5-21-1996

SR-95-96-56 (CC)

Marshall University

CURRICULUM COMMITTEE
RECOMMENDATION

SR-95-96-56 (CC)

Recommends the approval of the B.S. Degree in Environmental Science.

RATIONALE: This is an appropriate addition to programs offered at Marshall.

FACULTY SENATE PRESIDENT:

APPROVED BY SENATE: Elaine Baker DATE: 5/21/96

DISAPPROVED BY SENATE: _____ DATE: _____

UNIVERSITY PRESIDENT:

APPROVED: _____ DATE: 6/10/96

DISAPPROVED: _____ DATE: _____

COMMENTS:

MARSHALL UNIVERSITY
COLLEGE OF SCIENCE
Department of Biological Sciences
400 Hal Greer Boulevard
Huntington, West Virginia 25755-2510
304/696-5413

TO: Dr. Thomas Storch, Dean,
College of Science

FROM: Marcia Harrison, Chair of the College of Science Curriculum Committee MH

SUBJECT: Bachelor of Science Degree in Environmental Science

DATE: April 2, 1996

The College of Science Curriculum Committee unanimously voted to strongly support the proposed Environmental Science Program.

The College of Science Curriculum Committee reviewed and approved the current modifications of this program on March 29, 1996 at 1:30 p.m. in S350. The Committee feels that this program provides science students with a greater variety of options in environmental studies beyond the current offerings.

3/11/96

MARSHALL UNIVERSITY

(Date of submission TBD)

DEVELOPMENT OF ENVIRONMENTAL SCIENCE CURRICULUM

BACHELOR OF SCIENCE DEGREE IN ENVIRONMENTAL SCIENCE

PROPOSED EFFECTIVE DATE : January 1997

SUMMARY STATEMENT:

A curriculum is proposed which will lead to a Bachelor of Science Degree in Environmental Science. The four-year program will be offered at Marshall University and will provide the student the conceptual and practical knowledge in various science disciplines which are essential to an understanding of Environmental Science. All students will take a core curriculum of general education and science courses, and then select from one of the concentration areas offered by the College of Science, College of Business, and the School of Medicine. The areas of concentration initially offered are: biology, chemistry, environmental economics and environmental management, environmental health, and modeling. The Environmental Science degree will involve few new courses, since most of the courses are already being offered at Marshall.

PART I. PROGRAM DESCRIPTION

A. Program objectives:

Companies and government agencies in the region served by Marshall University require professional personnel to deal with environmental issues and regulations. Growth in regional employment needs in the environmental sector has surpassed the current availability of well-trained professionals, and all indications are that the demand will grow even more rapidly over the coming decade.

Marshall University's existing undergraduate degree programs have established a reputation for producing graduates who prove to be productive employees in regional companies and agencies. The program presented in this proposal has an overall objective of establishing and maintaining a B.S. degree in Environmental Science. The program will help meet regional needs for environmental professionals and assist employers with their environmental concerns.

Environmental Science is an interdisciplinary subject. Thus, a large portion of the B.S. degree program in Environmental Science consists of science, business, and general education courses already being offered at Marshall. A limited number of new courses and seminars will be developed which focus specifically on environmental issues and needs, and integrate concepts from various disciplines.

B. Program Identification

The Classification of Instructional Programs code for the Environmental Science program is 030102 - Environmental Science/Studies[1].

C. Program Features

1. Admissions and Performance Standards:

An applicant for admission to the Environmental Science (E.S.) Program must satisfy the general undergraduate admission requirements of Marshall University[2]. The candidate must comply with all requirements detailed in the most current undergraduate catalog of Marshall University. Students will be responsible for meeting the four new initiatives recently approved by the faculty and university president. The initiatives include Writing Across the Curriculum, Computer Literacy, International and Multicultural Studies, and the Capstone Experience.

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[1] Morgan, Robert, L., Classification of Instructional Programs, Office of Educational Research and Improvement, U.S. Department of Education, U.S. Government Printing Office, Washington, D.C. 1990, p. .

[2] Marshall University 1995-97 Catalog, pp 14-24.

2. Program Requirements:

A student must complete a minimum of 128 credit-hours in order to graduate from Marshall University, and comply with College of Science graduation requirements. About 84 credit-hours of the hours will be completed by the student in the core area of the program and about 44 credit-hours in the selected area of concentration. The exact number of hours in the core and concentration will vary slightly according to the specific courses selected by the student. The full curriculum is detailed on the following pages.

The majority of the courses in the E.S. Degree program are presently being offered by Marshall University. There are three new courses: Introduction to Environmental Science (ES 1XX), and two Environmental Science Seminar courses (ES 2XX and ES 3XX). The Introductory course will be team taught by representatives of the various departments of the College of Science, College of Business, and School of Medicine and will provide an opportunity for the student to receive a "broad brush" overview to the various science disciplines and associated environmental issues. Upon completion of the course the student should have a basic understanding of pertinent scientific fundamentals and issues, which can assist the student in selecting an area of concentration. It is intended that this course not have a prerequisite, and thus be open to all students.

Tri-State industry leaders have expressed concern that most new college graduates do not have strong communication skills. The Seminar courses address that shortcoming by incorporating student presentations and group projects on environmental topics. Speakers from area businesses/industry will be invited to make presentations on relevant environmental topics during both seminar courses to provide the students an opportunity to analyze real world cases.

Students will take the first Environmental Science Seminar course (ES 2XX) during their sophomore year, with Introduction to Environmental Science (ES 1XX) being the prerequisite. The junior level Environmental Science Seminar (ES 3XX) has ES 2XX as a prerequisite.

The core curriculum of the degree program comprises six sections: Orientation to Environmental Science; English Composition/Communication; Mathematics, Statistics, Computer Science; Humanities and Social Sciences; Natural Sciences; and the capstone course which is one of Marshall's new initiatives mentioned previously. The capstone experience provides the student an opportunity to utilize completed course work in a relevant research project, such as the development of an Environmental Impact Statement.

Revised 3/11/96

ENVIRONMENTAL SCIENCES CORE CURRICULUM

			Credit Hours
I.	**Orientation**		**7**
	ES 1XX	Introduction to Environmental Science*	3
		(Team taught by faculty from representative depts.)	
	ES 2XX	Environmental Science Seminar (PR: ES 1XX)*	2
	ES 3XX	Environmental Science Seminar (PR: ES 2XX)*	2
II.	**English Composition/Communication**		**12**
	ENG 101	English Composition I	3
	ENG 102 (or 201H)	English Composition II	3
	COM 103 (or 104H)	Fundamentals of Speech Communication	3
	ENG 354	Scientific and Technical Writing	3
III.	**Mathematics, Statistics, Computer Science**		**14**
	MTH 130	College Algebra	3
	MTH 131	Calculus & Analytical Geometry I	5
		(PR min. ACT 27 or MTH 130)	
	MTH 4XX	Statistics for Environmental Science*	3
	CSD 203	FORTRAN Programming	
	OR CSD 205	C Programming	3
IV.	**Humanities and Social Sciences**		**21-24**
	ECN 200	Survey of Economics	
	OR ECN 250	Principles of Microeconomics	3
	ECN 405	Environmental Economics	3
	GEO 320	Conservation of Natural Resources	3
	PSC 233	Introduction to Public Policy	3
	Electives	History and/or Literature	6-9
	Elective	Philosophy, Religion or Fine Art	3

Note: Students must satisfy the University requirements for International Studies (6 hrs) and Multicultural Studies (3 hrs) using Sections I-IV above.

V. Natural Sciences			*26*
BSC 120	Principles of Biology I	4	
BSC 121	Principles of Biology II		
OR	Invertebrate Zoology	4	
CHM 211	Principles of Chemistry I	3	
CHM 217	Chemistry I Lab	2	
CHM 212	Principles of Chemistry II	3	
CHM 218	Chemistry II Lab	2	
GLY 200	Physical Geology	3	
GLY 210L	Earth Materials Laboratory I	1	
PHY 201	General Physics I	3	
	(PR: MTH 130 and MTH 122)		
OR PHY 211	Principles of Physics I - 4 hrs.		
	(PR: MTH 131, CR: MTH 230)		
PHY 202	General Physics Lab I	1	
VI.	**Capstone Course** (in major field of study):		**4**
ES 4XX	Environmental Science Course		
	Approximate Core Credit Hours		**84-87**
	(Depending on core electives and concentration)		

* New Course

BIOLOGY CONCENTRATION

revised 3/11/96

Concentration

BSC 320	Principles of Ecology (Includes lab)	4
CHM 355	Organic Chemistry I	3
BSC 322	Principles of Cell Biology	4
AND		
BSC 324	Principles of Genetics	4

OR 6-8 hours of upper level biology courses

Students are to select ONE of the following three sets of courses with the companion labs.

1.	GLY 456	Environmental Geology	(3)	
	GLY 456L	Environmental Geology Lab	(1)	
2.	PHY 203	General Physics II (PR: MTH 130 and MTH 122)	(3)	
	OR PHY 213	Principles of Physics II - 4 hrs. (PR: MTH 131, CR: MTH 230)		
	PHY 204	General Physics Lab II	(1)	
3.	CHM 345	Introduction to Analytical Chemistry (Includes a lab)	(4)	4
		Subtotal		*19*

In addition, the student needs to choose either an Aquatic Specialization, or a Biological Survey Specialization. Within that specialization, a student will **select a total of 24 hours to complete.**

1. Aquatic Specialization

BSC 401	Ichthyology	4
BSC 421	Phycology	4
BSC 431	Limnology	4
BSC 442	Advanced Microbiology	4
GLY 455	Hydrogeology	4
GLY 456	Environmental Geology (Can be taken as lab option in core)	3
GLY 456	Environmental Geology Lab	1
	Total Selected Specialization Hours	*24*
	Total hours including core	**127-130**

OR

2. Biological Survey Specialization

BSC 401	Ichthyology	4
BSC 406	Herpetology	4
BSC 409	Mammalogy	4
BSC 414	Entomology	4
BSC 415	Plant Morphology	4
BSC 416	Plant Taxonomy	4
BSC 418	Mycology	4
BSC 421	Phycology	4
BSC 430	Plant Ecology	4
BSC 431	Limnology	4
BSC 442	Advanced Microbiology	4
BSC 460	Conservation of Forests, Soil and Wildlife	3
GLY 212	Field Mapping	2

Total Selected Specialization Hours *24*

Total hours including core **127-130**

Environmental Science Degree revised 3/11/96
Chemistry Concentration

The purpose of this concentration is to prepare students who intend on seeking positions with industry, government, or private environmental testing companies where hands-on experience in environmental chemical analyses is required or preferred. The additional chemical requirements give the student the background and lab experience in traditional wet chemical analysis (CHM 345) and modern instrumental analysis (CHM 423). As the majority of the priority pollutants are organic compunds, these students will benefit from our two semester organic sequence (CHM 355, 356,lecture, and 361, lab) that is also required of all chemistry and biology majors. Physical chemistry (CHM 307) strengthens the students understanding of the physical chemical processes (kinetics, thermodynamics, etc.) that affect the fate of compounds in the environment. With the addition of CHM 448, *Advanced Inorganic Chemistry,* a double major (BS Env. Sci., and BS, Major in Chemistry) may be declared. As of this date, there is a language requirement for the BS, Major in Chemistry. Such a double major would further enhance one's employment possibilities.

CHEMISTRY CONCENTRATION

CHM 345	Introduction to Analytical Chemistry (Includes lab)		4

Students are to select ONE of the following three sets of courses with the companion labs. GLY 456 or BSC 320 are recommended selections.

1.	GLY 456	Environmental Geology	(3)	
	GLY 456L	Environmental Geology Lab	(1)	
2.	BSC 320	Principles of Ecology I (Includes lab)	(4)	
3.	PHY 203	General Physics II (PR: MTH 130 and MTH 122)	(3)	
	OR PHY 213	Principles of Physics II - 4 hrs. (PR: MTH 131, CR: MTH 230)		
	PHY 204	General Physics Lab II	(1)	4

CHM 305	Chemical Literature	1
CHM 307	Introductory Physical Chemistry	4
CHM 355	Organic Chemistry I	3
CHM 356	Organic Chemistry II	3
CHM 361	Introductory Organic Chemistry Lab	3
CHM 423	Environmental Analytical Chemistry (PR CHM 345 Analytical CHM)	4
ES XXX	Environmental Regulations*	3
	4-5 Electives selected from the list below	15-20
	Total Concentration Hours	*44-49*
	Total Hours including Core	**128-133**

CHEMISTRY CONCENTRATION (continued)

Chemistry Electives

BSC 431	Limnology	3
CHM 426	Chromatography	3
CHM 448	Advanced Inorganic Chemistry	4
ES 4XX	Regulations -other*	3
GLY 455	Hydrology	4
GLY 456	Environmental Geology	4
MTH 230	Calculus and Analytic Geometry	4 (Strongly recommended)
PHY 410	Physics of Remote Sensing	3 (PR PHY203, MTH 225)
PHY 430	Applied Electronics and Instrumentation	4 (PR PHY203)

ENVIRONMENTAL ECONOMICS AND ENVIRONMENTAL MANAGEMENT CONCENTRATIONS

3/11/96

Core Specifications**

Students are to select TWO of the following four sets of courses with the companion labs.

1.	GLY 456	Environmental Geology	(3)	
	GLY 456L	Environmental Geology Lab	(1)	
2.	BSC 320	Principles of Ecology I (Includes lab)	(4)	
3.	PHY 203	General Physics II (PR: MTH 130 and MTH 122)	(3)	
	OR PHY 213	Principles of Physics II - 4 hrs. (PR: MTH 131, CR: MTH 230)		
	PHY 204	General Physics Lab II	(1)	
4.	CHM 345	Introduction to Analytical Chemistry	(4)	
	OR CHM 327	Intro. Organic Chemistry	(5)	
		(Both include a lab)		8-9
ECN 250		Principles of Microeconomics (Substitutes for ECN 200 in core)		(3)
ECN 253		Principles of Macroeconomics		3
ACC 207		Legal Environment of Business		3
MGT 310		Management Information Systems		3
			Additions to the core	*17-18*

Environmental Economics Concentration

ECN 326	Intermediate Macroeconomics	3
ECN 328	Intermediate Microeconomics Analysis	3
ECN 423	Introduction to Econometrics	3
ECN 440	History of Economic Thought	3
ECN 465	Research in Economics	3
ECN 490	Internship	3-6
	(Six hours strongly recommended)	
	Science Electives	6-9
	Total Concentration Hours	*27*
	Total Hours including Core	**128-132**

ENVIRONMENTAL ECONOMICS AND ENVIRONMENTAL MANAGEMENT CONCENTRATIONS (Continued)

Environmental Management Concentration

MGT 320	Principles of Management	3
MKT 340	Principles of Marketing	3
FIN 323	Principles of Business Finance	3
ACC 215	Principles of Accounting I	3
ACC 216	Principles of Accounting II	3
ECN 490	Internship	3-6
	(Six hours strongly recommended)	
	Science Electives	6-9
	Total Concentration Hours	*27*
	Total Hours including Core	**128-132**

** Due to AACSB accreditation guidelines no student pursuing the Environmental Economics or the Environmental Management concentration may take more than 32 credit hours (25%) in the College of Business.

ENVIRONMENTAL HEALTH CONCENTRATION 3/11/96

Concentration

CHM 327	Introductory Organic Chemistry (Includes a lab)	5

Students are to select ONE of the following four sets of courses with the companion labs.

1.	GLY 456	Environmental Geology	(3)	
	GLY 456L	Environmental Geology Lab	(1)	
2.	BSC 320	Principles of Ecology I (Includes lab)	(4)	
3.	PHY 203	General Physics II (PR: MTH 130 and MTH 122)	(3)	
	OR PHY 213	Principles of Physics II - 4 hrs. (PR: MTH 131, CR: MTH 230)		
	PHY 204	General Physics Lab II	(1)	
4.	CHM 345	Introduction to Analytical Chemistry (Includes lab)	(4)	4

ES XXX	Environmental Regulations *	3
ES XXX	Environmental Law*	3
BSC 227	Human Anatomy	4
BSC 228	Human Physiology	4
BSC 250	Microbiology & Human Disease	4
BSC XXX	Introduction to Human Health	3
ES 673	Applied Environmental Toxicology	3
ES 514	Risk Assessment Applied to Air Pollutants	3
ES 674	Epidemiological Health Research Techniques	3
	Electives selected from the list below	9
	Total Concentration Hours	*48*

Total Hours including Core **132****

ENVIRONMENTAL HEALTH CONCENTRATION (continued)

Environmental Health Electives

BSC 485	Independent Study (Toxicology Laboratory)	1-4
CHM 423	Environmental Analytical Chemistry	3
GLY 455	Hydrogeology	4
PHY XXX	Radiation Health	3
SED 451	Occupational Safety and Health Management	3
SED 454	Industrial Environmental Protection	3
EE 520	Solid Waste Management	3
EE 525	Waste Management	3
EE 615	Environmental Chemistry	3
ES 504	Air Pollution	3
ES 571	Industrial Hygiene Science I	3
ES 571	Industrial Hygiene Science II	3

* New Course (Including Environmental Regulations and Environmental Law as part of the core would strengthen the Environmental Health Concentration.)
**Proposed concentration would possibly be eligible for Environmental Health certification
The EE and ES courses are available through the WVGraduate College.

GEOLOGY CONCENTRATION

revised 3/11/96

	Concentration	
GLY 456	Environmental Geology	3
GLY 456L	Environmental Geology Lab	1

Students are to select ONE of the following three sets of courses with the companion labs.

1.	BSC 320 Principles of Ecology I (Includes lab)	(4)	
2.	PHY 203 General Physics II (PR: MTH 130 and MTH 122)	(3)	
	OR PHY 213 Principles of Physics II - 4 hrs. (PR: MTH 131, CR: MTH 230)		
	PHY 204 General Physics Lab II	(1)	
3.	CHM 345 Introduction to Analytical Chemistry (Includes lab)	(4)	
	OR CHM 327 Intro. Organic Chemistry (Includes lab)	(5)	4-5

GLY 212	Field Mapping	2
GLY 314	Mineralogy	4
GLY 325	Stratigraphy/Sedimentation	4
GLY 425	Geochemistry	4
GLY 430	Computer Applications	4
GLY 451/L	Geomorphology	4
GLY 455/L	Hydrogeology	4
GLY 457	Engineering Geology	3
	Electives selected from the list below	4-8
	Total Concentration Hours	*41-46*
	Total Hours including Core	**125-133**

Geology Electives

BSC 320 Principles of Ecology	4
GLY 260 Resources of the Earth	3
GLY 421 Petrology	4
GLY 423 Sedimentary Petrology	4
GLY 427 Fossil Fuels	4

* New Course

MODELING CONCENTRATION 3/11/96

Concentration

PHY 211	Principles of Physics I - replaces PHY 201 in the core (PR: MTH 131, CR: MTH 230)	(4)
PHY 213	Principles of Physics II (PR: MTH 131, CR: MTH 230)	4
MTH 230	Calculus with Analytic Geometry II	4

Students are to select ONE of the following three sets of courses with the companion labs.

1.	GLY 456	Environmental Geology	(3)	
	GLY 456L	Environmental Geology Lab	(1)	
2.	BSC 320 (Includes lab)	Principles of Ecology I	(4)	
3.	CHM 345	Introduction to Analytical Chemistry (Includes lab)	(4)	
	OR CHM 327	Intro. Organic Chemistry (Includes lab)	(5)	4-5

MTH 330	Linear Algebra	3
MTH 443	Numerical Analysis	3
MTH 445	Theory of Statistics I	3
PHY 410/510	Physics of Remote Sensing w/Applications	3
PHY 411/511	Digital Image Processing and Computer Modeling Simulations	3
PHY 412/512	Atmospheric Physics	3
CSD 119	Introduction to Computer Science I	3
CSD 120	Introduction to Computer Science II	3
CSD 2XX	Computer Interfacing with Scientific Instruments	3
CSD 2XX	Object Oriented Programming	3
	Total Concentration Hours	*42-43*

Total Hours including Core **126-130**

Additional recommended courses:

PHY 304	Optics	3
and PHY 405/505	Optics Lab	2
PHY 314	Electronics	3
and PHY 415/515	Electronics Lab	2

D. Program Outcomes

The primary outcome of the program is graduates who should have a broad knowledge of relevant science areas, and environmental concentrations in specific disciplines, who can become productive members of the workforce. Marshall University's existing undergraduate degree programs have established a reputation for providing graduates who prove to be productive employees in regional companies and agencies. The program can help meet regional needs for environmental professionals to assist employers with their environmental concerns.

PART II - PROGRAM NEED AND JUSTIFICATION

A. Relationship to Institutional Goals/Objectives

Marshall University has identified institutional areas of emphasis, one of which is "a university concerned with **environmental issues** which, unquestionably, will be a dominant factor of life in the 21st Century"[3]. Marshall emphasizes its "interactive university" role in responding to needs of the region -- and well educated environmental professionals are in great demand in the region. The E.S. degree will complement science offerings available at Marshall, and help address regional environmental issues.

B. Existing Programs

The E.S. Program will provide education and training not currently available through any four-year public college or university in West Virginia. The following private institutions in West Virginia offer an undergraduate degree in E.S.: Bethany College, Davis and Elkins College, Salem-Teikyo University, and University of Charleston[4].

C. Program Planning and Development

Dr. J. Wade Gilley charged the Center for Environmental, Geotechnical, and Applied Sciences with the task of leading the effort to develop an undergraduate degree in E.S.. An initial meeting was held November 28, 1994. As a result of that meeting a planning committee was formed. The committee was chaired by Dr. Tony Szwilski, Professor of Environmental Engineering and Science. Committee members were: Dr. Richard Begley, Chair and Associate Professor of Engineering; Dr. Matthew Carlton, Professor of Mathematics; Dr. Warren Dumke, Professor of Physics and Physical Sciences; Dr. Protip Ghosh, Professor of Geology; Dr. James Hooper, (ex-officio) Environmental Center Director and Weisberg Professor; Dr. Michael Little, Professor of Biological Sciences; Dr. Graham Rankin, Assistant Professor of Chemistry; Dr. Tom Storch (ex-officio) Dean of Science and N.B. Green Professor; Dr. John Szarek, Associate Professor of Pharmacology, MU Medical School; Dr. David Walker, Associate Professor of Computer Science and Software

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[3] Marshall University 1995-97 Catalog, p.6.

[4] Directory of Postsecondary Opportunities in West Virginia 1995-96, Central Office of the State College and University Systems of West Virginia.

Development. Also participating: Dr. Bruce Brown, Chair and Associate Professor of Clinical Laboratory Science; Ms. Elizabeth Hanrahan, Program Specialist, Environmental Center; Dr. Calvin Kent, Dean of Business and Lewis Professor.

Existing programs were evaluated during the planning process, including those of East Tennessee State University, Eastern Kentucky University, North Carolina State University, Ohio University, Ohio State University, Stanford, University of California, University of Scranton, and Western Washington University's Huxley College of Environmental Studies. North Carolina State University's (NCSU) program was selected for use as a model in developing Marshall's program. NCSU provides the flexible concentration option so that students can develop a specialization of interest as well as a broad knowledge of environmental issues and concerns.

Considerable time and effort have been contributed by the committee in planning this E.S. degree program. The Environmental Center has also contributed considerable personnel time in researching and evaluating existing E.S. degrees, and coordinating the degree program planning process.

A consensus was reached by the planning committee regarding the courses selected for the core curriculum. Committee members have the view that students need a solid background in the sciences before selecting an area of concentration.

D. Clientele and Need

It has been briefly mentioned in newspaper articles that the Environmental Center was coordinating the planning of the E.S. undergraduate degree. Through that minimal publicity the Environmental Center has developed a database of about 50 students who have already expressed a strong interest in the E.S. degree program. The Center receives a number of calls from these interested students concerning the progress of the proposed degree.

Many companies in the region, including state and federal agencies (WV Department of Environmental Protection, U.S. Army Corps of Engineers), have increasing demands for E.S. graduates. This B.S. degree will qualify graduates to fulfill many of the needs of these organizations. Upon completion of the B.S. degree program an individual interested in further education will have the option of pursuing a Master's degree in the area of concentration or in Environmental Science.

Marshall University has made strong efforts to work with the returning student population through the Adult and Extended Education Program. The Mid-Ohio Valley Center in Point Pleasant and the Southern Mountain Center in Mount Gay have recently been established to coordinate upper level course offerings at those Centers. Appropriate accommodations will be made to work with these students in pursuit of their degrees.

E. Employment Opportunities

Employment opportunities are ample and include state and federal government jobs in natural resource management and environmental protection, and business/industrial jobs in

environmental and health management. The state and federal governments have career opportunities for environmental scientists who will work on water and air quality issues, waste management, and develop environmental policy and regulations. Due to increasingly demanding environmental and health regulations, larger companies are creating internal environmental and health groups to manage the environmental and health functions, including permits, testing, and training, required by the regulations.

New international environmental management standards (IS 14000) are being developed that will have significant impact on many companies. Business in general is becoming more conscious of sustainable development practices and will increasingly adopt the standards in order to become better corporate citizens. Effective environmental management will help companies maintain regulatory compliance and competitiveness. The rapid growth of small manufacturers has increased the demand for environmental services for the companies too small to employ a full-time environmental manager. These environmental services are being supplied by consulting companies, thus creating new job opportunities. There are also numerous employment opportunities with environmental companies engaged in cleaning up polluted soil and groundwater resulting from past business activities. Other opportunities include environmental managers/scientists with city and local government, hospitals, and university physical plants. There are thus many employment opportunities for Marshall graduates with a broadly based B.S. degree in Environmental Science.

F. Program Impact

The principal impact of the environmental degree program will be to satisfy the demand from industry and government for graduates with a good understanding of the major environmental issues, knowledge and training from a core of relevant quality multidisciplinary undergraduate courses and emphasis in one of five environmental concentrations. The decision of a company to locate a plant in West Virginia, and the Tri-State region in particular, will be enhanced by the availability of a workforce with the knowledge, training and skills to make the business a success. The initiation of a Marshall University B.S. E.S. degree program will be an immediate benefit to West Virginia and the Tri-State region.

Students are taking a bachelor of science degree as one significant step in preparing for a career of more than forty years. The integration of quality fundamental courses from the College of Science, School of Medicine, and College of Business, provides an excellent base for continuing education and upon which to build a career that is certain to have many facets and challenges. Therefore, the impact of the E.S. degree program will be immediate, to satisfy the current demand for environmental scientists and managers; and long-term, to produce a graduate that has a unique balanced perspective and awareness of the complex global environmental issues and the ongoing needs of the community.

The B.S. environmental degree program will enhance the external and internal productivity of Marshall University by producing marketable graduates, and maximize the utilization of existing university resources.

G. Cooperative Arrangements

The proposed degree program is interdisciplinary by its very nature, and thus will require cross-college cooperation for its success. The degree program planning committee has representation from all of the departments of the College of Science, as well as participants from the College of Business and School of Medicine at Marshall University. One of the proposed concentrations in the E.S. degree is Modeling. The concentration was a result of collaboration by faculty from the Math, Physics, and Computer Science and Software Development departments.

The Center for Environmental, Geotechnical and Applied Sciences at MU has from its beginning emphasized efforts of joint interest to MU and West Virginia Graduate College. Presidents Prisk and Gilley signed a Memorandum of Understanding concerning the formation of the Environmental Center in May of 1993. The Center coordinates the offering of the WVGC M.S. in Environmental Science/Environmental Engineering. A three-year plan of course offerings in Huntington is in place. Two faculty members holding joint appointments between the two institutions have offices at the Environmental Center -- including Dr. Szwilski, the E.S. committee chair.

Through the cooperation of WVGC in offering the M.S. in Environmental Science/Environmental Engineering in Huntington there is the opportunity for a student to complete a B.S. degree and then pursue a masters in Environmental Science.

H. Alternatives to Program Development

There are no existing alternatives in West Virginia for students who want to graduate with a B.S. degree in E.S. from a public university. The only other B.S. degree programs in West Virginia are offered by private universities in more generalized areas of environmental issues. A student motivated to undertake a career in the environmental profession could take a B.S. degree at Marshall University and a M.S. degree through the West Virginia Graduate College.

A student wishing to graduate with a quality degree in E.S. has many advantages to pursuing the degree at Marshall University, and any alternative to the proposed program will not benefit the state and region financially or logistically. Students could travel out of state, but this would be a costly and inefficient proposition. The Tri-State region, in which Marshall University is the geographical center, provides unique environmental resources and industries. The industry is represented by larger companies such as Ashland Inc., INCO and Union Carbide, and numerous small and medium sized manufacturers with whom Marshall University has a mutually beneficial relationship.

PART III PROGRAM IMPLEMENTATION AND PROJECTED RESOURCE REQUIREMENTS

A. Program Administration

The E.S. Bachelor of Science program will be administered by the Center for Environmental, Geotechnical, and Applied Sciences (CEGAS) in cooperation with the College of Science. Enrollments will be handled by the current system. Students upon registering will be assigned to an advisor in one of the participating organizations (College of Science, College of Business, School of Medicine, or CEGAS). On choosing an area of concentration the student will then be advised by a faculty member from that concentration area. The primary objective of the program organization will be to enhance the cooperative and multidisciplinary nature of the E.S. degree track. The principal personnel having direct administrative responsibility will be the program coordinator, concentration coordinators and program committee members.

Program Coordinator: The Program Coordinator of the E.S. undergraduate degree program will be from CEGAS, and will have the following responsibilities:

- Coordinate the E.S. program through the Concentration Coordinators
- Work with the departments to ensure that the core courses are meeting the needs of the environmental science majors, including appropriate scheduling
- Serve as chairman of the Program Committee

Program Committee: The Program Committee is composed of the chairperson (Program Coordinator), Concentration Coordinators, and two ES faculty members elected by the Program Committee for two-year staggered terms. Ex-officio members may also be appointed -- e.g., representatives from business/industry. The responsibilities of the Program Committee will be to:

- Advise the chairperson-Program Coordinator and serves as liaison to the departments' E.S. faculty
- Evaluate and recommend concentration and core curriculum changes
- Promote the E.S. program to students, faculty and public

Concentration Coordinator: Each ES program concentration will have a coordinator appointed by the corresponding department head or dean. Responsibilities will be to:

- Coordinate and promote the ES program and ES concentration associated with their department (or college)
- Monitor and approve courses used by students to meet curriculum requirements
- Coordinate record keeping
- Serve as a member of the program committee

ES Faculty Members: Membership into E.S. faculty status will be available to any Marshall University faculty member with agreement of his/her department head and dean, and approval by the Program Committee. An E.S. faculty member may perform one or more of the following activities:

- Serve as coordinator for an ES concentration
- Advise undergraduate students in the ES program

- Teach an E.S. course (ES XXX)
- Teach a required concentration course in the ES program

B. Program Projections

(To be completed)

C. Faculty Instructional Requirements

No new full-time faculty will be required for the establishment of the environmental science degree program or the teaching of courses. Environmental courses available through an ongoing collaboration with the West Virginia Graduate College will be offered as electives for the concentrations for those meeting the undergraduate admission standards of WVGC. Three new courses have been identified for the core curriculum -- Introduction to Environmental Science, and two environmental seminars, which will be team taught by Marshall faculty and invited guests from industry and government.

PART IV PROGRAM EVALUATION

A. Evaluation Procedures

The University System Board of Trustees has set up a five year review schedule for academic programs. The new degree program will undergo regular internal reviews as well. The Program Coordinator in CEGAS will coordinate program evaluation and will work with the departments to ensure that the core courses are meeting the needs of the E.S. concentrations and the mission of Marshall University. The Program Committee will evaluate and recommend concentration and core curriculum changes as required. Each ES Concentration Coordinator will monitor courses used by their students, and provide suggestions for improvement.

B. Accreditation Status

MU is accredited by the Commission on Institutions of Higher Education of the North Central Association of Colleges and Schools, and is a member of the Council of Graduate Schools in the U.S. The E.S. program will satisfy the policies set forth by these organizations. The National Environmental Health Science and Protection Accreditation Council (NEHSPAC) is the U.S. accrediting body for Environmental Health programs. There is currently no national accrediting body for environmental science programs, per se. If and when a national accrediting body is established for Environmental Science, Marshall will assess the desirability of moving to comply with the accreditation standards.