements

Suggested Electives

CE 5500—Analysis and Design of Water Supply Systems (4)
CE 5501—Analysis and Design of Wastewater Systems (4)
Chem 5521—Elementary Physical Chemistry (3)
ChEn 5001—Computational Methods in Chemical Engineering and Material Science (4)
ChEn 5101—Principles of Chemical Engineering I (4)
ChEn 5102—Principles of Chemical Engineering II (4)
ForP 5300—Wood-Fluid Relations (3)
ForP 5301—Mechanical Properties (3)
IEOR 5020—Engineering Cost Accounting, Analysis and Control (4)
ME 3201—Mechanical Engineering Systems Analysis (4)
ME 3303—Applied Thermodynamics (4)
ME 3701—Basic Measurements Laboratory I (2)
ME 3702—Basic Measurements Laboratory II (2)
ME 5283—Industrial Instrumentation and Automatic Control (4)
Stat 5301—Designing Experiments (5)

Total Graduation Requirements—192 credits
Required courses listed above (169-170 credits), and electives (22-23 credits).

Wood Science—This specialization is designed for students who want a broad education in forest products coupled with strong training in biology, chemistry, math, and physics. Completion of this specialization is excellent preparation for technical jobs in the wood products industry or for going on to graduate school.

Freshman and Sophomore Years—94 credits plus electives

A. Communication, Language, and Symbolic Systems—33 required credits
Math 1251—Differential Calculus (4)
Math 1252—Intregal Calculus (4)
Math 1261—Algebra and Geometry of Euclidean Space (4)
Math 3251—Vector Differential Calculus (4)
Rhet 1101—Writing to Inform and Persuade (4)
Rhet 1104—Library Research Methods (1)
Rhet 1151—Writing in Your Major (4)

B. Physical, Biological, and Analytical Sciences—41 required credits
Biol 1009—General Biology (5)
Biol 1103—General Botany (5)
Chem 1051—Chemical Principles I (4)
Chem 1052—Chemical Principles II (4)
Chem 3301—Elementary Organic Chemistry I (4)
Chem 3302—Elementary Organic Chemistry II (4)
Chem 3305—Elementary Organic Chemistry Laboratory I (2)
Chem 3306—Elementary Organic Chemistry Laboratory II (2)
ForP 1001—Forest Products Orientation (1)
ForP 1301—Wood as a Raw Material (4)
ForP 1303—Wood Structure and Identification (2)
FR 1100—Dendrology (4)
Physics 1251—General Physics (4)
Physics 1252—General Physics (4)
Physics 1253—General Physics (4)

C. The Individual and Society—8 required credits
AgEc 1101—Principles of Microeconomics (4)
AgEc 1102—Principles of Macroeconomics (4)

D. Literature, Humanities, and Fine Arts—8 required credits
See the Liberal Education Requirements section of this bulletin for additional Category D suggestions.

Junior Year—45 required credits
Chem 3100—Quantitative Analysis Lecture (3)
Chem 3101—Quantitative Analysis Laboratory (2)
Chem 5520—Elementary Physical Chemistry (3)
ForP 3300—Wood Industry Tours (2)
ForP 5300—Wood-Fluid Relationships (3)
ForP 5301—Mechanical Properties (3)
ForP 5302—Wood Chemistry I (3)
ForP 5303—Wood Deterioration (4)
ForP 5331—Undergraduate Seminar (2)
Rhet 1222—Public Speaking (4)
Stat 3011—Statistical Analysis (4)
Electives and liberal education requirements

Senior Year—36-37 required credits
CSci 3101—A FORTRAN Introduction to Computer Programming (4)
or CSci 3102—Introduction to Pascal Programming (4)
or CSci 3113—Introduction to Programming in C (4)
or AgEt 3030—Introduction to Problem Solving with Computers (4)
ForP 5304—Wood Drying and Preservation Processes (4)
ForP 5305—Pulp and Paper Technology (4)
ForP 5306—Analysis of Production Systems (3)
ForP 5307—Wood-Base Panel Technology (4)
ForP 5353—Wood Chemistry II (3)
ForP 5355—Mechanics and Structural Design With Wood Products (4)
ForP 5361—Adhesion and Adhesives (3)
FR 5240—Natural Resource Policy and Administration (3)
or FR 5250—Role of Renewable Natural Resources in Developing Countries (2)
Rhet 3562—Writing in Your Profession (4)
Electives and liberal education requirements

Total Graduation Requirements—192 credits
Required courses listed above (163-164 credits), and electives (28-29 credits).

Forest Resources

This curriculum prepares students to manage forest and related lands for timber, wildlife, recreation, water production, and environmental enhancement. Graduates may become directly involved in land management or play specialized supporting roles in areas ranging from resource planning or nursery management to public relations. Still others find employment in related fields such as environmental education and interpretation.

All students take the *core curriculum* of required courses (including the Itasca and Cloquet sessions) listed below. In addition, students must complete a minimum of 20 credits in one of the seven *areas of emphasis* listed below. A student may also submit a proposal for an individual area of emphasis, including an explanation of its professional relevance and the courses to be completed, to the faculty for their review and approval.

Core Curriculum

Freshman and Sophomore Years—75-80 required credits plus electives

A. Communication, Language, and Symbolic Systems—25-27 required credits
Math 1142—Short Calculus (5)
or Math 1251—Differential Calculus (4)
CSci 3101—A FORTRAN Introduction to Computer Programming (4)
or CSci 3102—Introduction to Pascal Programming (4)
or AgET 3030—Introduction to Problem Solving with Computers (4)
or GC 1571—Introduction to BASIC Programming and Microcomputers (5)[1]
Rhet 1101—Writing to Inform and Persuade (4)
Rhet 1104—Library Research Methods (1)
Rhet 1151—Writing in Your Major (4)
Rhet 1222—Public Speaking (4)
Stat 3011—Statistical Analysis (4)
or Stat 5021—Statistical Analysis (5)

B. Physical, Biological, and Analytical Sciences—34-37 required credits
Biol 1008—Introductory Biology: An Evolutionary Approach (4)
or Biol 1009—General Biology (5)
Biol 1103—General Botany (5)
Chem 1001—General Principles of Chemistry (4)
or Chem 1051—Chemical Principles I (4)
Chem 1002—Elementary Organic Chemistry (4)
or Chem 1052—Chemical Principles II (4)
ForP 1301—Wood as a Raw Material (4)
FR 1001—Forest Resources Orientation (1)
FR 3300—Elements of Surveying (2)[2] *(Cloquet)*
or CE 3100—Introduction to Surveying and Mapping (4)[3]
Geo 1001—Introduction to Geology (4)
and Geo 1021—Introduction to Geology Lab: Geology of Minnesota (1)
or Geo 1111—Physical Geology (5)
Phys 1001—The Physical World (4)
Phys 1005—Physics Laboratory (1)

C. The Individual and Society—8 required credits (no more than 6 credits in any discipline)
AgEc 1101—Principles of Microeconomics (4)
AgEc 1102—Principles of Macroeconomics (4)
See the Liberal Education Requirements section of this bulletin for additional Category C suggestions.

D. Literature, Humanities, and Fine Arts—8 required credits
See the Liberal Education Requirements section of this bulletin for additional Category D suggestions.

Itasca Session—6 required credits
This summer term is to be taken between the freshman and sophomore or sophomore and junior years.
FR 3100—Minnesota Plants (2)
FR 3101—Northern Forest Ecosystems (3)
FR 3201—Field Forest Measurements (1)

Junior and Senior Years—67 required credits
FR 1100—Dendrology (4)
FR 3103—Meteorology and Climatology for Natural Resource Managers (2)
FR 3104—Forest Ecology (3)
FR 5100—Silviculture (4)
FR 5114—Forest Hydrology (4)
FR 5200—Aerial Photo Interpretation (3)
FR 5226—Forest Economics and Planning (5)
FR 5232—Management of Recreational Lands (4)
FR 5240—Natural Resource Policy and Administration (3)
FR 5212—Natural Resources Inventory (4)
FR 5215—Forest Fire Management (2)
FW 3052—Introduction to Fisheries and Wildlife (3)
Rhet 3562—Writing in Your Profession (4)
Soil 1020—The Soil Resource (4)

Fall Quarter—Cloquet Session
FR 5101—Field Silviculture (4)
FR 5115—Forest Hydrology, Field Applications (2)
FR 5126—Silviculture: Soil-Site Relationships (2)
FR 5220—Remote Sensing, Forest Resources Inventory (4)
FR 5236—Forest Recreation Planning (1)
FR 5248—Harvesting and Engineering (3)
FW 3167—Techniques of Forest Wildlife Management (2)
Electives and liberal education requirements

Total Graduation Requirements—192 credits
Required courses listed above (148-153 credits), credits to satisfy area of emphasis, and electives (39-44 credits).

Areas of Emphasis

Forest Hydrology—This interdisciplinary emphasis helps develop skills to solve water resource problems. Students can qualify as hydrologists on the Civil Service register, and with proper selection of electives can also meet the criteria for hydrologists as established by the American Institute of Hydrology. For more information, contact Dr. Kenneth N. Brooks, 235 Natural Resources Administration Building (612/624-2774); or Dr. James A. Perry, 312 Green Hall (612/624-9796).

Required Courses—27 credits
Math 1251, 1252—Differential, Integral Calculus (4,4)
FR 5153—Advanced Forest Hydrology (4)
CE 3400—Fluid Mechanics (4)
CE 5401—Water Resources Engineering (4)
CE 5405—Hydrology and Hydrologic Design (4)
NRES 5060—Water Quality in Natural Resource Management (3)

Recommended Electives—at least four related courses; the list below is not all-inclusive.
FR 5231—Range Management (3)
FR 5250—Role of Renewable Natural Resources in Developing Countries (2)
FR 5262—Remote Sensing of Natural Resources (4)
FR 5264—Quantitative Techniques in Forest Management (3)
AgEn 5540—Watershed Engineering (4)
CE 5402—Computational Hydraulics (4)
CE 5410—Open Channel Hydraulics (4)
CE 5425—Groundwater Mechanics (4)
CE 5501—Analysis and Design of Wastewater Systems (4)
CE 5505—Water Quality Engineering (4)
CE 5506—Environmental Water Chemistry (4)
Geo 5251—Geomorphology (4-5)
Geo 5611—Groundwater Geology (5)
Soil 5232—Soil Physics (5)
Soil 5310—Soil Chemistry (4)
Soil 5240—Microclimatology (4)
Soil 5710—Forest Soils (3-4)

Forest Soils—This emphasis covers forest soil science, land use, management planning, and forest production. Students will qualify as soil scientists on the Civil Service register as well as satisfy requirements for a soil science minor (which can be entered directly on the transcript). For more information, contact Dr. David F. Grigal, 556 Borlaug Hall (612/625-4232); or Dr. Edward Sucoff, 103 Green Hall (612/624-7249).

Required Courses—23-25 credits
Soil 1020—The Soil Resource (4)
or Soil 3125—Basic Soil Science (4)
Soil 3220—Soil Conservation and Land Use Management (4)
Soil 3416—Soil Fertility (5)
Soil 5510—Field Study of Soils for Environmental Assessment (4)
Soil 5710—Forest Soils (3-4)
Soil elective (3-4)

Recommended Electives—at least two courses (including 3 cr in Soil Science)
Ent 5250—Forest Entomology (4)
FR 3104—Forest Ecology (3)
FR 5120—Introductory Tree Physiology and Genetics (4)
FR 5153—Advanced Forest Hydrology (4)
FR 5231—Range Management (3)
FR 5262—Remote Sensing of Natural Resources (4)
FR 5264—Quantitative Techniques in Forest Management (3)

[1]*Students who wish to take FR 5110 should not take GC 1571.*
[2]*FR 3300 may be taken as part of the Cloquet Session.*
[3]*Students need override from the Civil Engineering Department to register.*

Geo 5251—Geomorphology (4-5)
Geo 5261—Glacial Geology (4-5)
Soil 5610—Soil Biology (4)
Soil 3118—Seminars on Special Topics (1 each)
Soil 5232—Soil Physics (5)
Soil 5240—Microclimatology (4)
Soil 5515—Soil Development, Classification, and Geography (4)
Soil 5550—Peatlands: Formation, Classification, and Utilization (3)
Soil 5560—Interpretation of Land Resources (3)
PlPa 5050—Forest Pathology (4)

Management and Administration—This emphasis is for students interested in administrative careers in public resource agencies or forest industries. Concepts and techniques used to develop policies and programs and to manage people and processes in large organizations are explored, providing a framework for systematic individual development through experience and continuing education. For more information, contact Dr. Paul V. Ellefson, 330B Green Hall (612/624-3735); Dr. Hans M. Gregersen, 301D Green Hall (612/624-6298); or Dr. Dietmar W. Rose, 301H Green Hall (612/624-9711).

Required Courses—11 credits
Mgmt 3001—Fundamentals of Management (4)
Acct 1050—Introduction to Financial Reporting (4)
FR 5241—Natural Resource Management: Political and Administrative Processes (3)
or FR 5264—Quantitative Techniques in Forest Management (3)

Recommended Electives—at least three courses
Acct 3001—Introduction to Management Accounting (4)
BLaw 3058—Introduction to Law, the Law of Contracts and Sales Contracts (4)
or PA 5102 Legal Environment of Public Affairs (3)
BGS 3002—Business and Society (4)
IR 3010—Human Relations and Applied Organization Theory (4)
BFin 3000—Finance Fundamentals (4)
Mgmt 3002—Psychology in Management (4)
IDSc 3030—Information Systems and Information Management (4)
PA 5200—Introduction to Planning (3)
Pol 3307—The American Bureaucracy (4)

Industrial Forest Management—This emphasis is for students who wish to gain a more complete understanding of industrial forest management. Planning, decision-making, and project implementation activities are emphasized. For more information, contact Dr. Dietmar W. Rose, 301H Green Hall (612/624-9711).

Required Courses—28-29 credits
ForP 3303—Forest Products Marketing (3)
ForP 3300—Wood Industry Tours (2)
or ForP 5306—Analysis of Production Systems (3)
FR 5241—Natural Resource Management: Political and Administrative Processes (3)
FR 5264—Quantitative Techniques in Forest Management (3)
IEOR 5050—Engineering Economics Analysis (4)
Math 1252—Integral Calculus (4)
Math 1261—Algebra and Geometry of Euclidean Space (4)

Recommended Electives—
IEOR 3000—Introduction to Industrial Engineering Analysis (4)
IEOR 5020—Engineering Cost Accounting, Analysis and Control (4)
IEOR 5040—Introduction to Operations Research (4)
IEOR 5441—Operations Research II (4)
IDSc 3030—Information Systems and Information Management Systems (4)
CSci 3101—A FORTRAN Introduction to Computer Programming (4)
Stat 5021—Statistical Analysis (5)
Stat 5301—Designing Experiments (5)
Stat 5302—Applied Regression Analysis (5)

Resource Measurements and Information Systems—This emphasis is for students who have analytical skills and are interested in forest measurement and information systems. Focus is on subjects such as sampling, mathematical modelling, statistics, computer science, remote sensing, and decision support systems. For more information, contact Dr. Alan R. Ek, 115C Green Hall (612/624-3400); Dr. Thomas E. Burk, 35A Natural Resources Administration Building (612/624-6741); or Dr. Marvin E. Bauer, 220B Green Hall (612/624-3703).

Required Courses—22 credits
Stat 5021—Statistical Analysis (5)
Math 1252—Integral Calculus (4)
Math 1261—Algebra and Geometry of Euclidean Space (4)
CSci 3101—A FORTRAN Introduction to Computer Programming (4)
or CSci 3102—Introduction to Pascal Programming (4)
or GC 1572—Introduction to Computer Programming (5)
or other FORTRAN or Pascal or BASIC (4)

Recommended Electives—at least two courses
FR 5264—Quantitative Techniques in Forest Management (3)
or IEOR 5040—Introduction to Operations Research (4)
FR 5262—Remote Sensing of Natural Resources (4)
or FR 5130—Geographic Information Systems in Natural Resource Analysis (3)
Stat 5302—Applied Regression Analysis (5)
or Stat 5301—Designing Experiments (5)

Forest Harvesting—This emphasis is for students interested in timber harvesting and its impact on other land management considerations. The coursework is interdisciplinary and requires careful preparation for spending the senior year at the University of Idaho earning 14 semester credits (21 quarter credits). Students are trained for careers in logging engineering firms, forest products companies, and government agencies. Typical work includes planning and designing timber sales, supervising logging crews, designing and laying out roads, and managing wood procurement. For more information, contact Dr. Charles R. Blinn, 314 Green Hall (612/624-3788).

Junior Year

Fall Quarter (Minnesota)—10-12 credits
FR 3103—Meteorology and Climatology for Natural Resource Managers (2)
FR 3104—Forest Ecology (3)
FW 3052—Introduction to Fisheries and Wildlife (3)
CE 3100—Introduction to Surveying and Mapping (4)[1] *or* FR 3300—Elements of Surveying (2) *(Cloquet)*

Winter Quarter (Minnesota)—14 credits
Rhet 3562—Writing in Your Profession (4)
FR 5100—Silviculture (4)
FR 5200—Aerial Photo Interpretation (3)
FR 5240—Natural Resource Policy and Administration (3)

Spring Quarter (Minnesota)—14 credits
FR 5212—Natural Resources Inventory (4)
FR 5215—Forest Fire Management (2)
FR 5226—Forest Economics and Planning (5)
FR 5231—Range Management (3)

Senior Year

Fall Quarter (Cloquet)—18 credits

Spring Semester (Idaho)—6 or 9 semester credits
For Pr 431—Production and Cost Control in Timber Harvesting (3 sem/4.5 qtr cr)
For Pr 433—Forest Tractor Systems Analysis (3 sem/4.5 qtr cr)
For Pr 434—Cable Systems Analysis (3 sem/4.5 qtr cr; taught in alt yrs)[2]

Fall Semester (Idaho)—5 or 8 semester credits
For Pr 432—Low Volume Forest Roads (3 sem/4.5 qtr cr)
For Pr 434—Cable Systems Analysis (3 sem/4.5 qtr cr; taught as directed study in alt yrs)
For 462—Watershed Management (2 sem/3 qtr cr)

Recommended Electives (Idaho)
Bus 370—Industrial Management (3 sem/4.5 qtr cr)
CE 482—Project Management Techniques (1-4 sem/1.5-6 qtr cr)
CE 486—Engineering Economics (3 sem/4.5 qtr cr)
For Pr 444—Wood Products Manufacturing (2 sem/3 qtr cr)
For Pr 477—Topics in Forest Industries Management (3 sem/4.5 qtr cr)
For Pr 522—Advanced Forest Roads (3 sem/4.5 qtr cr)
For Pr 534—Advanced Techniques of Timber Harvesting (3 sem/4.5 qtr cr)
For 470—Introduction to Forest Resources Planning (2 sem/3 qtr cr)
For 476—Forest Resource Investments (2 sem/3 qtr cr)
For 477—Forest Management Scheduling (2 sem/3 qtr cr)
For 575—Advanced Forest Management (2 sem/3 qtr cr)

Recommended Electives (Minnesota)
Soil 5710—Forest Soils (3-4)
FR 5153—Advanced Forest Hydrology (4)

Silviculture/Forest Biology—This emphasis is for students interested in the biological sciences such as ecology, silviculture, and physiology. It provides background information for careers as forest resource managers and silviculturist specialists. For more information, contact Dr. Glenn Furnier, 101E Green Hall (612/624-3720); Dr. Carl Mohn, 105 Green Hall, (612/624-7281); Dr. Peter Reich, 220F Green Hall (612/624-4270); or Dr. Edward Sucoff, 103 Green Hall (612/624-7249).

Required Courses—15 credits
Ent 5250—Forest Entomology (4)
FR 5120—Introductory Tree Physiology and Genetics (4)
PlPa 5050—Forest Pathology (4)
Soil 5710—Forest Soils (3)

Adviser-Approved Electives—a minimum of 12 credits from 3000- and/or 5000-level related courses in biology, forestry, and/or soils approved by the student's adviser. The list below contains suggestions. Other courses may be substituted.

EEB 5014—Ecology of Plant Communities (5)
EEB 5016—Ecological Plant Geography (5)
EEB 5044—Evolution (4)
EEB 5601—Limnology (4)
FR 5106—Senior Silviculture Seminar (2-3)
FR 5110—Forestry Applications of Microcomputers (4)
FR 5130—Geographic Information Systems in Natural Resource Analysis (3)
FR 5231—Range Management (3)
FR 5262—Remote Sensing of Natural Resources (4)
FR 5703—Colloquium in Natural Resources (1-4 cr)
PBio 3201—Introductory Taxonomy (4)
Soil 5510—Field Study of Soils for Environmental Assessment (4)
Soil 5610—Soil Biology (4)

[1]*Students need override from the Civil Engineering Department to register.*
[2]*To be taken only once, during spring quarter or as directed study in fall quarter.*

Forest Resources Minor

This minor helps students in natural resources or related areas to develop a solid understanding of forest resource dynamics and management and the importance of forest resources in our society. The minor incorporates a fundamental science background plus coursework dealing with the multiple uses and manipulation of forest resources and their assessment and policy implications. Open to students who have completed required background courses or the equivalent, the minor is awarded once the minor core and optional courses are completed.

Minor Core—14-15 credits
FR 1100—Dendrology (4)
FR 1200—Introduction to Forest Resources (3)
or FR 1201—Conservation of Natural Resources (3)
or FR 1202—Farm and Small Woodlands Forestry (3)
or FR 1203—Introduction to Minnesota's Natural Resources (3)
FR 3104—Forest Ecology (3)[1]
or Biol 5041—Ecology (4)
FR 5100—Silviculture (4)

Optional Courses—7 credits, with at least one course from each of these two categories:

Management and Policy
ForP 1301—Wood as a Raw Material (4)
FR 3250 or 5250—Role of Renewable Natural Resources in Developing Countries (2)
FR 5200—Aerial Photo Interpretation (3)
FR 5212—Natural Resources Inventory (4)
FR 5220—Remote Sensing, Forest Resources Inventory (4) *(Cloquet)*
FR 5226—Forest Economics and Planning (5)
FR 5231—Range Management (3)
FR 5232—Management of Recreational Lands (4)
FR 5233—Principles of Outdoor Recreation Planning (3)
FR 5236—Forest Recreation Planning (1) *(Cloquet)*
FR 5240—Natural Resource Policy and Administration (3)
FR 5241—Natural Resource Management: Political and Administrative Processes (3)
FR 5248—Harvesting and Engineering (3) *(Cloquet)*
FR 5257—Recreation Land Policy (3)
FR 5259—Analysis of Outdoor Recreation Behavior (3)
FR 5262—Remote Sensing of Natural Resources (4)
FR 5264—Quantitative Techniques in Forest Management (3)
FR 5500—Urban Forest Management (3)

Biology
Ent 5250—Forest Entomology (4)
FR 3103—Meteorology and Climatology for Natural Resource Managers (2)
FR 5101—Field Silviculture (4) *(Cloquet)*
FR 5114—Forest Hydrology (4)
FR 5115—Forest Hydrology, Field Applications (2) *(Cloquet)*
FR 5120—Introductory Tree Physiology and Genetics (4)
FR 5126—Silviculture: Soil-Site Relationships (2) *(Cloquet)*
FR 5152—Forest Genetics (3)
FR 5153—Advanced Forest Hydrology (4)
FR 5215—Forest Fire Management (2)
NRES 5060—Water Quality in Natural Resource Management (3)
PlPa 5050—Forest Pathology (4)
Soil 1020—The Soil Resource (4)

Natural Resources and Environmental Studies

The Natural Resources and Environmental Studies curriculum, jointly offered with the College of Agriculture, is intended for students interested in an interdisciplinary education focusing on the use and management of natural resources and the study of the environment.

Students have considerable flexibility in designing their study program. Programs can be designed to achieve one or more of the following objectives:

- Gain an understanding of the interaction between natural resources and modern society. Learn about the significant social and environmental roles that natural resources can play nationally and internationally.
- Prepare for careers in public and private organizations that are responsible for planning the use and management of natural resources and protection of the environment. Learn about subjects that will prepare you for positions in fields such as environmental assessment, resource inventory, natural resource planning, environmental protection, sustainable development, policy analysis, waste management, and natural resource management.
- Develop appropriate background for graduate study.

[1]*This requirement can also be met by the following courses offered at Itasca: FR 3100—Minnesota Plants (2), FR 3101—Northern Forest Ecosystems (3), FR 3201—Field Forest Measurements (1)*
[2]*Students must complete two colloquia.*

All students take the core curriculum of required courses (including two colloquia) listed below. In addition, students must complete a minimum of 24 credits in one of the six areas of concentration.

Core Curriculum

Freshman and Sophomore Years—83-88 required credits plus electives

A. Communication, Language, and Symbolic Systems—22 required credits
Rhet 1101—Writing to Inform and Persuade (4)
Rhet 1104—Library Research Methods (1)
Rhet 1151—Writing in Your Major (4)
Rhet 1222—Public Speaking (4)
Math 1142—Short Calculus (5)
Stat 3011—Statistical Analysis (4)

B. Physical, Biological, and Analytical Sciences—32-37 required credits
Biol 1009—General Biology (5)
Biol 1103—Botany (5)
or Biol 1106—Zoology (5)
Chem 1051, 1052—Chemical Principles I and II (4,4)
or Chem 1001—General Principles of Chemistry (4) and Chem 1002—Elementary Organic Chemistry (4)
or Chem 1003—Physical World Chemistry (5)
Phys 1041, 1045—Introductory Physics and Laboratory (4,1)
or Phys 1001, 1005—The Physical World (4,1)
Geo 1001—Introduction to Geology (4)
or Geo 1111—Introductory Physical Geology (5)
NRES 1001—Orientation to Natural Resources and Environmental Studies (1)
NRES 3001—Colloquium in Natural Resources and Environmental Studies (1)[2]
FR 1201—Conservation of Natural Resources (3)
FR 3250—Role of Renewable Natural Resources in Developing Countries (2)
or NRES 1040—Natural Resources as Raw Materials (2)
or NRES 1010—Issues in the Environment (3)

C. The Individual and Society—21 credits
Required Courses—13 credits
AgEc 1101—Principles of Microeconomics (4)
AgEc 1102—Principles of Macroeconomics (4)
Pol 1001—Political Science (5)

Suggested Courses—8 credits
Pol 3307—The American Bureaucracy (4)
Soc 1001—Introduction to Sociology (4)
Soc 1002—The American Community (4)
HSci 1711—Technology and Western Civilization (4)
Anth 5117—Anthropology of Resource Management (4)

D. Literature, Humanities, and Fine Arts—8 credits
Suggested Courses—
Hum 1005—Humanities in the Modern World (4)
Rhet 1301—Modern Thought and the Enlightenment (4)
Rhet 1302—Modern Thought and the Industrial Revolution (4)
Rhet 1303—Modern Thought and the Impact of Evolution (4)
Rhet 1310—Humanities: The Land in American Experience (4)
See the Liberal Education Requirements section of this bulletin for additional Category D suggestions.

Junior and Senior Years—90-96 credits
Required courses plus courses in Area of Concentration

Required Courses—44-52 credits
FR 3103—Meteorology and Climatology for Natural Resource Managers (2)
or Soil 1262—Introduction to Meteorology (4)
FR 3104—Forest Ecology (3)
or EEB 3001—Introduction to Ecology (4)
FR 5100—Silviculture (4)
FR 5114—Forest Hydrology (4)
or AgEt 5410—Hydrology and Water Quality (5)
FR 5240—Natural Resource Policy and Administration (3)
FR 5226—Forest Economics and Planning (5)
or AgEc 3610—Resource Development and Environmental Economics (4)
FW 3052—Introduction to Fisheries and Wildlife (3)
Rhet 3562—Writing in your Profession (4)
Soil 1020—The Soil Resource (4)
or Soil 3125—Basic Soil Science (4)
Soil 3220—Soil Conservation and Land Management (4)
or Soil 5210—Soil Physical Properties and the Environment (4)
or Soil 5510—Field Study of Soil for Environmental Assessment (4)
NRES 3050—Experience and Training in a Field Setting (1-4)
NRES 5099—Problem Solving in Natural Resources I (2)
NRES 5100—Problem Solving in Natural Resources II (3)
NRES 5210—Survey, Measurement, and Modeling Methods for Natural Resources I (3)

Total Graduation Requirements—180 credits
Required courses listed above (127-140), credits in Area of Concentration (24 credits minimum), and electives (16-29 credits).

Areas of Concentration—24 credits minimum

Resource Assessment—Focus on development of skills for assessing the magnitude and quality of various natural and environmental resources with techniques such as remote sensing, quantitative analysis, and geographic information systems. For more information, contact Dr. Marvin E. Bauer, 220B Green Hall (612/624-3703); Dr. James R. Kitts, 216 Hodson Hall (612/624-3298); Dr Alan R. Ek, 115C Green Hall (612/624-3400); Dr. Lloyd P. Queen, 220C Green Hall (612/624-9271); or Dr. Thomas E. Burk, 35A Natural Resources Administration Building (612/624-6741).

AgEc 3040—Economic Development of American Agriculture (4)
AgEc 3610—Resource Development and Environmental Economics (4)
FR 3104—Forest Ecology (3)
or EEB 3001—Introduction to Ecology (4)
EEB 5613—Assessing the Ecological Effects of Pollution (4)
Econ 5611—Resource and Environmental Economics (4)
FR 3300—Elements of Surveying (2)
FR 5130—Geographic Information Systems in Natural Resource Analysis (3)
FR 5200—Aerial Photo Interpretation (3)
FR 5212—Natural Resources Inventory (4)
FR 5231—Range Management (3)
FR 5232—Management of Recreational Lands (4)
FR 5233—Principles of Outdoor Recreational Planning (3)
FR 5241—Natural Resource Management: Political and Administrative Processes (3)
FR 5262—Remote Sensing of Natural Resources (4)
FR 5412—Advanced Remote Sensing (4)
FW 5455—Aquaculture (3)
FW 5460—Pollution Effects on Aquatic Systems (3)
FW 5601—Assessment and Management of Vertebrate Populations (5)
FW 5603—Ecology and Management of Fish and Wildlife Habitats (4)
FW 5604—Fisheries and Wildlife Management (4)
FW 5620—Geographical Information Systems (GIS) for Fisheries, Wildlife, and Biological Conservation (4)
Geog 5562—Introduction to Geographic Information Systems (4)
LA 5227—Impact Assessment and Environmental Mediation (5)
NRES 3060/5060—Water Quality in Natural Resource Management (3)
NRES 5220—Survey, Measurement, and Modeling Methods for Natural Resources II (4)
Soil 5232—Soil Physics (5)
Soil 5550—Peatlands: Formation, Classification, and Utilization (3)

Water Resources—Focus on the management of water resources to achieve desired water quantity and quality. Special emphasis on water movement, storage, and hydrologic and climatologic cycles. (Students should take Math 1251 and 1252 in place of Math 1142.) For more information, contact Dr. Kenneth N. Brooks, 235E Natural Resources Administration Building (612/624-2774); or Dr. James A. Perry, 312 Green Hall (612/624-9796).

AgEn 5540—Watershed Engineering (4)
AgEn 5550—Water Management Engineering (4)
AgET 5410—Hydrology and Water Quality (5)
CE 3400—Fluid Mechanics (4)
CE 5401—Water Resources Engineering (4)
CE 5505—Water Quality Engineering (4)
CE 5510—Solid and Hazardous Waste Management (4)
CE 5515—Water and Waste Water Microbiology (4)
FR 3104—Forest Ecology (3)
or EEB 3001—Introduction to Ecology (4)
FR 3103—Meteorology and Climatology for Natural Resource Managers (2)
FR 5114—Forest Hydrology (4)
FR 5115—Forest Hydrology, Field Applications (2)
(Cloquet)
FR 5153—Advanced Forest Hydrology (4)
FW 5460—Pollution Impacts on Aquatic Systems (3)
Geo 5601—Limnology (4)
Geo 5611—Groundwater Geology (4)
Geog 5444—Geography of Water Resources (4)
NRES 3060/5060—Water Quality in Natural Resource Management (3)
PubH 5242—Environmental Health Aspects of Groundwater Systems (2)
Soil 3416—Soil Fertility (5)
Soil 5240—Microclimatology (4)

Resources and Environmental Protection—Focus on understanding major environmental protection issues and their solutions. Topical concerns include solid waste management, global climate change, and protection of plant and animal resources. For more information, contact Dr. Edward Sucoff, 103 Green Hall (612/624-7249); Dr. Dietmar W. Rose, 301H Green Hall (612/624-9711); Dr. Hans M. Gregersen, 301D Green Hall (612/624-6298); Dr. James A. Perry, 312 Green Hall (612/624-9796); Dr. Carl Mohn, 105 Green Hall (612/624-7281); Dr. Ira R. Adelman, 200 Hodson Hall (612/624-3600); Dr. Anne Kapuscinski, 130 Hodson Hall (612/624-2720); or Dr. James R. Kitts, 216 Hodson Hall (612/624-3298).

AgEc 5600—Land Economics (3)
FR 3104—Forest Ecology (3)
or EEB 3110—Introduction to Ecology (4)
EEB 5613—Assessing the Ecological Effects of Pollution (4)
Econ 5611—Resource and Environmental Economics (4)
FR 5130—Geographic Information Systems in Natural Resource Analysis (3)
FR 5241—Natural Resource Management: Political and Administrative Processes (3)
FR 5262—Remote Sensing of Natural Resources (4)
FW 5460—Pollution Impacts on Aquatic Systems (3)
FW 5570—Avian Conservation (1-2)
FW 5603—Ecology and Management of Fish and Wildlife Habitats (4)
FW 5604—Fisheries and Wildlife Management (4)
FW 5620—Geographical Information Systems (GIS) for Fisheries, Wildlife, and Biological Conservation (4)
Geo 5108—Advanced Environmental Geology (4)
LA 5227—Impact Assessment and Environmental Mediation (5)
NRES 3060/5060—Water Quality in Natural Resource Management (3)

PA 5102—Legal Environment of Public Affairs (3)
PA 5721—Environmental Policy (3)
Pol 5523—Politics of the Regulatory Process (4)
PubH 5181—Air Pollution (3)
PubH 5242—Environmental Health Aspects of Groundwater Systems (2)
PubH 5253—Introduction to Hazardous Waste Management (3)
Soil 3416—Soil Fertility (5)
Soil 5340—Organic and Pesticidal Residues (5)

Environmental Issues and Planning— Focus on major issues in natural resources and the environment at local, national, and worldwide levels. Special emphasis on understanding, analysis, planning, and decision making required to address these problems. For more information, contact Dr. Paul V. Ellefson, 330B Green Hall (612/624-3735); Dr. Howard M. Hoganson, North Central Experiment Station, Grand Rapids, MN 55744 (218/327-4490); Dr. Francesca J. Cuthbert, 320 Hodson Hall (612/624-1756); Dr. David W. Lime, 301G Green Hall (612/624-2250); Dr. Melvin J. Baughman, 330G Green Hall (612/624-0734); Dr. Anne Kapuscinski, 130 Hodson Hall (612/624-2720); Dr. Dorothy H. Anderson, 301F Green Hall (612/624-2721); or Dr. Peter A. Jordan, 201C Green Hall (612/624-9281).

AgEc 3040—Economic Development of American Agriculture (4)
AgEc 3610—Resource Development and Environmental Economics (4)
AgEc 5650—Economics of Natural Resource Policy (4)
Anth 5117—Energy Research Use (4)
FR 3104—Forest Ecology (3)
or EEB 3001—Introduction to Ecology (4)
EEB 5613—Assessing the Ecological Effects of Pollution (4)
Econ 5611—Resource and Environmental Economics (4)
FR 5232—Management of Recreational Lands (4)
FR 5233—Principles of Outdoor Recreation Planning (3)
FR 5241—Natural Resource Management: Political and Administrative Processes (3)
FR 5257—Recreation Land Policy (3)
FW 5460—Pollution Impacts on Aquatic Systems (3)
FW 5603—Ecology and Management of Fish and Wildlife Habitats (4)
FW 5604—Fisheries and Wildlife Management (4)
LA 5227—Impact Assessment and Environmental Mediation (5)
PA 5001—Politics, Planning, and Decision Making (3)
PA 5102—Legal Environment of Public Affairs (3)
PA 5721—Environmental Policy (3)
Pol 5523—Politics of the Regulatory Process (4)

Soil Resources—Focus on management, interpretation, and inventory of soil resources. Emphasis on preventing soil erosion and reducing land degradation and adverse impacts of erosion on water and air quality. For more information, contact Dr. Edward Sucoff, 103 Green Hall (612/624-7249.)

AgEc 5600—Land Economics (3)
AgET 5410—Hydrology and Water Quality (5)
FR 3104—Forest Ecology (3)
or EEB 3001—Introduction to Ecology (4)
FR 5200—Aerial Photo Interpretation (3)
FR 5231—Range Management (3)
Soil 3220—Soil Conservation and Land Use Management (4)
Soil 3416—Soil Fertility (5)
Soil 5510—Field Study of Soils for Environmental Assessment (4)
Soil 5232—Soil Physics (4)
Soil 5240—Microclimatology (3)
Soil 5340—Organic and Pesticidal Residues (5)
Soil 5550—Peatlands: Formation, Classification, and Utilization (3)
Soil 5610—Soil Biology (4)
Soil 5710—Forest Soils (3)

Waste Management—Focus on the requirements needed to manage the waste stream. Understanding the processes involved in managing wastes and implementing procedures for MSW composting, incineration, recycling and the implications of landfilling of solid waste. For more information, contact Dr. James A. Perry, 312 Green Hall (612/624-9796).

CE 5510—Solid and Hazardous Waste Management (4)
Econ 5611—Resource and Environmental Economics (4)
FW 5460—Pollution Effects on Aquatic Systems (3)
NRES 5600—Principles of Waste Management (4)
PA 5001—Politics, Planning, and Decision Making (3)
PA 5721—Environmental Policy (3)
Pol 5523—Politics of the Regulatory Process (4)
PubH 5242—Environmental Health Aspects of Groundwater Systems (3)
Soil 5340—Organic and Pesticidal Residues (3)
Soil 5610—Soil Biology (4)

Recreation Resource Management

The objectives of this curriculum are to prepare students for careers in the comprehensive planning and management of land and water for recreation, with emphasis on natural non-urban areas; for participation in

government resource-oriented recreation programs as well as private planning and consulting; and for graduate work in resource planning and management.

Freshman and Sophomore Years—92-100 required credits

A. Communication, Language, and Symbolic Systems—17-18 required credits
Math 1142—Short Calculus (5)
or Math 1251—Differential Calculus (4)
Rhet 1101—Writing to Inform and Persuade (4)
Rhet 1104—Library Research Methods (1)
Rhet 1151—Writing in Your Major (4)
Rhet 1222—Public Speaking (4)

B. Physical, Biological, and Analytical Sciences—41-48 required credits
Biol 1008—Introductory Biology: An Evolutionary Approach (4)
or Biol 1009—General Biology (5)
Biol 1103—General Botany (5)
Biol 5041—Ecology (4)
Chem 1002—Elementary Organic Chemistry (4)
or Chem 1051—Chemical Principles I (4) and Chem 1052—Chemical Principles II (4)
FR 1001—Forest Resources Orientation (1)
FR 1100—Dendrology (4)
FR 1201—Conservation of Natural Resources (3)
Geo 1001—Introduction to Geology (4)
and Geo 1021—Introduction to Geology Lab: Geology of Minnesota (1)
or Geo 1111—Physical Geology (5)
LA 1024—Landscape Theory (4)
or LA 1031—Introduction to Landscape Architecture (4)
or LA 1001—Landscape Architecture: The Design of Environments (2)
Phys 1001—The Physical World (4)
and Phys 1005—Physics Laboratory (1) (Students who have completed high school physics with a B or better may be exempt, but must first see their adviser)
Soils 1020—The Soil Resource (4)
or Soils 3125—Basic Soil Science (4)
Electives and liberal education requirements

C. The Individual and Society—26-27 required credits
AgEc 1101—Principles of Microeconomics (4)
AgEc 1102—Principles of Macroeconomics (4)
Geog 1401—Physical Geography (5)
or Geog 1301—Human Geography (5)
Pol 1041—Contemporary Political Ideologies (4)
or Pol 3321—Issues in American Public Policy (4)
or Pol 1001—American Government and Politics (5)
Psy 1001—Introduction to Psychology (5)
Soc 1001—Introduction to Sociology (4)
Electives and liberal education requirements

D. Literature, Humanities, and Fine Arts—8 required credits
See the Liberal Education Requirements section of this bulletin for additional Category D suggestions.

Junior Year—42-46 required credits
AgEc 3610—Community Resource Development (4)
or AgEc 5620—Regional Economic Analysis (3-4)
FW 3052—Introduction to Fisheries and Wildlife (3)
FR 5114—Forest Hydrology (4)
FR 5130—Geographic Information Systems in Natural Resource Analysis (3)
FR 3300—Elements of Surveying (2) *(Cloquet)*
or Geog 3511—Introduction to Cartography (5)
FR 5232—Management of Recreational Lands (4)
Rec 3550—Park and Recreation Administration (5)
or Rec 3530—Recreation and Park Areas and Facilities (5)
Rhet 3254—Advanced Public Speaking (4)
or Rhet 3266—Communication, Discussion, in Small Group Decision Making (4)
Rhet 3562—Writing in Your Profession (4)
Soc 3801—Sociological Methods I: Descriptive Statistics (5)
Soc 3802—Sociological Methods II: Statistical Inference (5)
Electives and liberal education requirements

Senior Year—26-28 required credits
EEB 5014—Ecology of Plant Communities (5)
or EEB 5016—Ecological Plant Geography (5)
FR 5200—Aerial Photo Interpretation (3)
Soc 3803—Sociological Research Methods III: Research Methods (5)
or NRES 5210—Survey, Measurement and Modeling Methods for Natural Resources I (3)
FR 5233—Principles of Outdoor Recreation Planning (3)
FR 5259—Analysis of Outdoor Recreation Behavior (3)
or FR 5257—Recreation Land Policy (3)
NRES 5099—Problem Solving in Natural Resources and Environmental Studies I (2)
NRES 5100—Problem Solving in Natural Resources and Environmental Studies II (3)
Soc 3401—Social Organization (4)
or Soc 5661—Rural Community Analysis (4)
Electives and Liberal education requirements

Recommended Electives—
FR 3100—Minnesota Plants (2) *(Itasca)*
FR 3101—Northern Forest Ecosystems (3) *(Itasca)*
FR 3201—Field Forest Measurements (1) *(Itasca)*
FR 5212—Natural Resources Inventory (4)
FR 5226—Forest Economics and Planning (5)
PlPa 5050—Forest Pathology (4)
FR 5114—Forest Hydrology (4)
FR 5215—Forest Fire Management (2)
FR 5110—Forestry Applications of Microcomputers (4)
Hort 1021—Woody Plant Materials (5)
or Hort 1022—Herbaceous Plant Materials (5)
PBio 1009—Minnesota Plant Life (4)
Rhet 5170—Managerial Communications (4)
AgEc 1250—Principles of Accounting (5)
AgET 3030—Introduction to Problem Solving with Computers (4)
or CSci 3113—Introduction to Programming in C (4)
or CSci 3101—A FORTRAN Introduction to Computer Programming (4)
or GC 1571—Introduction to BASIC Programming and Microcomputers (5)
BLaw 3058—Introduction to Law, the Law of Contracts and Sales Contracts (4)
Mgmt 3001—Fundamentals of Management (4)
Mgmt 3002—Psychology in Management (4)

Pol 1001—American Government and Politics (5)
Rec 5250—Financing Leisure Services (3)
Soc 1651—Rural Sociology (4)
FR 5231—Range Management (3)

Total Graduation Requirements—192 credits
Required courses listed above (160-175 credits, and electives (17-32).

Urban Forestry

Urban Forestry involves planning and managing vegetation and associated natural resources in and near urban communities—along streets and in parks, transportation right-of-ways, private lands, greenbelts, and open spaces. Urban foresters help communities plan and design their urban forests, supervise tree selection and planting, design insect and disease protection programs, and provide related services. City governments are the principal employers, as well as state and federal forestry agencies, forestry consulting firms, tree service firms, nursery firms, and utility companies. Graduates may also be qualified for traditional professional forestry positions, including those in the federal government.

Freshman and Sophomore Years—71-76 required credits plus electives

A. Communication, Language, and Symbolic Systems—26-28 required credits
Math 1142—Short Calculus (5)
Rhet 1101—Writing to Inform and Persuade (4)
Rhet 1104—Library Research Methods (1)
Rhet 1151—Writing in Your Major (4)
Rhet 1222—Public Speaking (4)
Stat 3011—Statistical Analysis (4)
or Stat 5021—Statistical Analysis (5)
GC 1571—Introduction to BASIC Programming and Microcomputers (5)[1]
or AgEt 3030—Introduction to Problem Solving with Computers (4)
or CSci 3101—A FORTRAN Introduction to Computer Programming (4)
or CSci 3102—Introduction to Pascal Programming (4)

B. Physical, Biological, and Analytical Sciences—29-32 required courses
Biol 1009—General Biology (5)
Biol 1103—General Botany (5)
Chem 1051, 1052—Chemical Principles I and II (4,4)
or Chem 1001—General Principles of Chemistry (4) and Chem 1002—Elementary Organic Chemistry (4)
or Chem 1003—Physical World Chemistry (5)
FR 1001—Forest Resources Orientation (1)
Hort 1021—Woody Plant Materials (5)
Phys 1001—The Physical World (4)
Phys 1005—Physics Laboratory (1)
Soils 1020—The Soil Resource (4)
or Soils 3125—Basic Soil Science (4)

C. The Individual and Society—8 required credits (no more than 6 credits in any one discipline)
AgEc 1102—Principles of Macroeconomics (4)
See the Liberal Education Requirements section of this bulletin for additional Category C suggestions.

D. Literature, Humanities and Fine Arts—8 required credits
See the Liberal Education Requirements section of this bulletin for additional Category D suggestions.

Itasca Session—6 required credits
This summer term is to be taken between the freshman and sophomore or sophomore and junior years.
FR 3100—Minnesota Plants (2)
FR 3101—Northern Forest Ecosystems (3)
FR 3201—Field Forest Measurements (1)

Junior Year—34-35 required credits and recommended electives
ForP 1301—Wood as a Raw Material (4)
FR 1100—Dendrology (4)
FR 3104—Forest Ecology (3)
FR 5100—Silviculture (4)
FR 5120—Introductory Tree Physiology and Genetics (4)
FR 5212—Natural Resources Inventory (4)
FR 5233—Principles of Outdoor Recreation Planning (3)
or Hort 3030—Landscape Design of Residential and Small Commercial Sites (4)
PlPa 5050—Forest Pathology (4)
Rhet 3562—Writing in Your Profession (4)
Electives and liberal education requirements

Senior Year—32 required credits and recommended electives
AgEc 1250—Principles of Accounting (4)
Ent 5250—Forest Entomology (4)
FR 5200—Aerial Photo Interpretation (3)
FR 5226—Forest Economics and Planning (5)
FR 5240—Natural Resource Policy and Administration (3)
FR 5500—Urban Forest Management (3)
Hort 5046—Nursery Management and Production I (4)
Hort 5047—Nursery Scheduling and Enterprise Development (2)
Hort 5048—Nursery Management and Production II (4)
Electives and Liberal education requirements

Recommended Electives—at least 19 credits
BLaw 3058—Introduction to Law, the Law of Contracts and Sales Contracts (4)
Ent 5210—Insect Pest Management (4)
FW 3052—Introduction to Fisheries and Wildlife (3)
ForP 1303—Wood Structure and Identification (2)
FR 1202 Farm and Small Woodlands Forestry (2)
FR 3103—Meteorology and Climatology for Natural Resource Managers (2)
FR 3202—Leadership and Management Skills Development (2)
FR 3300—Elements of Surveying (2)
FR 5110—Forestry Applications of Microcomputers (3)

[1]*Students who wish to take FR 5110 should not take GC 1571. AgEt 3030 is the prereq for FR 5110.*

FR 5114—Forest Hydrology (4)
FR 5152—Forest Genetics (3)
FR 5232—Management of Recreational Lands (4)
FR 5241—Natural Resource Management: Political and Administrative Processes (3)
Hort 1022—Herbaceous Plant Materials (5)
Hort 1036—Plant Propagation (4)
Hort 1100—Biology of Horticultural Production (4)
Hort 3072—Turf Management (4)
Hort 5026—Landscape Management (5)
IR 3010—The Individual in the Organization (4)
or IR 3002—Personnel and Industrial Relations (4)
or Jour 3159—Public Relations (4)
LA 1031—Introduction to Landscape Architecture (4)
Mgmt 3001—Fundamentals of Management (4)
PA 5231—Strategy and Tactics in Project Planning (4)

Total Graduation Requirements—192 credits. Required courses (144-149 credits) recommended electives (19 credits), and electives (24-29 credits) credits.

College of Natural Resources

Course Descriptions

Course Descriptions

Course Numbering and Symbols—
Courses primarily for freshmen and sophomores are numbered 1000 through 1998; for juniors and seniors, 3000 through 3998; for juniors, seniors, and graduate students, 5000 through 5998. Courses numbered 8000 and above are restricted to students registered in the Graduate School.

The following symbols are used throughout the course descriptions:

, The comma, used in prerequisite listings, means "and."

§ Credit will not be granted if credit has been received for the course listed after this symbol.

¶ Concurrent registration is allowed (or required) in the course listed after this symbol.

† All courses preceding this symbol must be completed before credit will be granted for any quarter of the sequence.

Δ Registration Override Permit, completed and signed by the unit offering the course, is required for registration.

Registration Override Permit, completed and signed by the instructor, is required for registration.

When no abbreviated department prefix precedes the course number listed as a prerequisite, that prerequisite is in the same department as the course being described.

Agricultural and Applied Economics (AgEc)

1101. PRINCIPLES OF MICROECONOMICS. (4 cr, §Econ 1002; prereq 1102)
Economics of the firm and household; factor and product price determination; theory of production, consumption, and distribution; supply and demand analysis; equilibrium analysis.

1102. PRINCIPLES OF MACROECONOMICS. (4 cr, §Econ 1001)
Determinants of natural income and employment levels; prices and money; the banking system; monetary and fiscal policy; economic growth and development; role of government in the economy.

Agricultural Engineering Technology (AgET)

3030. INTRODUCTION TO PROBLEM SOLVING WITH COMPUTERS. (4 cr; prereq Math 1111 or equiv; 3 lect hrs, 1 rec hr per wk)
Elementary problem solving using computers. Writing programs in BASIC language. Use of timesharing terminals. Elements of computer hardware and software.

Chemistry (Chem)

1001. GENERAL PRINCIPLES OF CHEMISTRY. (4 cr, §1003, §1008, §1031-1032, §1051-1052)
Introduction to chemistry, matter and energy, atoms, molecules, chemical bonding, the mole and chemical calculations, gases, liquids, solids, solutions, chemical reactions, acids, bases, and equilibrium.

1002. ELEMENTARY ORGANIC CHEMISTRY. (4 cr, §3301, §3302; prereq 1001 or advanced placement by exam)
Short introduction to organic chemistry with emphasis on biological systems.

1003. PHYSICAL WORLD CHEMISTRY. (5 cr, §any other college chem course)
Fundamental concepts of chemical bonding, structure of matter, and forces in the physical world. Scientific methods and principles that contribute to understanding the environment and problems faced in improving it. Lab.

1051-1052†. GENERAL PRINCIPLES I AND II. (4 cr per qtr, §1001-1002, §1003, §1031-1032)
Introduction to chemistry from the standpoint of atomic structure; periodic properties of elements and compounds derivable from structural considerations; laws governing behavior of matter, theories of solutions, acids, bases, and equilibria.

3301. ELEMENTARY ORGANIC CHEMISTRY I. (4 cr, §3331; for non-chemistry majors; prereq 1005 or 1032 or equiv; 4 lect hrs per wk)
Important classes of organic compounds, both aliphatic and aromatic, together with some heterocyclic compounds.

3302. ELEMENTARY ORGANIC CHEMISTRY II. (4 cr; prereq 3301, 3305; 4 lect hrs per wk; if 3305 is taken concurrently, a passing grade is required for 3305 to receive cr for 3302)
Continuation of 3301.

3305. ELEMENTARY ORGANIC CHEMISTRY LABORATORY I. (2 cr; prereq 3301 or ¶3301; 1 lab conf, 4 lab hrs per wk)
Techniques used to prepare typical organic substances.

3306. ELEMENTARY ORGANIC CHEMISTRY LABORATORY II. (2 cr; prereq 3302 or ¶3302; 1 lab conf, 4 lab hrs per wk)
Techniques used to prepare typical organic substances.

Fisheries and Wildlife (FW)

1001. ORIENTATION IN FISHERIES AND WILDLIFE. (1 cr; S-N only)
Survey of technical requirements and education of fishery and wildlife technicians and scientists; introduction to fields of work, problems, and career opportunities.

1002. WILDLIFE: ECOLOGY, VALUES, AND HUMAN IMPACT. (3 cr)
Controversial issues involving specific wildlife management principles and techniques. For students without natural science background interested in natural resource topics, especially wildlife issues.

1101. ETHICS AND VALUES IN RESOURCE MANAGEMENT. (3 cr)
Various aesthetic, economic, and ecological values of wildlife and fisheries resources. Short field exercises and class discussions are directed at understanding the process and ethics of resource management and such controversies as sport, subsistence, and native peoples' harvest rights and genetic engineering.

3052. INTRODUCTION TO FISHERIES AND WILDLIFE. (3 cr)
Introduction to general ecological principles applied to management of fish and wildlife populations and their habitats; survey of legislation, agencies, and policy affecting vertebrate populations; natural history of important Minnesota game and nongame vertebrates.

3167. TECHNIQUES OF FOREST WILDLIFE MANAGEMENT. (2 cr; prereq Δ; at Cloquet)
Biology and management of important forest wildlife species; methods of evaluating forest wildlife populations and habitats.

3600. FISHERIES AND WILDLIFE FIELD TECHNIQUES. (5 cr; prereq 3052, Δ; at Itasca)
Introduction to various field techniques and skills; planning and implementing field projects; data collection and analysis using microcomputers. Written reports and a field journal.

5129. MAMMALOGY. (5 cr, §EEB 5129; prereq Biol 1106 or 3011 or #)
Recent families and orders of mammals of the world and genera and species of mammals of North America, with emphasis on morphology, evolution, and zoogeographic history.

5278. PROGRAMMING IN C. (3 cr; offered when feasible)
Programming in C for application to the life sciences.

5279. SPECIAL LECTURES: FISHERIES. (Cr ar; offered when feasible)
Lectures in special fields of fisheries given by a visiting scholar or regular staff member.

5393. SPECIAL PROBLEMS: FISHERIES BIOLOGY. (Cr ar; prereq #)
Individual field, library, and laboratory research in fisheries biology.

5398. SPECIAL PROBLEMS: WILDLIFE BIOLOGY. (Cr ar; prereq #)
Individual field, library, and laboratory research in wildlife biology.

5455. AQUACULTURE. (3 cr; prereq Biol 1009, 1103, 1106 or equiv, Chem 1051-52 or equiv or #; offered alt yrs)
Role of aquaculture in resource management and world food production; institutional and economic considerations; principles of husbandry of aquatic organisms; interactions between fish metabolism and water quality; nutrition and energetics; fish health and genetics.

5459. FISH PHYSIOLOGY. (4 cr; prereq AnSci 3301 or EEB 5136 or EEB 5156 or #)
Relationships between the physiology of fish, their behavior, and the aquatic environment. Includes examination of ionic and osmotic balance, gas exchange, locomotion, orientation and migration, reproduction, endocrinology, growth, and stress.

5460. POLLUTION IMPACTS ON AQUATIC SYSTEMS. (3 cr; prereq Biol 5041, Chem 1051, 1052, 3301, 3305, EEB 5601 or #; offered alt yrs)
Pollution assessment approaches, biological effects, fate and flow of contaminants in aquatic systems, major types of pollutants.

5461. THE BEHAVIOR OF FISHES. (2 cr; prereq EEB 1111 or FW 5459 or #)
Organismal and sub-organismal perspectives of fish behavior. Topics include feeding behavior and optimal foraging theory, learning and intelligence in fish, genetic basis of behavior, neural and endocrine bases of behavior, communication, orientation and navigation, schooling and shoaling, reproduction, and applying an understanding of fish behavior to the harvest, management, and conservation of fishes.

5570. AVIAN CONSERVATION. (4 cr; prereq #; offered alt yrs)
Current problems in avian conservation and management, with equal emphasis on non-game, wetland, and game birds.

5601. ASSESSMENT AND MANAGEMENT OF VERTEBRATE POPULATIONS. (5 cr; prereq Math 1142 or 1211, PubH 5450 or equiv, competency in microcomputer word processing and spreadsheet data entry)
Conceptual models of populations, description of population characteristics, and computer-assisted estimation of population parameters for the purpose of management.

5603. ECOLOGY AND MANAGEMENT OF FISH AND WILDLIFE HABITATS. (4 cr; prereq 5601 or #)
Ecological analysis of environmental factors as they influence distribution, abundance, and productivity of terrestrial and aquatic vertebrates. Emphasis on those factors subject to human influence. Three or four all-afternoon and/or Saturday morning field trips.

5604. FISHERIES AND WILDLIFE MANAGEMENT. (4 cr; prereq 5601 or #)
Basic understanding of fisheries and wildlife management with emphasis on managed species of interest. Introduction to tactics and strategies of fisheries and wildlife management. Understanding of the role of strategic planning in directing and redirecting management actions. Use and efficacy of fisheries and wildlife management tools.

5620. GEOGRAPHICAL INFORMATION SYSTEMS (GIS) FOR FISHERIES, WILDLIFE, AND BIOLOGICAL CONSERVATION. (4 cr; prereq Biol 5041, #)
Hands-on experience with GIS as a tool for understanding, analyzing, and managing ecological systems. Students learn ARC-INFO and apply it to problems in fisheries, wildlife, and biological conservation.

5701, 5702†. SENIOR PROJECT. (1-2 cr; prereq FW sr or grad or #)
Two-quarter course providing problem-solving training. Management problem identification and analysis design, information and data gathering and analysis, and oral and written problem reporting. Problem selection influenced by guest speakers, resource agency contacts, and group discussions; topic is a contemporary fisheries and wildlife management issue.

For Graduate Students Only

(For description, see *Graduate School Bulletin*)

8200. SEMINAR

8364. RESEARCH IN FISHERIES BIOLOGY

8377. RESEARCH IN WILDLIFE BIOLOGY

8448. FISHERY SCIENCE

8451. PRODUCTION BIOLOGY OF FISHERY ENVIRONMENTS

8452. CONSERVATION BIOLOGY: GENETIC AND DEMOGRAPHIC ISSUES

8459. STREAM AND RIVER ECOLOGY

8574. WILDLIFE MANAGEMENT: UPLAND GAME

8576. WILDLIFE MANAGEMENT: LARGE MAMMALS

8579. ECOSYSTEM ANALYSIS AND SIMULATION: A NUMERICAL APPROACH

Forest Products (ForP)

1001. FOREST PRODUCTS ORIENTATION. (1 cr)
Information about curricula offerings, specializations, career options, CLE requirements, financial aid, scholarships, summer employment, and other student-related concerns.

1100. WOOD IN AMERICAN LIFE. (3 cr; prereq Math 1111 or #)
Past, present, and future uses of wood. Types of products, quantities of wood used, import/export balances, forest resource situation, prospects of substitution for wood and environmental trade-offs, wood conversion efficiency and impacts on quantities needed, wood for energy, and proper wood products use.

1301. WOOD AS A RAW MATERIAL. (4 cr)
Physical and chemical nature of solid wood and wood fiber as it relates to the requirements of major wood-based industries. World supply and consumption. Weekly demonstration labs dealing with structure and properties of wood and manufacture of solid, particle, and fiber products.

1303. WOOD STRUCTURE AND IDENTIFICATION. (2 cr; prereq 1301 or #)
Features of wood structure vital to identifying wood of various tree species and understanding physical properties of wood. Lecture and lab.

3202. LEADERSHIP AND MANAGEMENT SKILLS DEVELOPMENT. (2 cr)
Discussions and classroom exercises on management, planning, directing, controlling, and organization; group problem solving, the implications of organizational change, time management, and career planning and development.

3300. WOOD INDUSTRY TOURS. (2 cr; prereq 1301; jr or sr standing or #)
Five-day bus tour of visits to a dozen or more manufacturers representing a broad cross section of the wood-using industry. Scheduled during spring quarter break.

3301. INDUSTRIAL INTERNSHIP. (2 cr; prereq ForP cooperative education student)
Industrial work assignment in ForP cooperative education program. Evaluation based on formal report written by student at end of each quarter of work assignment.

3303. FOREST PRODUCTS MARKETING. (3 cr)
Survey of marketing in the forest products industry, including review of basic marketing concepts and terminology.

3310. WOOD-FRAME BUILDING SYSTEMS AND MATERIALS. (4 cr; prereq Phys 1001 or equiv)
Light-frame construction methods and material selection with emphasis on wood-based products and components. Basic wood properties and products, cost estimating, building codes, construction practices, heat loss, and residential construction terminology.

3312. BUILDING MATERIALS ESTIMATING. (2 cr)
Modern methods of estimating quantity, grade, and specifications of building materials for light-frame construction.

3325. DIRECTED STUDY EXPERIENCE. (1-5 cr; prereq #)
Opportunity to pursue experiences not available under independent study or extra credit registration. The student develops, in consultation with the project adviser, a prospectus and completes progress reports and a final report on his or her project.

3361. INTRODUCTION TO ADHESIVES. (3 cr; prereq BioC 1301, Phys 1042; offered alt even yrs)
Scope and use of adhesive applications. Fundamental nature of adhesion; ideal adhesive joint. Adhesive polymers. Fabrication and mechanical properties of adhesively bonded assemblies.

5300. WOOD-FLUID RELATIONSHIPS. (3 cr; prereq 1301)
Moisture in wood and its relationship to density and specific gravity, shrinking and swelling, electrical properties, strength properties, thermoconductivity, sorption isotherms, dimensional stabilization, permeability and diffusion. Lectures only.

5301. MECHANICAL PROPERTIES. (3 cr; prereq 1301 or #)
Basic mechanics and strength of materials as applied to wood products.

5302. WOOD CHEMISTRY I. (3 cr; prereq Chem 3302)
Molecular structure of wood cell wall. Structures, properties, and reactions of monosaccharides and derivatives; oligosaccharides. Structure, properties, and biogenesis of cellulose; cellulose derivatives; comparison with starch.

5303. WOOD DETERIORATION. (4 cr; prereq 1301 or #)
Deterioration of wood and wood products by bacteria, fungi, insects, marine organisms, fire, and weathering; methods of preservation and preservatives used. Lecture and lab.

5304. WOOD DRYING AND PRESERVATION PROCESSES. (4 cr; prereq 5300, 5303)
Examination of materials, equipment, processes, and technical considerations inherent in the industrial drying and/or preservative treatment of wood products. Lectures, lab exercises, and plant visits.

5305. PULP AND PAPER TECHNOLOGY. (2 cr; prereq #)
Pulping processes, fiber refining and processing, manufacture of paper; fiber and paper properties; paper recycling; water requirements and effluent treatment.

5306. ANALYSIS OF PRODUCTION SYSTEMS. (3 cr; prereq 1301 or #; 3300 recommended)
Engineering and economic analysis of manufacturing and distribution systems for wood-based products. Material balances, equipment selection, economic analysis, and presentation techniques.

5307. WOOD-BASE PANEL TECHNOLOGY. (4 cr; prereq 5300, 5301 or #)
Design, manufacture, properties, and applications of structural and nonstructural wood-base panels. Adhesives and their application in the panel industry. Lecture and lab.

5310. PULP AND PAPER PROCESS LABORATORY. (3 cr; prereq 5305 or #)
Chemical and mechanical pulping, pulp preparation, secondary fiber, de-inking, wet-end additives. Lab problems and exercises supplemented by lectures.

5312. PULP AND PAPER PROCESS CALCULATIONS. (4 cr; prereq ForP 5311, ChEn 5101, ME 3301 [co-req])
Physical and chemical process calculations; steady and unsteady state material and energy balances applied to pulping and papermaking processes; flowsheet and system calculations; computer-aided material and energy balances.

5313. PULP AND PAPER PROCESS OPERATIONS I. (4 cr; prereq ForP 5305, 5312, 5353, CE 3400, ME 3301, ME 5342 or ChEn 5102 or #)
Applying principles of momentum, heat, and mass transfer to unit operations in the pulp and paper industry; fluid transport, filtration, sheet formation, sedimentation, drainage, pressing, heat exchange, evaporation, washing, bleaching, humidification and drying, chemical and energy recovery. Computer simulation of multiple-stage systems.

5314. PULP AND PAPER PROCESS OPERATIONS II: PAPER MACHINE OPERATIONS, FINISHING, AND CONVERTING. (3 cr; prereq ForP 5305, 5310, 5311, 5312, 5315, 5321 [co-req], 5359, CE 3400, ME 3301, ME 5342 or #)
Theory and practice of the design and operation of paper machines and associated finishing and converting equipment.

5315. PAPER ENGINEERING LABORATORY. (2 cr; prereq 5305, 5310 or ¶5310, 5312 or #)
Experiments that illustrate and apply the principles of momentum, heat, and mass transfer. Operation and performance optimization of pilot-plant paper machine. Process engineering studies of industrial production systems.

5316. COATED PRODUCT DEVELOPMENT. (2 cr; prereq 5359)
Coating process and products (primarily paper); theory, techniques, and procedures for formulating and applying coatings; properties and uses of coated products.

5318. PULP AND PAPER PROCESS DYNAMICS AND CONTROL. (3 cr; prereq ForP 5305, 5310, 5311, 5312, 5315, 5321 [co-req], CE 3400, ME 3301, ME 5342 or #)
Theory and practice of process control in the pulp and paper industry: sensors, control equipment and algorithms, final control elements; applications to industrial pulp and paper manufacturing, available hardware and software.

5320. BIOLOGICAL AND ENVIRONMENTAL SCIENCE OF PULP AND PAPER. (3 cr; prereq sr or grad standing in ForP or #)
Biology and chemistry of the pulp and paper processes as related to their impacts on the environment; treatment of process effluents and discharges; government regulations and industry compliance; theory, design, and operation of equipment for the treatment or prevention of environmental effects; biochemistry of pulp and paper aquatic systems; advances in biological pulping and papermaking.

5321. MATERIAL SCIENCE OF PAPER (PAPER AND FIBER PHYSICS AND PROPERTIES). (4 cr; prereq ForP 5305, 5310, 5311, 5312, 5315, 5359, CE 3400, ME 3301, ME 5342, Chem 5520 [co-req] or #)
Advances in understanding the response of fibers subjected to various operations of papermaking processes: mechanisms acting in stock preparation, refining, wet-end operations, web consolidation, and drying; analysis of their corresponding influences on fiber, pulp suspension, and paper properties; challenges placed on end products by changing raw materials and requirements, including introduction of recycled pulp in paper products.

5331. UNDERGRADUATE SEMINAR. (2 cr; prereq ForP major; must be taken before sr yr)
Career planning, resume preparation, discussion of job interviewing, and practice of technical presentation.

5350. WOODY TISSUE MICROTECHNIQUE. (2 cr; offered when feasible)
Use of sliding and rotary microtomes, maceration, differential staining, and special techniques in preparing woody tissue for microscopic study. Lab.

5353. WOOD CHEMISTRY II. (3 cr; prereq 5302)
Composition, distribution, and structures of hemicelluloses and their interactions with cellulose. Biosynthesis, structure, and analytical degradation of lignins. Wood delignification. Pulp bleaching chemistry. Lignin biodegradation.

5355. MECHANICS AND STRUCTURAL DESIGN WITH WOOD PRODUCTS. (4 cr; prereq 5301)
Mechanical behavior of lumber, plywood, and particleboard as applied to structural considerations in building construction. Lecture and lab.

5356. ADVANCED FOREST PRODUCTS MARKETING. (3 cr; prereq 3303 or #)
Marketing and market analysis, sales, and retail and wholesale distribution of forest products. Lectures and case studies.

5359. SURFACE AND COLLOID CHEMISTRY OF PAPERMAKING. (3 cr; prereq 5361, Chem 3302, Chem 5520 [co-req], ME 3301 or #)
Principles of surface and colloid chemistry applied to basic problems in pulp and paper manufacturing operations and product uses.

5360. STRUCTURE AND PROPERTIES OF IMPORTANT TROPICAL WOODS. (2 cr; prereq 1303)
Structure and methods of identifying commercially important tropical woods. Properties and favored uses of these woods.

5361. ADHESION AND ADHESIVES. (3 cr; prereq Chem 3302)
Scope and use of adhesive applications. Fundamental nature of adhesion; ideal adhesive joint. Conformations of linear polymers. Statistical thermodynamics and polymer adsorption onto adherent surface. Adhesives in common use. Mechanical properties of adhesive joints.

5401. SENIOR TOPICS. (Cr ar; prereq sr, #)
Independent study in a field of interest to a forestry major. Planned with adviser.

5405. PAPER IN TODAY'S WORLD. (3 cr, §5305; offered through CEE)
For elementary and secondary school teachers, though other interested students may enroll. Enables teachers to prepare a teaching unit on pulp and paper for use in an elementary, junior high, or senior high school science class. Not open to Forest Products majors.

5410. USE OF WOOD MATERIALS IN BUILDING CONSTRUCTION. (4 cr; offered through CEE)
For architects, builders, contractors, building materials salespeople, and do-it-yourselfers. Emphasizes the nature, properties, limitations, and proper use of wood products. Not open to Forest Products majors.

5415. DESIGN OF WOOD STRUCTURES. (4 cr; 5310 or equiv)
Wood structure engineering. Wood properties, strength and allowable stresses, durability, engineered wood products, behavior and design of beams and beam-columns, design of buildings and bridges, miscellaneous applications.

5417. RESIDENTIAL RETROFIT FOR COLD CLIMATES. (2 or 4 cr; recommended for secondary teachers of residential housing construction)
Methods for economic analysis and energy auditing with available software to aid in the analyses. Design and construction guidelines for the envelope based on air infiltration-exfiltration, moisture transport, and heat loss. Influence of retrofitting on indoor air quality, practices to maintain a healthy environment and a sound structure. Principles in the choice and installation of heating, cooling, and ventilating systems. Integrated or systems approach to designing and constructing residential retrofit emphasized.

5420. USING PROCESS SIMULATION IN THE PULP AND PAPER INDUSTRY. (2 cr; offered through CEE)
Two-day, hands-on microcomputer workshop. Solving flowsheet calculation problems relating to pulp and paper process engineering and demonstrations of the types of problems that can be solved using these techniques. Primarily for practicing engineers in the paper industry. Not open to Forest Products majors.

For Graduate Students Only

(For description, see *Graduate School Bulletin*)

8300. RESEARCH PROBLEMS

8301. RESEARCH PROBLEMS

8302. RESEARCH PROBLEMS

8303. ADVANCED TOPICS IN PANEL PRODUCTS TECHNOLOGY

8304. ADVANCED TOPICS IN WOOD DRYING

8306. SEMINAR: FOREST PRODUCTS

8307. ADVANCES AND METHODS IN FOREST PRODUCTS PATHOLOGY AND PRESERVATION

8310. MECHANICS OF WOOD AND WOOD COMPOSITES

Forest Resources (FR)

1001. FOREST RESOURCES ORIENTATION. (1 cr)
Information about curricula offerings, areas of emphasis, CLE requirements, and summer job and internship programs.

1100. DENDROLOGY. (4 cr; prereq Biol 1103)
Identification, nomenclature, classification, and distribution of about 200 important forest trees. Preparation and use of keys, systems of natural classification, and field and lab methods of identification.

1110. COLLOQUIUM IN NATURAL RESOURCES. (1-4 cr)
Selected topics in Natural Resources.

1200. INTRODUCTION TO FOREST RESOURCES. (3 cr)
Multiple forest resources and their management. History, policy, and current issues in forest resources. Lectures and lab (including field trips).

1201. CONSERVATION OF NATURAL RESOURCES. (3 cr)
Development of thought on natural resource conservation in the United States. Renewable resources and their management problems; resource conservation and environmental management related to basic ecological principles.

1202. FARM AND SMALL WOODLANDS FORESTRY. (3 cr for non-forestry majors, 2 cr for majors [3 cr with paper]; prereq for majors 1100 or ¶1100)
Status and problems of the small woodland owner. Factors influencing tree growth. Cutting practices for and marketing products of small woodlands. Establishment and care of plantations, shelterbelts, and windbreaks. Field trips.

1203. INTRODUCTION TO MINNESOTA'S NATURAL RESOURCES. (3 cr, §1201; for non-forestry students)
Ecological, social, and economic implications of Minnesota's soil, water, forest, wildlife, and other resources are studied in field exercise and group discussions at nature centers and natural areas. Environmental teaching techniques for the elementary indoor classroom.

1300. INTRODUCTION TO FOREST COMMUNITIES. (2 cr; prereq soph, some plant identification, one biol course or #; at Itasca)
Introduction to the soils, vegetation, wildlife, and ecologic dynamics of three forest communities in Itasca State Park. Five-day course offered during College of Natural Resources Itasca Session. For non-College of Natural Resources students only.

3100. MINNESOTA PLANTS. (2 cr; prereq Biol 1103, Δ; at Itasca)
Identification of plants as related to habitat.

3101. NORTHERN FOREST ECOSYSTEMS. (3 cr; prereq Chem 1001 or Chem 1051, Δ; at Itasca)
Field examination of succession, soils, silvical characteristics, tree classification, stand structure, and regeneration ecology.

3102. SOUTHERN FOREST RESOURCE TOUR. (1 cr; prereq FR jr or sr or #; offered alt odd yrs)
One-week field tour of selected southern forest industries and public forest management agencies. Walnut production, southern pine silviculture, hardwood use, various mill tours. Discussions, paper.

3103. METEOROLOGY AND CLIMATOLOGY FOR NATURAL RESOURCE MANAGERS. (2 cr; prereq Phys 1001, Phys 1005 or #)
Fundamentals of meteorology and climatology as applied to wildland resource management.

3104. FOREST ECOLOGY. (3 cr; prereq Itasca Session or #)
Ecological concepts and principles as a basis for conservation and management of forest ecosystems.

3106. IMPORTANT PLANTS IN FISHERIES AND WILDLIFE HABITATS. (1 cr; prereq FW 3600 or ¶3600; at Itasca)
Field identification of important plants in fisheries and wildlife habitats.

3110. COLLOQUIUM IN NATURAL RESOURCES. (1-4 cr)
Selected topics in Natural Resources.

3201. FIELD FOREST MEASUREMENTS. (1 cr; prereq Math 1008, Δ; at Itasca)
Introduction to land survey, tree and stand measurement, and basic forest sampling techniques.

3202. LEADERSHIP AND MANAGEMENT SKILLS DEVELOPMENT. (2 cr)
Discussions and classroom exercises on management, planning, directing, controlling, and organization; group problem solving, the implications of organizational change, time management, and career planning and development.

3225. DIRECTED STUDY EXPERIENCE. (1-5 cr; prereq fr or soph standing)
Opportunity to pursue experiences not available under independent study or extra credit registration. The student develops, in consultation with the project adviser, a prospectus and completes progress reports and a final report on his or her project.

3250. ROLE OF RENEWABLE NATURAL RESOURCES IN DEVELOPING COUNTRIES. (2cr)
International perspective on important resource issues, including integration of natural resource, social, and economic considerations. Overview of issues and case studies.

3300. ELEMENTS OF SURVEYING. (2 cr; prereq Math 1008 or high school trigonometry, Δ; at Cloquet)
Basic concepts of elementary plane surveying for use in natural resource assessment. Introduction to public land and boundary surveys and geographic information systems. Lectures and labs.

5100. SILVICULTURE. (4 cr; prereq for FR majors: 1100, 3104, Itasca Session; for non-majors: 3104 or equiv, #)
Introduction to silvics, forest regeneration and site preparation techniques, intermediate silvicultural practices, and silvicultural systems.

5101. FIELD SILVICULTURE. (4 cr; prereq 5100, Δ; at Cloquet)
Regeneration surveys, plantation inspection, site preparation, and reforestation prescription. Practice in marking for thinning and determining effect on stands. Compartment examination and prescription. Written and oral reports.

5104. FOREST ECOLOGY. (3 cr; prereq one biol course or #)
Ecological concepts and principles as a basis for conservation and management of forest ecosystems.

5106. SENIOR SILVICULTURE SEMINAR. (2 cr [3 cr with research paper]; prereq sr, 5100 or #)
Students prepare, present, and critique seminars on silvicultural topics of interest. Guest speakers.

5110. FORESTRY APPLICATIONS OF MICRO-COMPUTERS. (4 cr; prereq Stat 3011, AgET 3030 or equiv; offered alt even yrs)
Use of commercial microcomputer software to solve forestry problems; applications programming; workings of hardware components. Lectures and hands-on access to microcomputers.

5114. FOREST HYDROLOGY. (4 cr; prereq Itasca Session, 3103, Geo 1001 or #)
Introduction to the hydrologic cycle and hydrologic processes. Effects of forest management activities on water yield, storm flow, and water quality.

5115. FOREST HYDROLOGY, FIELD APPLICATIONS. (2 cr; prereq 5114, Δ; at Cloquet)
Use of hydrologic instrumentation to measure precipitation, streamflow, infiltration capacity, soil moisture, air temperature, evaporation, and selected water quality constituents. Collection and interpretation of hydrologic information to evaluate forest-use impacts on water quantity and quality.

5120. INTRODUCTORY TREE PHYSIOLOGY AND GENETICS. (4 cr; prereq Chem 1001 or 1051, 10 cr biol)
Genetic variation in forest trees, underlying causes, use. Tree growth, nutrition, and water relations. Environmental and internal growth regulation. Plant biochemistry and photo-chemistry. Physiology related to silviculturally and ecologically significant phenomena.

5121. TREE PHYSIOLOGY LABORATORY. (1 cr; prereq 5120 or ¶5120)
Lab study of tree biology. Emphasis on design and conduct of experiments.

5126. SILVICULTURE: SOIL-SITE RELATIONSHIPS. (2 cr; prereq 1020, 5100, Δ; at Cloquet)
Field examination of forest soils and their relationship to site productivity and forest management.

5130. GEOGRAPHICAL INFORMATION SYSTEMS IN NATURAL RESOURCE ANALYSIS. (3 cr; prereq sr or grad or #)
Introduction to the application of Geographical Information Systems (G.I.S.) to natural resource and regional planning studies. Theory and technical points; emphasis on applications. Hands-on experience with microcomputer. Case study, including map digitizing, data processing, and generation of map products.

5152. FOREST GENETICS. (3 cr; prereq sr or #)
Genetic variation of forest-tree species and underlying principles; application of plant breeding principles to forestry.

5153. ADVANCED FOREST HYDROLOGY. (4 cr; prereq 5114 or #)
Current hydrologic problems in managing forested watersheds. Analytical methods used to evaluate effects of vegetation management on the quantity and quality of runoff. Lecture and lab.

5160. PRACTICUM IN FOREST BIOLOGY AND MEASUREMENTS. (3 cr; prereq grad, #; at Itasca)
Plant identification, plant dynamics, land survey, tree measurement.

5200. AERIAL PHOTO INTERPRETATION. (3 cr)
Types, characteristics, procurement, preparation, viewing, and interpretation of color, black-and-white, and color infrared aerial photographs; basic aerial photography; introduction to mapping; applications to resource surveys.

5212. NATURAL RESOURCES INVENTORY. (4 cr; prereq Itasca Session, AgET 3030 or equiv computer programming course with FORTRAN or BASIC language, Math 1142 or Math 1211, Stat 3011 or Stat 5021)
Measurement of stand variables, forest products, forest growth and yield. Elementary statistics. Sampling methods for estimating characteristics of natural resources and resource use for management decision making. Lecture and lab.

5215. FOREST FIRE MANAGEMENT. (2 cr; prereq 1100, 3103, 5100, Itasca Session or #)
Concepts, principles, and techniques of fire control and use in wildland management.

5220. REMOTE SENSING, FOREST RESOURCES INVENTORY. (4 cr; prereq 5200, 5212, Δ; at Cloquet)
Use of aerial photographs in property boundary location; interpretation and classification of forest vegetation types. Application of sampling methods for estimating natural resources and resource use for management decision making.

5221. PLANT MOLECULAR EVOLUTION. (3 cr; prereq Biol 5003 or GCB 3022 or GCB 5022; equiv to PBio 5221)
Experimental molecular techniques applicable to evolutionary studies. Molecular methods of quantifying genetic diversity. Statistical methods for phylogenetic reconstruction. Application of RFLPs to the study of chromosomal evolution. Application of RFLPs to the study of morphological evolution. Evolution of organellar gonomes. Evolution of multigene families. Role of transposable elements in plant evolution. DNA sequence evolution. Molecular aspects of development as related to plant evolution.

5225. DIRECTED STUDY EXPERIENCE. (1-5 cr; prereq jr or sr or grad standing)
Opportunity to pursue experiences not available under independent study or extra credit registration. The student develops, in consultation with the project adviser, a prospectus and completes progress reports and a final report on his or her project.

5226. FOREST ECONOMICS AND PLANNING. (5 cr; prereq 5212, AgEc 1101 or #)
Conduct and interpretation of economic analysis; forest planning concepts, principles, and techniques of forest regulation.

5231. RANGE MANAGEMENT. (3 cr; prereq Biol 1103 or #)
Important range plants; range livestock; range management methods and improvements; public grazing land administration; relationship of livestock grazing to wildlife, forest, watershed, and recreation management on public and private range lands.

5232. MANAGEMENT OF RECREATIONAL LANDS. (4 cr)
Understanding and applying recreation management tools from a public agency perspective. Management concepts such as ROS, LAC, social monitoring, and public information processes.

5233. PRINCIPLES OF OUTDOOR RECREATION PLANNING. (3 cr; prereq 5232, Stat 3100, 5021 or Soc 3801 or #)
Planning methodologies. Students use survey instruments and observational techniques for data gathering; analyze data from surveys, observation, and computer-mapping techniques; use GIS information in planning recreational uses and understanding the trade-offs between choices; and select appropriate planning strategies for public involvement processes involved in recreation resource planning.

5236. FOREST RECREATION PLANNING. (1 cr; prereq 5232, Δ; at Cloquet)
Recreation area and site planning, examples and managerial concerns. Fieldwork and presentation.

5240. NATURAL RESOURCE POLICY AND ADMINISTRATION. (3 cr; prereq For jr or sr or #)
Basic concepts of political and administrative processes in developing natural resource policies and programs. Policy processes, agenda setting, political decision rules, strategies for achieving agreement, participants in policy development, public means of implementing policies, and case examples.

5241. NATURAL RESOURCE MANAGEMENT: POLITICAL AND ADMINISTRATIVE PROCESSES. (3 cr; prereq 5240 or #)
Advanced concepts of political and administrative processes important to developing natural resource policies and programs. Issue creation and agenda-setting theories, incremental decision-making styles, role of analysis and analytical information, actions of major policy participants (e.g., courts, legislatures, interest groups, media), program planning, budgeting and staffing, and evaluation of natural resource case studies.

5248. HARVESTING AND ENGINEERING. (3 cr; prereq CE 3100 or FR 3300, Δ; at Cloquet)
Introduction to harvesting systems, relationship to forest management, and preparation and administration of timber sales. Fundamentals of location, construction, and maintenance of forest roads.

5250. ROLE OF RENEWABLE NATURAL RESOURCES IN DEVELOPING COUNTRIES. (2 cr)
International perspective on important resource issues, including integration of natural resource, social, and economic considerations. Overview of issues and case studies. Term paper, other requirements.

5257. RECREATION LAND POLICY. (3 cr; prereq 5232 or #)
Policy issues affecting the use and management of lands devoted entirely or in part to recreational objectives.

5259. ANALYSIS OF OUTDOOR RECREATION BEHAVIOR. (3 cr; prereq 5232, RRM major or grad or #)
Development of environmental framework for understanding recreation behavior. Contributions of several disciplines, current cultural trends, management implications.

5262. REMOTE SENSING OF NATURAL RESOURCES. (4 cr)
Introduction to remote sensing for natural resource inventories, land-use analyses, and environmental monitoring activities; photographic, thermal, multispectral, and radar sensing procedures; airborne and satellite systems; visual and computer-assisted analysis techniques; oriented toward an interdisciplinary audience.

5264. QUANTITATIVE TECHNIQUES IN FOREST MANAGEMENT. (3 cr; prereq 5212, 5226 or #)
Forestry applications of quantitative techniques in allocation and other decision-making problems. Mathematical programming, simulation, and other techniques.

5401. SENIOR TOPICS. (Cr ar; prereq Nat Res sr or #)
Independent study in a field of interest to the student. Work must be planned with a Natural Resources faculty member.

5403. FUNDAMENTALS OF NATURAL RESOURCE EDUCATION. (3 cr; offered through CEE)
For elementary teachers. Study of soil, water, forest, and wildlife resources of Minnesota and the biological principles and ecological implications of management. Discussion of environmental issues developed through natural resource manipulation. Development of outdoor teaching skills in environmental education in a metropolitan center.

5412. ADVANCED REMOTE SENSING. (4 cr; prereq 5262 or #)
Working knowledge of quantitative remote sensing. Both theoretical basis and practical aspects, including energy-matter interactions, radiation measurements and sensors, and digital image analysis.

5460. WATER QUALITY: THE INTERNATIONAL DIMENSION. (3 cr; prereq previous college-level classwork in water resources or #)
Water quality management practices and policies in non-U.S. countries. Water quality as one of many natural resources being managed by rapidly changing societies. World literature in natural resources.

5500. URBAN FOREST MANAGEMENT. (3 cr; prereq 5100 or #)
Discussion and development of basic concepts. Introduction to terminology and principles of urban tree inventory, propagation, and care; management case studies; equipment operation and costs.

5703. COLLOQUIUM IN FOREST BIOLOGY. (1-4 cr; prereq varies with topic, #)
Colloquium on specialized topics in forest biology and silviculture.

5704. COLLOQUIUM IN NATURAL RESOURCES. (1-4 cr; prereq varies with topic, #)
Colloquium on specialized topics in Natural Resources.

For Graduate Students Only

(For description, see *Graduate School Bulletin*)

8100. RESEARCH PROBLEMS: SILVICULTURE

8101. RESEARCH PROBLEMS: FOREST-TREE PHYSIOLOGY

8102. RESEARCH PROBLEMS: FOREST-TREE GENETICS

8103. RESEARCH PROBLEMS: FOREST HYDROLOGY

8104. RESEARCH PROBLEMS: FOREST ECOLOGY

8106. TOPICS IN SILVICULTURE-FOREST SOILS

8107. SEMINAR: FOREST RESOURCES

8200. RESEARCH PROBLEMS: FOREST MANAGEMENT

8201. RESEARCH PROBLEMS: FOREST ECONOMICS

8202. RESEARCH PROBLEMS: FOREST BIOMETRY

8203. RESEARCH PROBLEMS: FOREST RECREATION

8204. RESEARCH PROBLEMS: FOREST POLICY

8205. RESEARCH PROBLEMS: REMOTE SENSING

8207. ECONOMIC ANALYSIS OF FORESTRY PROJECTS

8211. SEMINAR: NATURAL RESOURCE POLICY ISSUES

Mathematics (Math)

1131. FINITE MATHEMATICS. (5 cr; prereq 3½ yrs high school math or grade of C or better in 1111)
Elementary computer programming, financial mathematics, probability, linear algebra, linear programming, Markov chains.

1142. SHORT CALCULUS. (5 cr; for students requiring minimal amount of calculus; prereq 3½ yrs high school math or grade of C or better in 1111 or 1201)
Derivatives, integrals, differential equations, maxima and minima, partial differentiation, applications.

1201. PRE-CALCULUS. (5 cr, §1111; for students needing to review high school higher algebra and trigonometry before taking calculus; prereq 4 yrs high school math including trigonometry)
Inequalities, analytical geometry; complex numbers, binomial theorem, mathematical induction; functions and graphs; trigonometric, exponential, and logarithmic functions.

1251-1252. ONE-VARIABLE DIFFERENTIAL AND INTEGRAL CALCULUS I-II. (4 cr per course, §1211-1221, §1411H-1421H, §1451H-1452H; prereq 4 yrs high school math including trigonometry or grade of C or better in Math 1201 or grade of C or better in 1008 (or equiv) and 1111 (or equiv); grade of C or better in 1251 required for 1252)
Calculus of functions of one variable and related geometry and applications.

1261. THE ALGEBRA AND GEOMETRY OF EUCLIDEAN SPACE. (4 cr, §1241, §1553, §3142, §3511H; prereq 1211 or 1251)
Vectors and their operations; matrices and matrix algebra, linear algebraic equations; Gaussian elimination; determinants and their applications; linear transformations; subspaces, quadratic functions, rigid motions, orthogonal matrices.

3251. MULTIVARIABLE DIFFERENTIAL CALCULUS. (4 cr, §3211, §3311, §3521H, §3552H; prereq 1251, 1261)
Differentiation of parametric curves; partial differentiation and the derivative as local linear approximation; the chain rule; applications to maximum/minimum problems with attention to boundaries and constraints, including Lagrange multipliers; Taylor's Theorem (multivariable) and the second derivative test.

3252. MULTIVARIABLE INTEGRAL CALCULUS. (4 cr, §for students with 3311 and 3331 or 3211 and 3331, §3551H, §3552H; prereq ¶3251)
Double and triple integrals; change of variable procedures with emphasis on polar and spherical coordinates; mass and centroid; integration on curves and surfaces; vector fields and the theorems of Green, Gauss, and Stokes.

3261. DIFFERENTIAL EQUATIONS WITH LINEAR ALGEBRA. (4 cr, §3221, §3321, §3531H, §3551H; prereq 1221 or 1252, 1241 or 1261 or 3142)
Differential equations, including first order equations, linear equations with constant coefficients, and linear systems. Companion topics from linear algebra; general vector spaces, independence, spanning sets, basis, dimension, eigenvalues, and eigenvectors.

3262. INFINITE SEQUENCES AND SERIES WITH METHODS OF APPROXIMATION. (4 cr; prereq ¶3261)
Infinite sequences and series; mathematical induction and its implications for recursively defined sequences; convergence and techniques for evaluating sequential limits and sums of series; applying sequences and series to approximations and estimates of error. Required for Honors students who have not taken Math 1552H.

Natural Resources and Environmental Studies (NRES)

1001. ORIENTATION TO NATURAL RESOURCES AND ENVIRONMENTAL STUDIES. (1 cr; S-N only)
Information about NRES major. Discussions with faculty adviser. Employment information. Current topics in NRES. Information about facilities. Discussions with alumni.

1010. ISSUES IN THE ENVIRONMENT. (3 cr)
Interdisciplinary offerings exploring five areas of environmental concern: aspects of environmental design providing maximum compatibility of human beings with their environment, sources of water pollution and their control, disposal and control of solid wastes from agriculture, minimization of pesticide pollution of the environment, and managed use of forest resources to maintain environmental quality. A televised course involving 20 taped lectures and 10 discussion periods.

1040. NATURAL RESOURCES AS RAW MATERIALS. (2 cr)
Role of natural resources as raw materials for industry and economic development. Environmental and economic trade-offs associated with raw material gathering, processing, and use. Implications of processing technologies, energy considerations.

3001. COLLOQUIUM IN NATURAL RESOURCES AND ENVIRONMENTAL STUDIES. (1 cr)
Round table discussions of current topics in Natural Resources and Environmental Studies.

3050. EXPERIENCE AND TRAINING IN A FIELD SETTING. (1-4 cr; prereq #)
Students must obtain professional experience in a field setting by attending field sessions, completing a Professional Experience Program, or volunteering for various Natural Resources and/or Environmental programs through local state or federal agencies. Approval by instructor required.

3060. WATER QUALITY IN NATURAL RESOURCE MANAGEMENT. (3 cr; prereq ¶5060)
Global and ecological perspective on the management of surface and groundwater resources.

3225. DIRECTED STUDY EXPERIENCE. (1-5 cr; prereq fr or soph standing)
Opportunity to pursue experiences not available under independent study or extra credit registration. The student develops, in consultation with the project adviser, a prospectus and completes progress reports and a final report on his or her project.

5060. WATER QUALITY IN NATURAL RESOURCE MANAGEMENT. (3 cr; prereq 3060)
Same as 3060. Students participate in a weekly discussion session and prepare an integrative paper discussing a water quality problem.

5099. PROBLEM SOLVING IN NATURAL RESOURCES AND ENVIRONMENTAL STUDIES I. (2 cr; prereq sr standing or #)
Helps students identify and analyze natural resources and environmental problems. Students identify a problem and develop a working plan for a solution, participating as a team.

5100. PROBLEM SOLVING IN NATURAL RESOURCES AND ENVIRONMENTAL STUDIES II. (3 cr; prereq 5099)
Developing a solution to the problem identified in 5099. Discussions reflect diverse aspects of the problem and assignments. Oral and written presentations. Students participate as a team.

5210. SURVEY, MEASUREMENT, AND MODELING METHODS FOR NATURAL RESOURCES I. (3 cr; prereq Math 1142, Stat 3011, AgEt 3030 or GC 1571 or equiv computer competency)
Introduction to survey design, measurement concepts, and modeling methods useful in the study of natural resources and environmental issues. Emphasis on data collection and analysis.

5220. SURVEY, MEASUREMENT, AND MODELING METHODS FOR NATURAL RESOURCES II. (4 cr; prereq 5210 or FR 5212 or equiv; offered alt yrs)
Advanced survey design, measurement concepts, and modeling methods for study of natural resources and environmental problems.

5225. DIRECTED STUDY EXPERIENCE. (1-5 cr; prereq jr or sr or grad standing)
Opportunity to pursue experiences not available under independent study or extra credit registration. The student develops, in consultation with the project adviser, a prospectus and completes progress reports and a final report on his or her project.

5600. PRINCIPLES OF WASTE MANAGEMENT. (4 cr; prereq Soil 1020 or 3125, one course in chem and biol)
Issues, problems, and solutions in remediating the waste stream generated by today's society. Topics include waste stream dynamics, MSW and yard waste composting, WTE incineration operation, ash disposal, recycling, landfill requirements, requirements for direct land disposal, regulatory trends, and case studies.

Physics (Phys)

1001. THE PHYSICAL WORLD. (4 cr, §any other physics courses except 1061)
Conceptual introduction to modern discoveries and theories in physics; discussion of their applications and importance in today's society. Relativity, cosmology, atomic physics, nuclear physics, solid state physics, superconductivity, computers, lasers, quarks, and unification theory. Development of classical background as needed.

1005. PHYSICS LABORATORY. (1 cr; prereq 1001 or ¶1001; S-N only)
Lab experiments offered with 1001.

1041-1042. INTRODUCTORY PHYSICS. (4 cr per qtr, §any other intro physics courses)
Lectures and problem sessions. Mechanics, fluids and gases, heat, waves, electricity and magnetism, light, optical instruments, atoms and spectra, nuclei, radioactivity. Associated labs are 1045-1046.

1045-1046. INTRODUCTORY PHYSICS LABORATORY. (1 cr per qtr; prereq for 1045: 1041 or ¶1041, prereq for 1046: 1042 or ¶1042; S-N only)
Lab experiments offered with 1041-1042.

1251-1252-1253-1254. GENERAL PHYSICS. (4 cr per qtr; prereq Math 1211 or ¶1211 for 1251, Math 1221 or ¶1221 for 1252, Math 1241 or ¶1241 for 1253; 3 lect, 1 rec, 2 lab hrs per wk)
Calculus-level general physics course.
1251: Mechanics.
1252: Heat, electricity.
1253: Magnetism, optics.
1254: 20th-century physics.

Rhetoric (Rhet)

1101. WRITING TO INFORM AND PERSUADE. (4 cr, §Comp 1011; prereq ¶1104)
Relationship of fact finding and clear thinking to informative and persuasive writing. Importance of thesis sentence, evidence, coherence, clarity, and correctness. Relatively short (500-750 words) assignments complement instruction in the Library Laboratory.

1104. LIBRARY RESEARCH METHODS. (1 cr; S-N only; taught by St. Paul campus library staff)
On-site instruction in information retrieval techniques. Lectures, audiovisual presentations, and problem-solving assignments strengthen skills in using the library.

1151. WRITING IN YOUR MAJOR. (4 cr; prereq 1101, 1104, soph status)
Students investigate and write on subjects related to their majors. The criterion of appropriateness: Good writing meets the expectation of readers and the conventions of a particular form. Assignments such as literature review, abstract, fact sheet, instructions, and feature article.

1222. PUBLIC SPEAKING. (4 cr; prereq 1101, 1104)
Fundamentals of speechmaking. Emphasis on organizing the speech and projecting it to the audience.

3254. ADVANCED PUBLIC SPEAKING. (4 cr; prereq 1222)
Training for specific speech situations most likely to be encountered professionally. Emphasis on analysis, design, preparation, and delivery of presentations to provide greater flexibility within a variety of speech environments.

3266. COMMUNICATION, DISCUSSION IN SMALL GROUP DECISION MAKING. (4 cr; prereq 1101)
Role of communication techniques in the small group decision-making process. Emphasis on discussion within a variety of decision-making modes such as voluntary groups, business meetings, and conflict groups.

3562. WRITING IN YOUR PROFESSION. (4 cr; prereq 1101, 1104, 1151, jr status)
Projects in professional writing. Relationship between structuring information to meet needs of particular readers and writing effectively. Assignments such as the feasibility report, proposal, memorandum, letter of application, and resume.

Soil Science (Soil)

1020. THE SOIL RESOURCE. (4 cr; prereq Chem 1001 or 1051)
Introduction to the physical, chemical, and biological aspects of soils. Use of the soil classification system to understand the use of soil survey information for land-use planning. Concepts of soil fertility for understanding plant growth requirements. Introduction to urban soils and their management. Understanding soil's role in environmental planning and conservation decisions.

5710. FOREST SOILS. (3 cr; prereq 1020, FR 5114)
Factors affecting tree growth; estimation, modification, and management effects on site productivity; regeneration.

Statistics (Stat)

3011. STATISTICAL ANALYSIS. (4 cr; prereq college algebra)

3012. STATISTICAL ANALYSIS. (4 cr; prereq 3011)

5021. STATISTICAL ANALYSIS. (5 cr, §3012; prereq college algebra)

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[2] *Associate member from Department of Entomology*
[3] *Associate member from Department of Ecology, Evolution, and Behavior*
[4] *Associate member from Department of Soil Science*
[5] *Associate member from Department of Horticultural Science*
[6] *Associate member from Division of Recreation, Park, and Leisure Studies*
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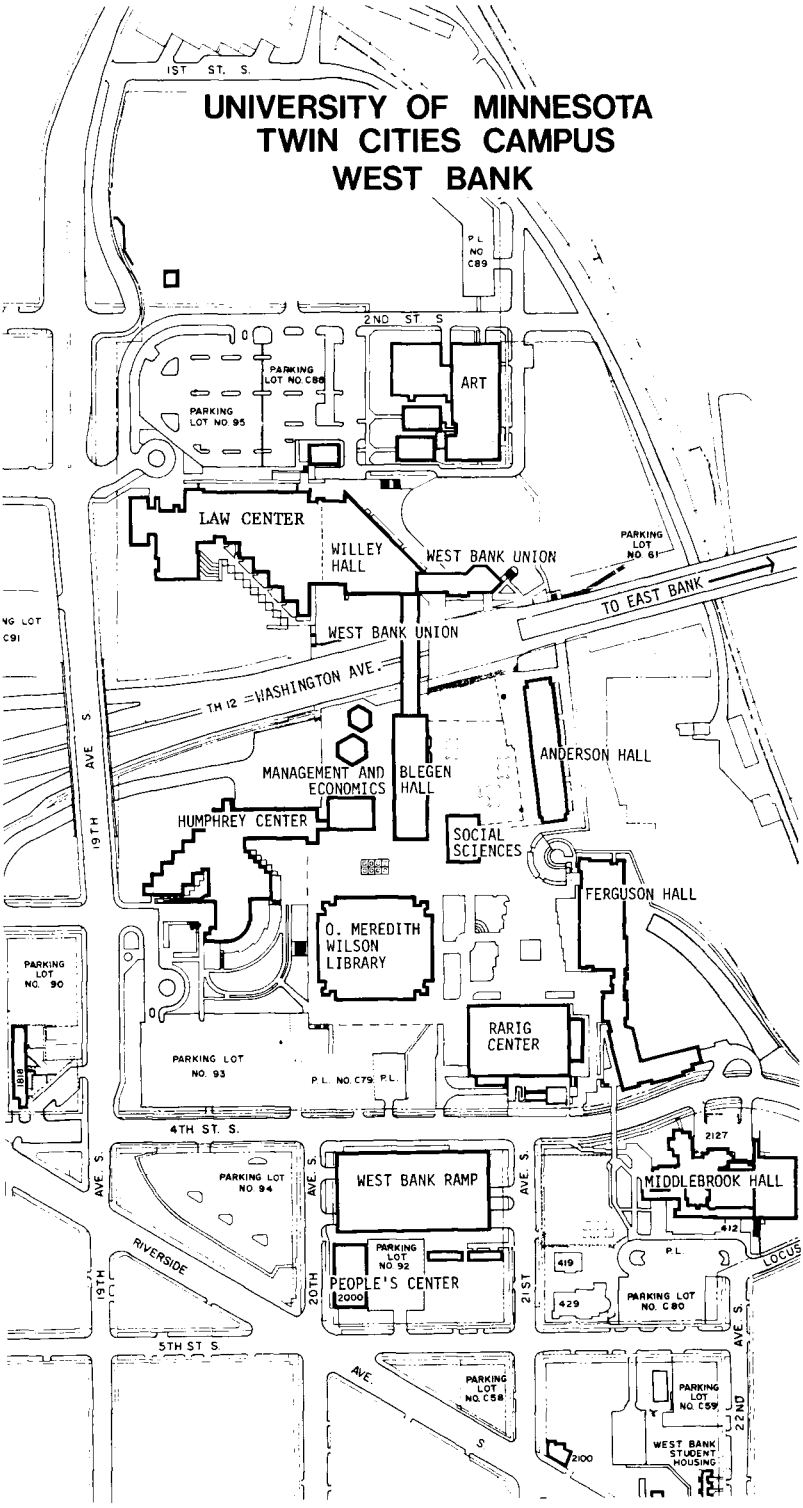
[12] *Associate member from Minnesota Extension Service*
[13] *Associate member from Department of Fisheries and Wildlife*
[14] *from USDA Forest Service North Central Forest Experiment Station*
[15] *from Minnesota Department of Natural Resources*
[16] *Recipient of the Horace T. Morse-Minnesota Alumni Association Award for Outstanding Contributions to Undergraduate Education*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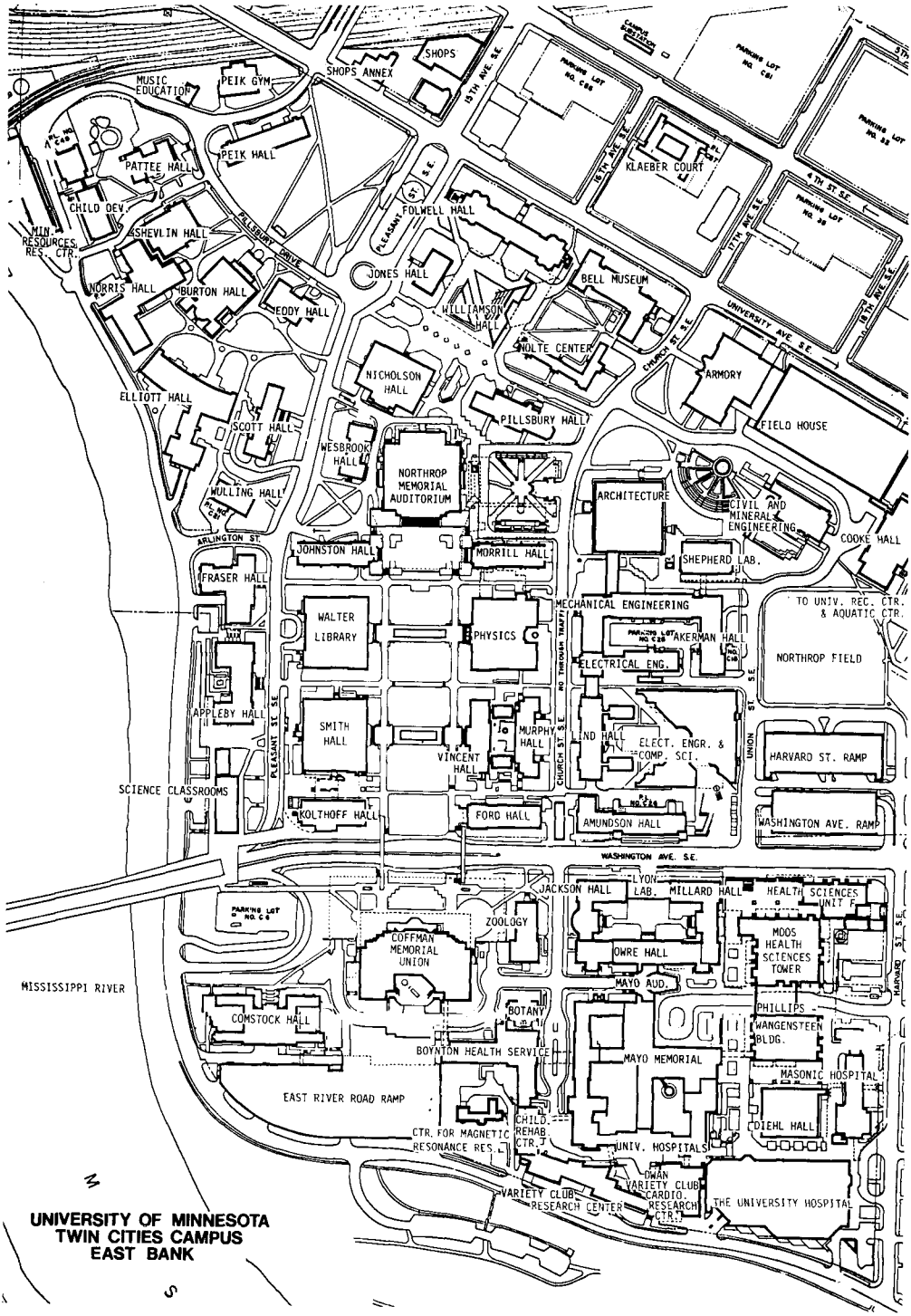
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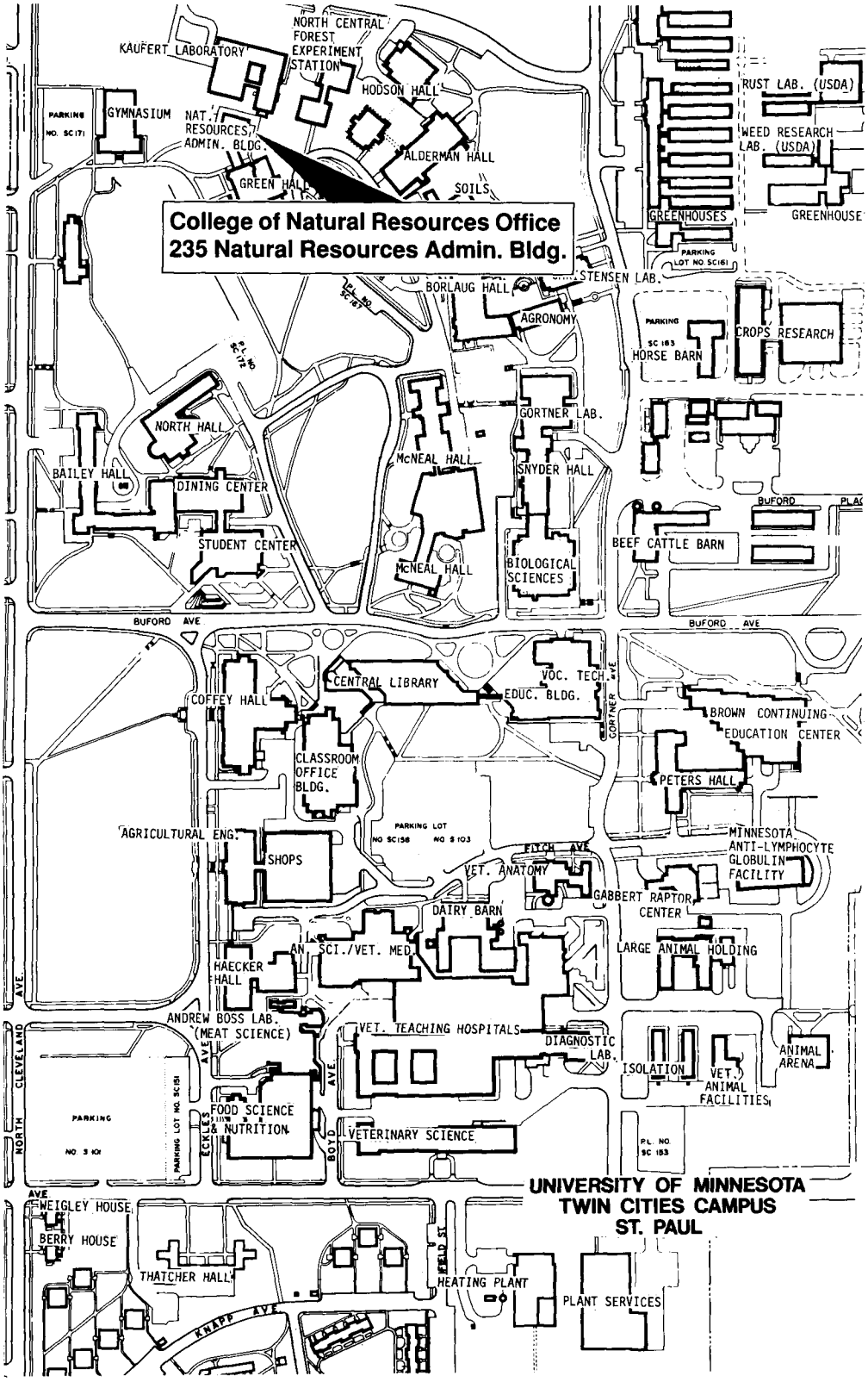
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Postal Statement

Volume 95, Number 4
April 1, 1992

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(USPS 651-720)

Published by the University of Minnesota, Office of the Vice President for Student Affairs, Publications and Communications Office, 110 Williamson Hall, 231 Pillsbury Drive S.E., Minneapolis, MN 55455; once in February, August, and November; twice in March; three times in April and September; and four times in July. Second-class postage paid at Minneapolis, Minnesota. POSTMASTER: Send address changes to University of Minnesota, 110 Williamson Hall, 231 Pillsbury Drive S.E., Minneapolis, MN 55455.

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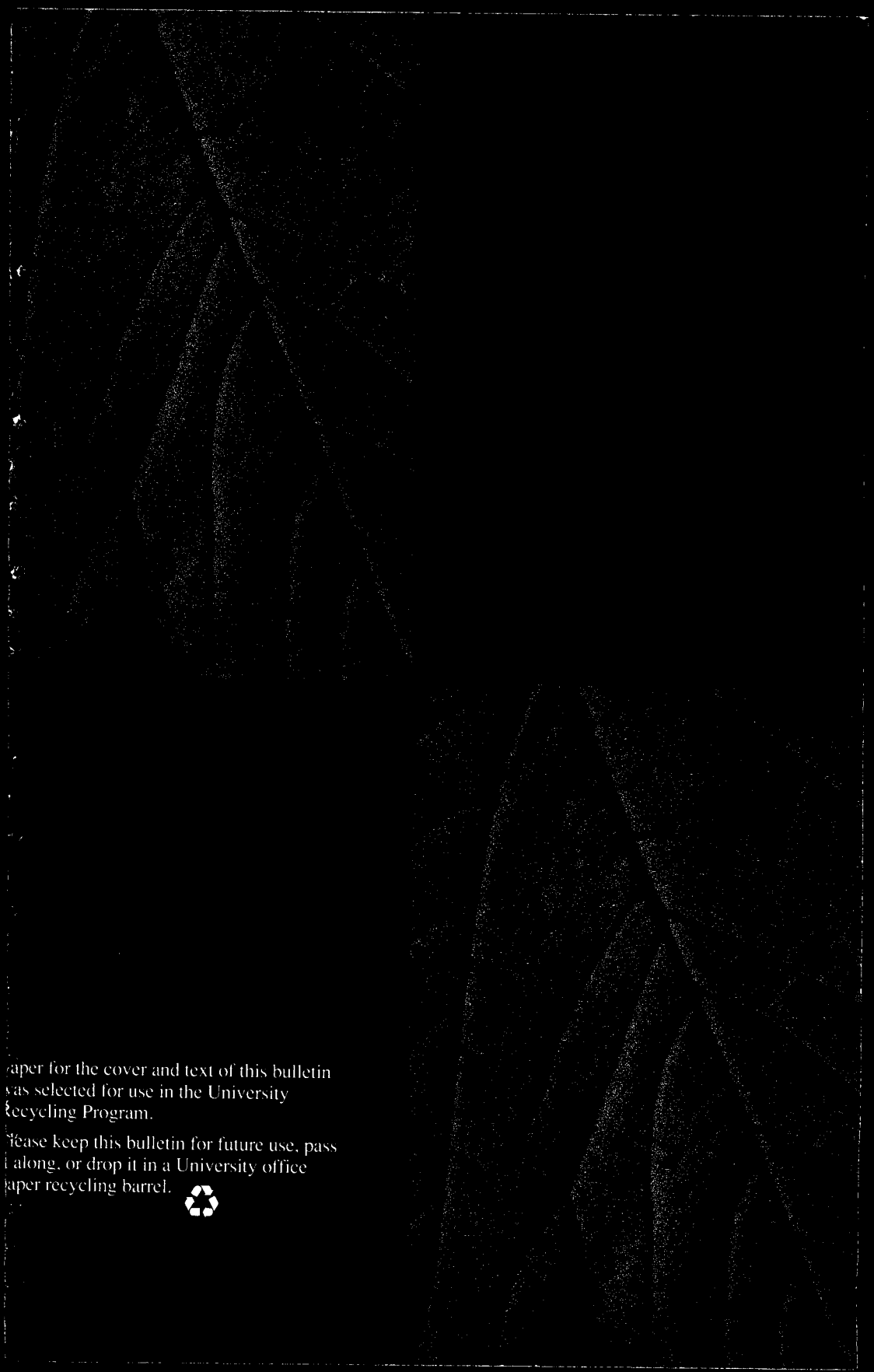

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