

Strategic Plan: 2006-2011

Nicholas School of the Environment and Earth Sciences

Executive Summary of Major Goals for 2006-2011

1. Achieve faculty and programmatic excellence in focal areas of:
 - a. Conservation Biology
 - b. Ecosystem Science and Management
 - c. Energy and Environment
 - d. Environmental Economics and Policy
 - e. Environmental Health
 - f. Global Change
 - g. Marine Science and Policy
 - h. Water Resources
2. Build strong relationships to the Nicholas Institute and to other Schools at Duke University.
3. Double enrollments and majors in undergraduate programs offered by the Nicholas School by 2011.
4. Increase financial aid available to students in the Masters Professional (MEM) Program, with a target of \$5 million in new endowments.
5. Increase undergraduate enrollments (to a target of 50 each semester) at the Duke University Marine Laboratory.
6. Increase overhead recovery from extramural funding to Nicholas School faculty.
7. Design and construct “Nicholas Hall.”
8. Raise \$45 million during the next five years to support these activities.

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I. Introduction

With rising human population and the desire of all humanity for a comfortable, healthy lifestyle, the Earth is experiencing increasing stress to the physical, chemical, and biological systems that sustain life on our planet. Extinctions of species are leading to widespread threats to the integrity of ecosystem function, which provides clean air and water, food, fuel, and fiber to all of us. There is no greater challenge facing humanity than to attain harmony with the global environment and to provide a sustainable future for the diversity of life on Earth.

In this context, the mission of the Nicholas School of the Environment and Earth Sciences at Duke University is to nurture and provide environmental leadership. The School seeks to accomplish this goal through three activities: 1) education: to train the next generation of environmental leaders and scholars; 2) research: to understand basic earth and environmental process, and human behavior related to the environment; 3) outreach: to inform society of environmental challenges and help to develop sound solutions.¹ While continuing to enhance its well-established missions of education and research, The School is now poised to make important contributions to its mission of service and public outreach, through the establishment of the Nicholas Institute for Environmental Policy Solutions (NIEPS), funded by a \$70,000,000 gift from the Nicholas family.

In recent years, the School has placed special emphasis in the areas of **global climate change, water resources, conservation biology, ecosystem management, marine science, and environmental health**—each melding environmental science,

¹ These three goals are embodied in the Nicholas School's mission statement, formally adopted by a vote of the faculty on 13 October 2000, and incorporated into the School's bylaws.

economics and policy—to provide a broad base of expertise to understand and improve the Earth’s environment—on land and at sea—for future generations. In the following, we present an evaluation of the status of the School, the challenges and opportunities before us, and our goals for the next five years. Not only will we solidify our position as a leader in our traditional areas of strength, but we will build a new program in **energy and the environment** to address this critical need for the Earth’s peoples. We also plan to expand our impact on Duke undergraduates—the future leaders of America and the world.

II. Context

A. Overview of the School.

The School of the Environment at Duke was formed in 1991 from the merger of the School of Forestry and Environmental Studies and the Duke University Marine Laboratory. The naming endowment gift was received from the Nicholas family in 1995. In 1997, the Department of Geology joined the School, which was renamed to the Nicholas School of the Environment and Earth Sciences in 2000. Today, the School consists of roughly 50 faculty in three Divisions, more than 400 students including undergraduates and graduate students at the professional and doctoral level, and an operating budget of approximately \$40,000,000 per year.

The School was the first of a small peer group of graduate professional schools of the environment, which now includes the Yale School of Forestry and Environmental Studies (hereafter Yale), The School of Natural Resources and Environment at the

University of Michigan (viz. Michigan), and the Bren School of Environmental Science and Management at the University of California at Santa Barbara (viz. UCSB).

The Nicholas School has a larger faculty than its competitors, but normalized for the number of faculty, our publication rates (Figure 1) and citations of faculty work (Figure 2) exceed those found at these Schools, attesting to the significant impact of the Nicholas School on environmental science and policy in the academic world. Nicholas School

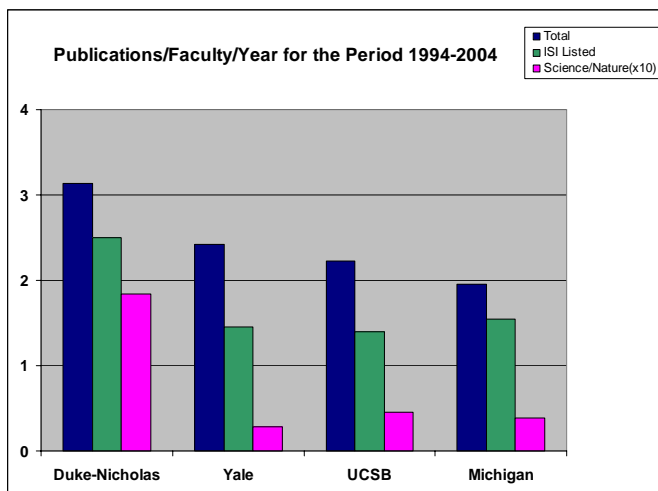


Figure 1. Faculty publication rates at Schools of the Environment for a recent 10-year period.

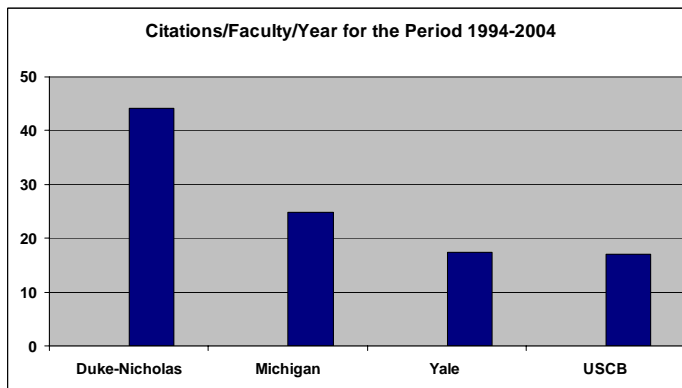


Figure 2. Citation rates for faculty at Schools of the Environment.

faculty are frequently expert witnesses in congressional hearings, quoted sources in the national media, invited members of important national committees (e.g., National Academy of Science), and elected officers in their professional societies (Appendix A). Media coverage of the Nicholas School has increased dramatically during the past five years (Figure 3).

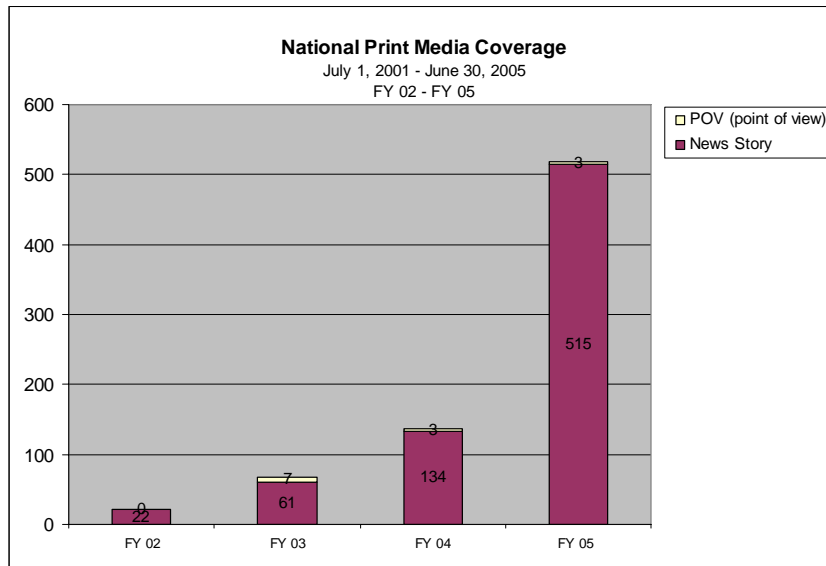


Figure 3. National print media coverage of the Nicholas School during the past four years

The School's three Divisions—Coastal Systems Science and Policy (CSSP), Earth and Ocean Sciences (EOS), and Environmental Science and Policy (ESP) largely reflect the historical origins of the Nicholas School. A substantial number of faculty have joint appointments between the Nicholas School and other units of the Duke campus and between Divisions within the School. Indeed, the CSSP Division, with its locus at the Duke University Marine Lab, actually has more members of its faculty located in Durham! Common interests in global change and geospatial technologies link activities

in all three Divisions, and work in energy and conservation biology spans at least two Divisions. The School has strong links to the Pratt School in the area of hydrology, to the Medical School in ecotoxicology, to the Law School in environmental law, and to the Sanford Institute of Public Policy.

B. Educational Programs

1. Professional Degree Programs

Most students in the Nicholas School are enrolled in the professional Master's program, which leads to the receipt of a Master of Environmental Management (MEM) or Master of Forestry (MF) degree after two years of study. Reflecting the overall philosophy and mission of the School, these programs train students to understand the scientific basis of environmental problems as well as the social, political, and economic factors that determine effective policy solutions. Graduates of the Nicholas School are found at all levels of public and private organizations, where they have a major influence on environmental policy in the United States (Figure 4).

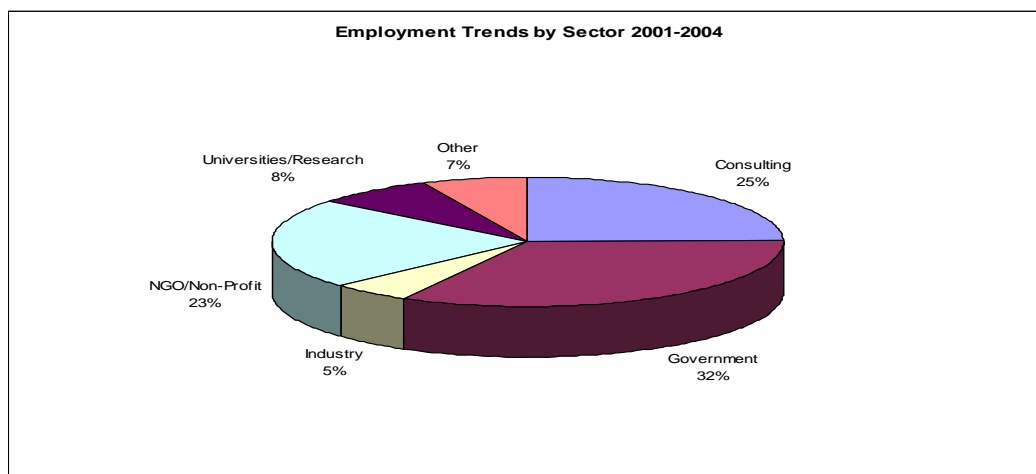


Figure 4. Employment by sector for MEM students graduating 2001-2004.

After reaching a peak in the mid-1990s, applications and enrollments to the MEM Program have declined to a relatively stable pool during the past five years (Figure 5).

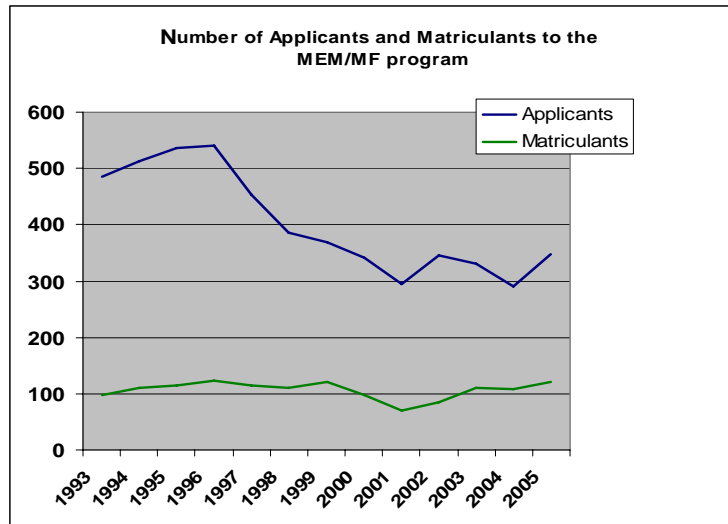


Figure 5. Applicants and matriculants to the MEM program per year, 1993-2005.

The ratio of matriculants to accepted applicants (i.e., yield) was 44.5% for the MEM class of fall 2005, and for students accepted in several programs, most choose Duke over its various competitors (Table 1).

Table 1. The matriculation choice of students admitted to the Nicholas School and to each of its major competitors

	2001	2002	2003	2004	2005
Duke	15	23	25	29	19
Yale	8	18	23	26	24
Duke	5	16	16	14	9
Michigan	11	12	9	8	4
Duke	3	6	21	21	25
UCSB	5	7	7	2	12

Looking forward, we see growing interest in the environment among the nation's young people, and the Nicholas School is well positioned to capture this enrollment. We recently refreshed the "tracks" of our professional degree program and expanded in new directions to meet changing environmental challenges (e.g., our new program in Energy and Environment, p. 20 & Appendix B). We have also enhanced our advertising of the program and its opportunities across the United States. During the next 3-5 years, the School will strive to increase its applicant pool to 500/year, with 130 students/year entering the professional program, from a greater diversity of backgrounds, cultures and nations.

2. Undergraduate Education

The Nicholas School also plays the focal role in environmental education of Duke undergraduates. Offering four majors on behalf of Trinity College, the School has more than 800 undergraduate enrollments annually in its classes in Durham and is responsible for 20-30 (2%) graduating seniors each year. The School also reaches roughly 100 Duke undergraduates through its summer and academic-year programs at the Duke University Marine Laboratory (DUML), roughly 180 miles east of Durham in the coastal town of Beaufort, NC.

As described in greater detail below (see Section V, page 30), in the coming years, the Nicholas School intends to rebalance its overall educational activities with the specific purpose of enhancing its participation in undergraduate education. It is our view that the Nicholas School is in a position to play a far greater role in the academic lives of a larger number of Duke undergraduates, both majors and non-majors.

3. Doctoral Programs

All faculty of the Nicholas School participate in the training of doctoral students, who currently number about 120². These students, mostly aspiring to academic careers, are vital to the intellectual life of the School and to the research productivity of its faculty. More than half of these students are supported by research funds or by fellowships they have won in national competition (e.g., National Science Foundation graduate fellowships). Since the creation of the Nicholas School, 52% of its Ph.D. graduates have found employment in higher education, 21% in corporate positions, 16% in government, and 5% in not-for-profit, non-government organizations. Our goals for the doctoral program are to increase the number of students enrolled by 25%, with an emphasis on increasing students from under-represented groups, and to align the doctoral programs with the School's Divisional structure (see Section V, p.35).

C. Environmental Outreach

The new Nicholas Institute of Environmental Policy Solutions (hereafter "The Institute" or NIEPS) is expected to play a prominent role in public outreach within the Nicholas School, supplying the best analysis of current environmental problems and attractive solutions to corporate, government, advocacy, and media organizations. Launched in fall 2005 and guided by its Director, Tim Profeta, and a core staff, the Institute will draw upon faculty expertise in the Nicholas School to develop its analyses of the science underlying current environmental issues, the potential effective policy

² This figure includes doctoral students enrolled in Nicholas School Programs as well as students in other programs (e.g., the University Program in Ecology), who are working with Nicholas School professors.

solutions to address them, and economic evaluation of different policy avenues.

Additional faculty will be added in joint positions between the Nicholas School and other units of the Duke campus to fill niches that are essential to the agility and expertise needed for Institute initiatives. Initial programs of the Institute will focus on climate change, energy policy, water resources, and coastal and marine environmental issues—all primary areas of faculty expertise within the School.

The Institute will also provide exciting educational opportunities for all levels of students in the Nicholas School. Exemplary MEM, doctoral, and postdoctoral students from developing countries will be selected as the Keohane Fellows, supported by a scholarship endowment to participate in working groups within the Institute. The Institute will also improve media recognition of Nicholas School activities through special initiatives; for example Nicholas “media fellows” will visit Durham and Beaufort, where they will see first-hand the exciting and important work of Nicholas School students and faculty.

III. Recent Challenges and Progress

In the years since the Nicholas School formulated its last strategic plan, the School has made substantial strides to bring its finances to a sound basis; to increase enrollment and provide greater financial aid in its MEM program; to improve faculty quality and diversity; and to upgrade its information technology (IT) services and connections between Durham and Beaufort. During the past four years, we have filled two endowed faculty positions (the Doris Duke Chair of Conservation Biology and the Rachel Carson Chair in Marine Policy) and raised funds for four new chairs: The

Korstian Chair of forest ecosystem management, the two Gendell Chairs in energy and the environment, and the Rogers-Repass Chair in marine conservation technology (joint with the Pratt School of Engineering). We have launched two new tracks in the MEM program in the areas of global change and energy and environment. An \$800,000 gift from the Henry Luce Foundation allowed the School to develop and launch a distance-learning program for its MEM degree, known as the Duke Environmental Leadership (DEL) Program (see Section V, p. 34). Long-standing commitments to build the Ocean Sciences Teaching Center (OSTC) in Beaufort will be realized with its opening in summer 2006. Planning is well-underway for the construction of Nicholas Hall on the Durham campus, which is essential to promote interaction among the EOS and ESP Divisions and the Nicholas Institute. Lastly, apart from the Nicholas family gifts, the School raised \$43 million during the Campaign for Duke, including more than \$2.3 million for 20 new financial aid endowments in the School.

IV. Strategic Planning for Faculty Development

The regular rank faculty of the Nicholas School consists of 50 individuals organized in three academic divisions. The faculty in all Divisions contribute to School-wide undergraduate, professional, and doctoral teaching programs. The faculty represent a broad range of expertise, perhaps broader than in any other professional school at Duke, spanning the biological, physical and social sciences. This breadth reflects both the historical development of these Divisions as once independent entities within the university and a philosophy that the best solutions to environmental problems will emerge from interdisciplinary collaboration.

Academic stature of the faculty has the greatest impact on the quality and reputation of any School. Over the next five years, the Nicholas School, in partnership with other schools, will fill as many as three Nicholas Institute professorships, as well as six other chairs with existing endowments. The School will also fill several junior-level positions, largely derived from retirements of current faculty. All decisions in the area of faculty hires will be critical to determining the School's success in achieving its mission to be the premier institution in environmental research and policy. The School must expand its impact globally through cooperation with international partners.

Priorities for the development of research programs in the Nicholas School and the Nicholas Institute are closely linked to faculty development. There are important connections between research and education, and in some cases, new faculty positions have been elevated in priority to meet pressing teaching needs. In all cases, priority will be given to female and African-American candidates to improve the gender and racial diversity of the School. Currently, the Nicholas School has 10 (i.e., 20%) female and 1 (2%) African American faculty members, but it will strive to increase those numbers substantially within the next five years.

In recent years, several national committees and panels have identified national priorities in environmental science and policy research. One recurring theme is the need for improved understanding of **global change**. For example, a National Research Council committee recently called for improved understanding of how to organize institutions that can help society respond to global climate change.³ The U.S. Climate Change Science Program recommended research to improve our understanding of the causes of climate

³ National Research Council, *Human Dimensions of Global Environmental Change: Research Pathways for the Next Decade*, Washington, D.C.: National Academy Press, 1999.

variability and change, and to study the sensitivity and response of natural and managed ecosystems and humans to climate change. The Millennium Project lists climate change among its 10 priorities for environmental sustainability.⁴

We also need a better understanding of **biogeochemistry** and **ecosystem processes** in both terrestrial and marine environments.⁵ The National Science Foundation has emphasized ecosystem science through its ongoing Biocomplexity Initiative⁶ and the creation of the National Ecological Observation Network (NEON). Environmental threats to marine and coastal ecosystems have been highlighted by several recent reports, including the Millennium Project. The Pew Oceans Commission concluded that the future of healthy and productive marine ecosystems would require a new ethic of treating the oceans as a public trust.⁷ The U.S. Commission on Ocean Policy found that “the oceans remain one of the least explored and most poorly understood environments on the planet, despite some tantalizing discoveries over the last century.” Both groups call for sustained investment to support research and the translation of that research into ecosystem-based management and policy for the marine environment.⁸

In the area of **environmental health**, the National Institute of Environmental Health Sciences in Research Triangle Park has prioritized research on environmental genomics to improve the understanding of variations in individuals’ susceptibility to

⁴ UN Millennium Project, Task Force on Environmental Sustainability, New York, 2005

⁵ *Global Change Ecosystems Research*, National Academy Press, Washington, 2000; *Grand Challenges in Environmental Sciences*, National Academy Press, Washington, 2001; *Global Environmental Change: Research Pathways for the Next Decade*, National Academy Press, 1998.

⁶ National Science Foundation, *Biocomplexity in the Environment*, <http://www.nsf.gov/geo/ere/ereweb/fund-biocomplex.cfm>, accessed 3/31/05

⁷ Pew Oceans Commission, *America's Living Oceans: Charting a Course for Sea Change*, http://www.pewtrusts.org/pdf/env_pew_oceans_final_report.pdf, May 2003.

⁸ U.S. Commission on Ocean Policy, *An Ocean Blueprint for the 21st Century*, Final Report, http://oceancommission.gov/documents/full_color_rpt/welcome.html, September 2004, p. 11

environmental agents.⁹ Changes in climate and the quality of air and water resources may well determine global environmental health during this century. A focus on global environmental health has emerged in the report of the Duke Committee on Global Health,¹⁰ with the Nicholas School playing a major role to understand how the environment will shape issues of human health during the next several decades. The report of the Provost's working group, charged to envision an interdisciplinary initiative in Environmental Health is included herewith as Appendix J, which is fully compatible with objectives of the Nicholas School.

The Nicholas School is uniquely positioned to respond to critical areas of environmental science and policy. *During the next five years, the Nicholas School will pursue a vigorous program of faculty development that will:*

- *increase faculty quality as measured by scholarly impact and the quality of educational programs;*
- *strengthen priority focal areas within the School;*
- *leverage interactions with other Duke schools and programs;*
- *increase the international emphasis of the school's research and teaching programs;*
- *contribute to the interdisciplinary research and outreach goals of the new Nicholas Institute for Environmental Policy Solutions;*
- *diversify the faculty with particular attention to recruitment of African-Americans and women.*

⁹ National Institute of Environmental Health Sciences, *Environmental Genome Project*, <http://www.niehs.nih.gov/envgenom/home.htm>, accessed 4/11/05.

¹⁰ Duke Global Health: Report of a University-Wide Steering Committee, June 2005

A. Current Focal Areas:

Given the diversity of faculty interests and the matrix of collaborations within the School and Duke, any taxonomy of faculty groups is somewhat arbitrary. The following eight focal areas are used to describe current research strengths of the Nicholas School.

- ***Conservation Biology***– The school has internationally recognized expertise in terrestrial and marine conservation biology, with research programs extending to Central and South America, Africa and Southeast Asia. Research themes include species extinctions, the loss of tropical forests and subsequent consequences for biodiversity, the effects of fishing on marine biodiversity, and the development of new conservation tools. Many faculty in the school work at the interface between conservation science and policy.
- ***Ecosystem Science and Management***– This focal area emphasizes an integrated, systems-level approach to understanding how natural ecosystems function and how humans impact those systems. With particular strengths in forested and wetlands ecosystems, the Nicholas School is a leader in applications of ecological science and modeling for ecosystem management.
- ***Environmental Economics and Policy*** - Duke University was ranked 2nd among major universities in a recent U.S. News and World Report poll in the area of environmental policy¹¹. This recognizes Duke’s campus-wide strengths in this area including faculty in the Nicholas School, the Sanford Institute of Public Policy, the Law School, the Political Science Department, and the Economics Department. With the emergence of the new Nicholas Institute for Environmental Policy Solutions, Duke has an opportunity to become the undisputed leader in this area.

¹¹ U.S. News and World Report: <http://www.usnews.com/usnews/edu/beyond/gradrank/gbpadsp6.htm>

- ***Environmental Health***– Very few programs in the nation have focused on interactions between environmental quality and human and sentinel organism health. Building on a long-term emphasis on ecotoxicology, as well as existing connections with the Medical School, the Nicholas School has an increasing national presence in this area, with unique programs linking genomics and geospatial analysis to questions of environmental health.
- ***Global Change***– An understanding of how global climate is evolving is one of the most pressing environmental issues of our time. With strengths in ecological, biogeochemical, geological, and physical processes, the Nicholas School is well positioned to play an important role in studies of paleoclimate, the distribution of climatic properties in ocean basins, and responses of natural systems to global change. In addition, faculty in environmental economics and policy contribute to the valuation of climate change impacts and the design of climate policy.
- ***Marine Science*** -The Duke University Marine Laboratory provides the foundation for studies in marine ecology and estuarine processes that is unique among our competitor institutions. Faculty research addresses critical questions of overfishing, marine bycatch, optimal placement of marine protected areas and vulnerability of coastal development to natural disasters.
- ***Water Resources and Surface Processes***– Between the Nicholas School and the Pratt School of Engineering, Duke has remarkable faculty expertise in hydrologic science and surface processes. Research themes include water quality modeling and assessment, salinization of water resources, the dynamics of coastal and nearshore surface processes, and water resources policy.
- ***Solid Earth Processes*** – Forming the core of the former geology department, faculty in EOS have particular expertise in the geology, geophysics and geochemistry of extensional plate boundaries (e.g., mid-ocean ridge) in terrestrial and marine environments. While not expected to be a growth area in future years,

this group will play a key role in energy resource sciences related to the new Energy and Environment initiative.

Consolidating the strengths of these areas will enable the School to attract significant external research support and to compete for the best professional and graduate students.

B. A new focal area—Energy & Environment

How modern society manages its reliance on fossil energy will play a key role in determining global economic growth, the health of the planet, and the world's political stability in the coming decades. Already, constrained supply, steadily growing demand, geopolitical events, and increasing concerns over global climate change have commanded the attention of business leaders, policy makers and advocates of the energy sector across the world. Recognizing and acting on these issues will require innovative thinkers and leaders who understand the energy system and the important interconnections between technology, policy, markets, and the environment.

Anticipating the need for future energy leaders, the Nicholas School has established an Energy and Environment program as part of a new paradigm in the study of environmental issues. Energy is integral to the very existence of modern society, and it, like water and climate, goes beyond environmental protection. Being the only School at Duke with expertise in the relevant sciences, as well as policy and economics, the Nicholas School is a natural leader for Duke University in a multidisciplinary approach towards developing a sustainable energy future. The School, however, does not intend to act on this issue alone, and we are engaging the University's other Schools in developing an exceptionally strong and broad collaborative undertaking on energy—one that will

stand out among similar offerings by other universities throughout the world. We have proposed a Center for Energy and Environment as an Academic Investment Proposal (AIP) to the Provost (Appendix B) to provide initial core funding for this program.

The goal of the Energy and Environment Program is to provide a comprehensive understanding of the world energy system—to assess, anticipate and act on changes that will occur as the world transitions to alternative energy sources during the next few decades. The program will provide students with a systematic framework for thinking about energy, as well as the skills to assess information and data, communicate between disparate audiences, and, ultimately, help corporations, governments and non-profit organizations respond effectively to energy challenges.

The endowment gift from Jeffrey and Martha Gendell launched the Energy and Environment Program, providing funds to hire two new faculty with a focus on energy. It has also provided initial support for a Visiting Executive program, a speaker series, and seed grants for new research into energy. Capitalizing on this gift, the Energy and Environment program will provide distinctive education, including:

- Broad perspective on the current energy system and future alternatives.
- Fundamental understanding of science and technology as it relates to energy and environment.
- Background in the economics, policy and business of energy.
- First-hand exposure to the energy sector and its corporate leaders.
- Critical skills in data analysis, modeling, and facilitation.
- Experience with communication, project management and teamwork.

The program will accomplish this through a mix of traditional and novel curricular elements, including:

- Experiential learning courses to draw upon expertise outside the University.
- Gendell Visiting Executive Program to bring energy leaders to campus
- Fieldtrips to provide first-hand exposure to the energy system and corporate

leaders.

- Internships to provide practical experience.
- Applied research by faculty and students.
- Gendell Speaker Series to inform students and faculty on evolving and current energy issues.

The program will be conducted at all four levels of education carried out at the School:

- Undergraduates will be offered energy courses, and majors/minors with energy focus.
- Master of Environmental Management (MEM) students will be able to concentrate in Energy and Environment starting fall 2006.
- Joint degree masters students can combine energy MEM with MBA, JD, MPP (policy) or MEMP (engineering).
- PhD students will receive a deeper technical focus in energy and environment.

New faculty will be added to address energy issues from new perspectives that cross traditional disciplines. Among our highest priority for faculty hiring, these new colleagues will bring expertise in Energy Technology and Resources and in Energy Economics and Policy to the Nicholas School. To address the full range of issues at all levels of education in the School, while also carrying out research that keeps the energy program at the cutting edge of developments in its field, support for additional faculty must be obtained as a development priority. Areas in which the Program needs to increase faculty expertise in include interactions between energy and water, climate, natural ecosystems, and human health.

C. Strategic Initiatives in Faculty Development:

In addition to the current searches for the Korstian and Repass chairs, 15 faculty hires are proposed to enhance the Nicholas School's research and teaching missions, its international impact, and its interactions with the NIEPS. Some positions will be funded

by new endowments (4), some may derive from retirements of existing faculty (3), and may be funded jointly with other schools as Nicholas Institute professorships (3). These strategic areas are intended to identify important opportunities for new investments in the School.

Energy and the Environment

Positions: (1) Energy Technology and Resources (Gendell Chair; current search)

(2) Energy Economics and Policy (Gendell Chair)

There is strong faculty support across all Divisions for the new program in Energy and the Environment as our top priority strategic initiative. How society manages its energy supply and demand will have major impacts on the planet's economic growth, environmental health, and geopolitical stability. With the Gendell endowments, the Nicholas School has an opportunity to launch a unique teaching and research program that examines the linkages between energy supply and use and the quality of the environment. The program will further differentiate from other energy programs in the country by integrating science, policy and business approaches to energy management. While initially envisioned as an undergraduate and Masters of Environmental Management degree program, it is equally important to develop strong scholarship in this area to address the many challenges society faces in meeting energy needs in sustainable ways. This new focal area would have synergies with several existing focal areas, most notably Global Change, Environmental Economics and Policy, and Environmental Health. It would also provide an important area of policy research and outreach for the Nicholas Institute. To jump-start the program, it is essential to establish a core group of faculty in the Nicholas School whose expertise is in the science and policy of energy resources, building on existing strengths focused on exploration. We believe that this core can be achieved with two strategic faculty positions: an expert in energy resources and technology, and an energy economist or policy analyst. Further growth in this area can be determined as the program matures and appropriate funding is identified. (See also, Appendix B).

Marine Science and Policy¹²

- Positions: (1) Coastal Ecosystem Processes
(2) Coastal Ecogeomorphology
(3) Conservation Genetics
(4) Biological Oceanography (Harvey Smith Chair)

World wide, coastal ocean ecosystems harbor the ocean's most valuable living resources, but also receive the brunt of human impact on the ocean. Coastal environments are among the most dynamic and changing ecosystems in the oceans, influenced by terrestrial and marine processes on a range of timescales. These environments are particularly sensitive to environmental changes, responding to variations in sea level, climate, and anthropogenic activities. An understanding of past and present coastal processes is required to predict future environmental conditions and necessary for successful management and conservation strategies. We seek faculty whose research addresses the broad topic of how biological responses in the coastal oceans (continental margins, beaches, estuaries and/or marshes) respond to physical forcing of all types and timescales including global change.

Estuaries and tidal marshes provide essential habitats for plants and animals, which in turn help determine the tidal-flow and sediment-transport patterns that continually reshape these environments. To build on the school's existing strength in coastal sciences, we envision expanding our expertise in the areas of coastal ecosystem processes and the emerging field of ecogeomorphology. Each of these fields takes an interdisciplinary approach to understanding the environmental challenges that confront the dynamic environment of our coastlines. Interdisciplinary research is required to address questions about these coupled systems, including how the habitats and landscapes will respond to environmental changes such as accelerated sea-level rise and the changing sediment and nutrient delivery from nearby watersheds undergoing changes in land use. Modern tools from molecular genetics can provide new insights into basic science issues in systematics, evolutionary biology, and biogeography. But these tools can also be applied in the field of conservation biology to determine connectivity among subpopulations, to clarify population structure, or to conduct forensic analysis of market samples. To build on our current strengths in ecology, organismal biology, and conservation, we propose a position in Conservation Genetics. Research might include (but is not limited to) use of modern genetic techniques to determine spatial population structure, connectivity, or changes in genetic variation under exploitation. This position would link strongly to university initiatives in genomics and to marine lab strengths in marine conservation biology.

Globally, oceans support valuable living resources and much of the planet's biodiversity. Ocean environments are dynamic and changing, influenced by terrestrial and marine processes on a range of time, chemical, physical and spatial scales. An understanding of

¹² These are priority positions for a program in Marine Science and Policy. Additional future positions anticipated at the Duke Marine Laboratory are listed in Appendix D. All are contributions to the success of the Center for Marine Conservation, which has applied for AIP funds from the Provost's Office (Appendix E).

past and present ocean processes is required to predict future environmental conditions and is necessary for informed and effective management and conservation strategies. We seek an individual whose research addresses the topic of biological oceanography in its broadest sense. This person will be a central to the development of the program of marine science and conservation and supportive of the recommendations by the Provost's Working Group in Earth System Science and Engineering, which recognized a critical need for expertise in understanding interactions between the oceans and the atmosphere. The position would be funded as the Harvey Smith Chair in Biological Oceanography, to be vacated with the upcoming retirement of Richard Barber.

Human and Environmental Health Interactions

Positions: (1) Environmental Health Policy (potential joint with NIEPS)
(2) Environmental Genomics of Populations.

Global health has emerged as a major Duke University initiative, and the Nicholas School is poised to help improve our understanding of the role of environment in determining the health and welfare of humans worldwide. The School's focal area in Environmental Health and Security can be significantly strengthened by adding two new, rather different but complementary, types of expertise. The environmental health group works on a series of basic and applied research questions, almost all of which have direct policy implications. Adding expertise in environmental health policy would bring another important dimension to many of the environmental health research projects on campus, such as in the Sanford Institute and would position the School to take advantage of the growing interest at the NIH for interdisciplinary approaches. This position could also fill gaps in the undergraduate and professional programs in the areas of public participation and environmental justice.

The second area of expertise is environmental genomics. Despite an emerging consensus that many complex and common diseases are influenced by multiple gene-gene and gene-environment interactions, little is known about how genetic and environmental factors interact to promote or prevent adverse outcomes in both human and ecological systems. This rapidly evolving area of research is at the forefront of environmental health research. These two positions would provide important links to the Medical Center, Arts and Sciences, the Sanford Institute, the Fuqua and Law Schools, the Institute for Genome Sciences and Policy, and the National Institute for Environmental Health Sciences (NIEHS) in Research Triangle Park.

These positions are supportive of the Provost's Working Group on Environment and Health Sciences at Duke (Appendix J).

Ecosystem Science and Management

Position: Geospatial analysis, currently being recruited.

Geospatial analysis involves the explicit consideration of spatial structure and spatial dependence in variable relationships to improve modeling, analysis, and inference about environmental processes. Geospatial analysis includes, but is not limited to, technology-based analytic tools, such as Geographic Information Systems (GIS), global positioning systems, and remote sensing. These tools, in combination with geospatial analytical methods (e.g., spatial statistics) allow researchers to explore diverse environmental processes, ranging from studies of landscape ecology to transportation planning to environmental health outcomes. Thus it has wide applicability across all of the focal areas of the Nicholas School. Although we have just completed one search in this area, there is a high priority need for an additional position to enhance the quality and potential of all Nicholas School research initiatives. In addition, this area represents one of the most popular and over-subscribed teaching areas in the school. An additional hire in this area would provide an opportunity to create linkages between the Nicholas School and the School of Medicine, Arts and Sciences, the Pratt School of Engineering, the Law School, and the Fuqua School of Business.

Environmental Policy and Economics

Positions: (1) Community Based Environmental Management
(2) Resource and Environmental Policy
(3) Land Use & Land Management
(4) Science of Disasters (potential joint with NIEPS or Fuqua)

Community-based environmental management has emerged as a dominant focus for Nicholas School students in conservation, ecosystem management, and coastal management particularly, but also in environmental health and watershed management. The role of individual actors and small-scale institutions, both public and private, in shaping environmental conditions in the U.S. and globally is a thriving research area in environmental social science. The Nicholas School proposes a tenure-track faculty position in community-based environmental management to meet teaching and advising needs and to take advantage of research initiatives requiring the integration of natural and social science at watershed to landscape scales, such as the NSF biocomplexity program. Teaching contributions might include participatory techniques for environmental management, qualitative methods, and environmental justice. A faculty member filling this position might work in a variety of environmental arenas, including land use change, environmental health, sustainable development, conservation or water resources, and come from one of many disciplines, including political science, rural sociology, anthropology or geography.

As a growing area of inquiry in several social science disciplines, resource and environmental policy informs the governance of natural resources at local, national and international levels. The Nicholas School proposes a tenure track faculty position in resource and environmental policy to strengthen various teaching and research programs across the school. Relevant research areas include land use or marine policy, comparative environmental politics, political economy of institutions, protected area management, the study of common property resources, and environmental policies in developing countries. Teaching contributions might include land use policy, protected areas management, policy analysis, and qualitative methods. Relevant disciplines include political science, sociology, geography, anthropology, political ecology, public policy or political economy.

A pressing need in our doctoral and MEMs programs is a position in land-use science covering the human dimension of land use. The ideal faculty member would have a background in geography, city and regional planning, or be an ecologist or social scientist interested in these themes. Such a faculty member would position the School to compete for funding opportunities in the North American Carbon Program, NASA's land cover change programs, and the Human Dimensions component of NSF's global change programs (especially Human Spatial Dynamics and Biocomplexity: Coupled Human-Natural Systems). This position could be filled by a tenure-track or POP hire, who might also have expertise in community-based, participatory methods, or land use impacts on watersheds.

Duke currently has significant strength in decision sciences, with two core faculty in the Nicholas School and the world class-decision sciences group at Duke's Fuqua School of Business and additional expertise in the Institute of Statistics and Decision Sciences (ISDS) in Trinity. This strategic hire would build on that strength by adding an expert in the crucial but often neglected science of disasters or catastrophes – low-probability, high- consequence events such as the December 2004 tsunami, an asteroid collision, or abrupt climate change, each with potentially dramatic impacts on human and ecological systems.

Global Change

Position: Biogeochemical Modeling

The field of biogeochemistry explores the interaction between biological and geochemical processes and their effects on nutrient and elemental cycles in space and time. An understanding of the cycling of carbon through the atmosphere, biosphere and lithosphere, for example, is essential to the development of predictive models of the effects of increased CO₂ emissions due to burning of fossil fuels. A recent report from the National Academy of Sciences lists studies of biogeochemical cycles as the nation's

highest priority for global change research.¹³ A strategic hire in either marine or global biogeochemistry would expand and complement the school's existing strengths in this area, as well as provide important links to the Chemistry and Biology departments. This position supports the recommendations of the Provost's Working Group on Earth System Science and Engineering.

Water Resources and Hydrology

Positions: (1) Global Water Cycle
(2) Watershed Hydrology and Management

Collectively the faculty of the Nicholas School, the Pratt School and the Department of Biology contain extensive expertise in studies of the movement of water at the Earth's surface, particularly the flux of water vapor from terrestrial ecosystems to the atmosphere. Adequate supplies of freshwater are perhaps the most pressing problem facing humanity in the future, and rapid rates of population growth are found in many areas that already have severe water shortages. If we are to improve the global level of public health, particularly reducing exposure to water-borne diseases, the quality of water supplied to human populations is as critical as its abundance. The Nicholas School proposes a senior hire who study the global water cycle and watershed hydrology, which will link the diverse expertise on the Duke campus to provide integrated assessments of watershed management for improved supplies of water, particularly in the developing world. Hires in this area are a direct contribution to recommendations by the Provost's Working Group in Water Resources and Hydrology and the Center for Hydrologic Sciences, which has applied for AIP funding from the Provost's Office (Appendix C).

D. Relationships between the Nicholas School and the Nicholas Institute

The launch of the Nicholas Institute for Environmental Policy Solutions (NIEPS) provides exciting new opportunities for faculty development and the strategic direction of the Nicholas School, while also posing challenges for coordinating hiring in ways that will advance the missions of both the School and the Institute. The NIEPS will be a university-wide, multidisciplinary enterprise mobilizing faculty and outside experts to investigate critical and complex environmental problems and to offer insightful syntheses

¹³ *Grand Challenges in Environmental Sciences*, National Academy Press, Washington, 2001; see also *Global Environmental Change, Research Pathways for the Next Decade*, National Academy Press, Washington, 1998.

and creative policy solutions. In addition to the Nicholas School faculty development priorities described above, the new Director of the Institute will work with external and internal advisory groups to develop a strategic plan and a list of hiring priorities for the Institute. Alternative approaches for hiring the scholars of the Institute are described in Appendix F. The appointment of regular rank faculty (Nicholas Institute professors and research professors) will occur through customary avenues for hiring in the Nicholas School and other academic units. In addition, the Institute will be able to hire visiting faculty, research scientists, and post-doctoral scholars so that it can respond nimbly to emerging opportunities.

E. Relationships to other Schools at Duke

The Nicholas School seeks to build strong relationships to the other Schools at Duke. Currently, two appointments with the Law School—one joint and one secondary—bring important legal expertise to bear on environmental problems considered within the Nicholas School. We are in the process of creating an interdisciplinary clinic for the study and application of environmental law (Appendix L). Students from the Law School and the Nicholas School will, under faculty supervision, work with clients on real, pressing environmental challenges in North Carolina and the Southeast. The clinic will foster interdisciplinary problem-solving skills in ways that traditional forms of classroom instruction simply cannot provide. As a result, students will learn both practical advocacy and how to work closely with professionals outside their discipline.

Similarly, a joint hire in environmental genomics will solidify cooperation between the Nicholas School and the Duke University Medical School in the area of

global environmental health. A proposal for a joint position in environmental ethics between the Nicholas School and the Divinity School has been circulated to potential donors (Appendix G). Faculty hires in decision sciences, business and the environment, and energy policy could well include joint positions with the Fuqua School of Business. A joint hire with the English Department would allow the Nicholas School to expand its curriculum at the Duke Marine Laboratory to include classes in the literature of and in creative composition about the marine environment. Similarly, an artist-in-residence at the Marine Laboratory could offer courses that fulfill the humanities requirements of Duke undergraduates, providing an undergraduate experience that could not be found on the Durham campus.

V. Strategic Planning for Educational Programs

A. Undergraduate Education

Across the campus, Duke undergraduates express a deep interest and concern for the future health of our environment. The Nicholas School bears the central responsibility for education in environmental science and policy on the Duke campus, reaching nearly 800 (~7%) undergraduate enrollments per year in environmental and earth science courses. This percentage is too low, given the widespread interest in environmental issues among undergraduates, as well as the importance of educating our students for the challenges our world will face in the coming years. With respect to undergraduate education, and consistent with the Undergraduate Experience Task force, the School will embark on two new initiatives:

1. To educate and engage the greatest possible number of Duke undergraduates,

whatever their major, in environmental issues that confront our world. This includes both curricular and co-curricular activities.

2. To develop in a select group of Duke undergraduates (i.e., our majors) a passion for future environmental leadership and service based on a deep understanding of environmental and social sciences

During the next five years, with respect to curricular efforts, the Nicholas School will refocus attention and faculty resources on undergraduate education, with the goal of doubling both the number of students we teach as well as the number of our majors.

Undergraduate initiatives, both planned and underway, include the following:

- Broadening the scope of our course offerings to address the interests of current Nicholas School majors as well as undergraduates majoring in other fields. Examples include offering an introductory environment course intended for non-science majors, a GIS-based course designed to expose our majors to geospatial analysis, and an undergraduate course on conservation ecology.
- Offering a Minor in Environmental Science and Policy (recently approved by the Trinity Curriculum Committee) to attract students majoring in other fields who seek an understanding of environmental issues but cannot accommodate the extensive science pre-requisites required of our majors into their course of study at Duke.
- Offering an interdisciplinary undergraduate certificate in ‘Energy and the Environment’ that is attractive to both science and engineering majors as well as students majoring in Economics, Public Policy and Political Science. This certificate will complement both the new MEM track in Energy and the Environment and the focus on energy in the Nicholas Institute. As with all undergraduate certificates, the ‘Energy and Environment’ certificate will be interdisciplinary in nature, encompassing exposure to energy markets and policy, energy technology, and energy resources, and drawing upon the expertise of diverse schools across campus.
- Reinvigorating undergraduate study at the Marine Laboratory by more broadly advertising the unique educational experience at the Lab, and reaching out to attract new undergraduate cohorts such as the undergraduate engineers.
- Explore merging the four majors currently administered by the Nicholas School (A.B. and B.S. Environment majors; A.B. and B.S. Earth and Ocean Science majors) into two majors, leading to an A.B. degree in “Environmental Sciences and Policy,” and a B.S. degree in “Environmental and Earth Sciences.” The

popular A.B. degree would undergo only minor changes, but the B.S. degree would have track options such as Ecology, Earth Science, Marine Science, and Environmental Health.

- Develop additional courses with a service-learning component (the Nicholas School currently offers one in collaboration with the Pratt School).
- Pair appropriate Nicholas School professional courses with undergraduate sections to expand our course offerings and promote interaction with professional school faculty and students (e.g., we recently added an undergraduate laboratory section to the popular professional school GIS course).

With respect to co-curricular activities, we will:

- Engage the larger Duke undergraduate population in environmental issues by capitalizing on their interest in outdoor activities, such as hosting local field trips to canoe on the Eno River, to hike in the Duke Forest, or to visit the Marine Lab.
- Continue to help students select summer internship or research opportunities that build on and make use of their knowledge in the service of society. The >100 Stanback internships that focus on environmental and social justice issues have been provided our students with a wealth of valuable summer opportunities that complement their curricular program.
- Enhance our interaction with student environmental organizations such as Project WILD, Environmental Alliance, and Delta Smarthouse.
- Continue to work closely with the Career Center to acquaint our students early in their college careers with the diverse services the Center offers (we have recently instituted yearly meetings with all of our majors and the Career Center staff).

The initiatives outlined above mesh well with the goals outlined in the Undergraduate Experience Task Force report. Specifically, they promote interdisciplinary teaching and learning; foster opportunities for service learning and civic engagement; provide opportunities for greater interactions with professional school faculty and programs; encourage greater interaction between Trinity and Pratt students, and foster a more seamless relationship between curricular and co-curricular activities.

B. Professional Education

The Master of Environmental Management (MEM) degree is pursued via one of eight curriculum “tracks” that prepare a student for future employment in specific areas of environmental management. The majority of this two-year degree program consists of coursework, with a modest “master’s project” serving as a capstone experience in the second year. Students take the majority of their classes in the Nicholas School, although they have access to courses across the Duke campus, at UNC, and at NCSU. Some tracks are more popular than others; the programs in Coastal Environmental Management, Conservation Science and Policy, and Environmental Economics and Policy attract the majority (75%) of students. A recent strategic plan for forestry (MF degree) (Appendix H) notes the success of its graduates, suggests improvements to the forestry curriculum, and recommends working with the Society of American Foresters to renew accreditation of the Master of Forestry degree, with continued emphasis on sustainable management of forest ecosystems for multiple social goals.

Among similar degree programs, the Nicholas School charges less for tuition than either of its major competitors,¹⁴ yet cost is the most frequent reason given by students who opt not to attend the Nicholas School in favor of other opportunities or no graduate education at all. Most students find that it costs about \$40,000/year to attend the Nicholas School, so they leave Duke with substantial debts and limited salary opportunities compared to students in law, business or medicine. Nevertheless, student morale is high; most are passionately committed to a career in environmental preservation and happy with the education they receive at the Nicholas School.

¹⁴ (For 2005-06, Nicholas \$24,300 vs. \$24,800 at Yale and \$28,833 at Michigan)

The Nicholas School is able to provide some level of financial aid to about 80% of the students attending, in the form of scholarships, assistantships, and loans. During the past few years, the School has shifted from giving a modest amount of aid to the largest possible number of qualified applicants, to giving significantly greater awards to students of exceptional merit. *Increasing the availability of financial aid so that the best and the brightest applicants can attend the MEM program is the highest fund-raising priority to achieve our strategic priorities.* We seek to achieve a steady-state enrollment of 260 in the masters professional program.

The Nicholas School will engage the Fuqua School of Business to enhance the “management” skills and courses that comprise the Master of Environmental Management (MEM) degree program. We will strive to increase the number of students who are enrolled in the joint MEM-MBA degree program, as well as to offer basic courses in the concepts of sustainable development, industrial ecology, and environment for Fuqua students. We hope that Fuqua will respond by enlarging its curriculum in financial management for non-profits, business and the environment, and financial models for business ventures, and other classes that will provide relevant business background and skills for Nicholas School students pursuing a career in environmental management.

The DEL Program (<http://www.nicholas.duke.edu/del/>)

The Duke Environmental Leadership (DEL) Program advances the Nicholas School mission by providing a distance-learning program and continuing education courses designed specifically for environmental, business and community leaders. The

DEL Program increases the capacity of the Nicholas School to reach outside audiences and expands access to the School's faculty, research and resources, while also providing traditional MEM students an opportunity to meet working professionals. The DEL Program offers an ideal alternative for those currently engaged in resource management, environmental preservation, and policy analysis to pursue further education while retaining their current employment.

None of our competitor schools have continuing education- or distance-learning programs for practicing professionals. A broader comparison to other universities, agencies and organizations shows that the major competitors in this area are consulting firms, government training institutes, and land grant schools with an extension mandate. As a result, the Nicholas School is well-positioned to become a leader in the education and training of environmental professionals. Current DEL enrollment is about 8 students entering each year. We will strive to increase this to 10-12 students/year (20-25 total) in the DEL distance-learning program during the next 3-5 years.

C. Doctoral Education

A thriving doctoral program is an essential ingredient for the recruitment of the best faculty to join the Nicholas School. Currently, the School supports about 2.5 doctoral students per faculty member, or 120 total, including 59% female and 9% of minority background. As for the MEM program, financial aid resources for doctoral students must be increased substantially if we are to attract the best applicants against competitive offers from other institutions. The size of the doctoral program should also grow modestly, perhaps to a steady-state population of 160 students during the next five years.

While training grants are rare in the environmental sciences, the Nicholas School faculty are committed to the continued pursuit of a major grant to support doctoral students, through programs such as the IGERT program of the National Science Foundation.

Modest adjustments need to be made in the administration of the doctoral programs of the School. Currently, doctoral students enroll in the Nicholas School through four programs administered by the Duke University Graduate School: These programs are:

1. Environment, 2. Earth and Ocean Sciences, 3. The University Program in Ecology (<http://www.ecology.duke.edu/index.html>), and 4. The Integrated Toxicology Program (<http://toxicology.geneimprint.com/>).

For the most effective advertising and administration, the Nicholas School has recently proposed that its Graduate Program in Environment be divided to form separate programs in Environmental Science and Policy and Marine Science and Policy, to parallel the Divisional structure of the School

(Appendix K)

VI. Facilities, Centers and Institutes

A. The Duke University Marine Laboratory

The Duke University Marine Laboratory (DUML) is the ‘east campus’ of the Nicholas School. With 13 resident teaching and research faculty and a total staff of 74, DUML operates year-round with undergraduate, professional masters, and doctoral students in residence. In addition to matriculated Duke students, DUML hosts thousands of visitors each year including undergraduates from other institutions, the Duke Talent Identification Program (TIP), Duke Alumni College, and other visiting groups.

The DUML is the administrative home of the Division of Coastal Systems Science and Policy (CSSP) and the new Center for Marine Conservation, although both of these entities have significant participation by faculty based in Durham as well. DUML is the homeport of the *R/V CAPE HATTERAS*, the 135-foot National Science Foundation vessel operated through Duke on behalf of the Duke-University of North Carolina Oceanographic Consortium; the *R/V SUSAN HUSDON*, a 57-foot research vessel owned and operated by Duke, and a number of smaller boats. Shoreside facilities include a full-service dining hall, dormitories, library, laboratories, and a student center.

The Duke University Marine Lab and the CSSP Division, in conjunction with the Earth and Ocean Sciences (EOS) Division are at the forefront of marine science, policy, and conservation worldwide. The graduates of the Coastal Environmental Management (CEM) and PhD programs are filling top jobs in the fields of marine science and conservation, and the faculty are participants in and advisors to major coastal and ocean conservation initiatives, including the Pew Ocean Commission, the U.S. Commission on Ocean Policy, Conservation International's "Defying Ocean's End" Program, the Monterey Bay Aquarium's Seafood Watch Program, and the Ocean Studies Board of the National Academies of Science and Engineering.

There are three major strategic challenges facing DUML. The first is the recruitment of more undergraduate students, in particular from Duke, to study at DUML. Although MEM and Ph.D. enrollment are both at targets set by the CSSP Division, the undergraduate enrollment has diminished since the early 1990s and is below target level. This challenge will be addressed through the use of professional recruiters, improved advertising materials and strategies, increased contact between the Beaufort and Durham

campus, a proposed partial waiver of tuition for students in Beaufort, and a major revision of the DUML curriculum that began in spring 2006. The latter change has already produced a measurable improvement in spring 2006 enrollments, and we have initiated similar revisions for fall semester. We have also begun a new initiative to attract a previously untapped group of Duke undergraduates—engineering students. These students, many of whom have biology course requirements and interests that bridge the engineering and life sciences, will find exciting research opportunities that apply their technical expertise to studies of the marine environment.

The second challenge involves the DUML research and teaching facilities. The original DUML ‘quad’ buildings were built in 1938, and are still in use. A second burst of construction occurred in the late 1960s and early 1970s with the addition of the Gray Library/Auditorium, Bookhout Laboratory and the maintenance building. A third round of construction began shortly after 2000 with the addition of the Oceanography Building, the Student Center, the Ocean Science Teaching Center—one of Duke’s first “green” buildings, scheduled to be completed in June of 2006—and the remodeling of the dorms and dining hall. The second strategic challenge thus is the renovation and replacement of some of the older research and teaching facilities to the state of the art for the 21st century.

We are also developing the new Center for Marine Conservation, based at the Marine Lab but involving faculty from both the Beaufort and Durham campuses, in a way that unifies the marine conservation program at Duke in close cooperation with the Nicholas Institute. To this end, we have proposed a Provost’s Strategic Initiative project in support of the Center for Marine Conservation (Appendix E). The Center is an

interdisciplinary consortium in the Nicholas School of the Environment and Earth Sciences focusing on research, education, and outreach in marine conservation. Recognizing the interdisciplinary and often global nature of marine conservation, we seek to integrate across the natural and social sciences and to engage international partners. We focus on problem solving and incorporating science into regional, national and international policy-making. Faculty and Center Associates will provide an unparalleled range of expertise and experience from both the natural and social sciences, as well as experience with integrating science into policy in a variety of marine systems. The Center also serves as the marine arm of the Nicholas Institute, providing government officials with the tools and approaches that will enhance their ability to implement ecosystem-based management in the oceans.

Both the U.S. Commission on Ocean Policy and the Pew Oceans Commission pointed to ecosystem-based management as a primary policy goal for marine systems in the United States. Implementing marine ecosystem-based management is by its nature a place-based approach—places in the coastal zone, watersheds, estuaries, continental shelves, or the open sea that will be managed. The Center faculty is uniquely qualified to address the key issues for developing a place-based approach for the management of these systems. Key elements of our approach will include:

1. *Developing geospatial analysis tools to integrate, display, and analyze spatially explicit data for dynamic oceans.*
2. *Collecting, cleaning, and archiving spatially-explicit data on the physical, biological, social, economic, and governance features of coastal and ocean ecosystems.*

3. *Developing new biophysical and social scientific analyses in support of policy development for integrated place-based management of coastal and marine ecosystems.*

While we are elaborating the concepts and developing the tools, we also propose to educate a new generation of researchers and environmental managers through our undergraduate, professional masters, and Ph.D. level students to take on the challenges of place-based management in marine ecosystems through interaction with activities of the Center.

B. Centers and Institutes

The Nicholas School is the home or a cooperating partner of various Centers that serve to bring faculty and students together for interdisciplinary research opportunities. For instance, the Center for Hydrologic Sciences (<http://www.nicholas.duke.edu/chs/>) serves as the locus for activities of the Nicholas School and the Pratt School of Engineering in the areas of water resources (Appendix C). The recruitment of a senior faculty member in hydrology will cement collaboration between these Schools. The Program for the Study of Developed Shorelines (PSDS; <http://www.nicholas.duke.edu/psds/>) is well known for its studies of beach erosion and recommendations for coastal zone ecosystem management. The Center on Global Change (<http://www.nicholas.duke.edu/cgc/>) has served to incubate faculty collaboration in a wide variety of projects, most recently in the response of coastal ecosystems to sea level rise and global climate change. Together with the Nicholas Institute, this Center and the Nicholas School have entered into a joint partnership with Duke Energy, which is providing \$2.5 million to support

studies of carbon sequestration and CO₂ mitigation strategies useful to the company.

This Center in cooperation with the Nicholas and Pratt Schools can serve as the locus for improved expertise in earth system observation and modeling, as recommended by the Provost's Working Group on earth systems science.

In addition to campus affiliations, the Nicholas School also has close cooperative relationships with the Organization for Tropical Studies (OTS), the Carolina Population Center at UNC, and the Forest History Society in Durham. New potential collaborations will emerge between the School and the National Institute for Environmental Health Science through Duke's Institute for Global Health. *The Nicholas School must strengthen the intellectual environment and financial viability of cooperative University Centers, while at the same time not allowing their proliferation to dilute and confuse the "brand" name of the Nicholas School in the field of environmental science and policy.*

The Duke Forest (<http://www.nicholas.duke.edu/forest/>)

Since 1931 the Duke Forest has provided continuous teaching and research opportunities for Duke faculty and students in the fields of forestry, botany, zoology and an increasing array of environmental sciences. With over 7000 acres, the Forest is recognized nationally as a premier scientific resource and is used by other universities and schools as well as state and federal government agencies to study natural resource and environmental science issues. On any given day, activities in the forest range from class instruction to long-term research and demonstration on diverse topics, such as plant ecology, invertebrate zoology, forest economics and global climate change.

Data from hundreds of studies and surveys during the last 74 years provide exceptional information on the succession and stand dynamics of southern forests, giving the Duke Forest an irreplaceable historical and ecological value. Duke Forest databases record changes in forest ecosystems over time in excess of the working career of any single researcher. Few other sites in North America have data of equal quality, quantity and duration.

Mirroring the evolution of the School of Forestry when it merged into the Nicholas School, academic uses of the Duke Forest have broadened well beyond the original objectives to encompass a variety of disciplines in the natural and environmental sciences. Class exercises on the Forest result in over 15,000 visits each year by Nicholas School students and those from other institutions. Research funding currently totals more than \$4 million annually for projects utilizing the Forest, and more than 475 theses, dissertations and published articles have been produced from research conducted in Duke Forest. Projects by Duke Faculty bring more than \$1.3 million annually in indirect cost recovery to the institution.

Numerous projects occur at the Free-Air CO₂ Enrichment (FACE) site in the Blackwood Division. Research at this site is part of a national assessment of the potential effects of increased atmospheric carbon dioxide on growth, physiology, and ecosystem processes. Other current projects, including experimental and model analysis of large scale forest disturbances, lightning and ionosphere remote sensing, and the study of long term successional changes in forest communities exemplify, the diversity of research throughout the Duke Forest.

The Duke Forest has identified the following areas essential to its further enhancement as an academic resource:

- Research and Teaching: **Continue development of online data bases, Internet mapping (GIS) capabilities, and additional long-term monitoring plots.** The value of the Duke Forest as a teaching and research laboratory has increased dramatically in its 74-year history. The use of the Duke Forest in teaching will increase by working with Nicholas School and other Duke faculty to provide expanded opportunities for research and for teaching in both graduate and undergraduate curricula (see Appendix H).
- Community Outreach: **Establish a Duke Forest Interpretive Center:** The Duke Forest is regionally recognized as significant open space providing numerous amenities such as important wildlife habitat, clean water and air, and passive recreation. Public knowledge about natural history, human influences on ecosystems and current environmental research could be enhanced by a public display and interpretive building on the Duke Forest
- Land Base: **Undertake a careful examination of the land area required to meet research and teaching objectives.** Factors such as maintaining biodiversity, buffering of research sites, balancing managed vs. preserved areas and understanding the full impact of development pressures, must be part of strategic planning considerations for lands included in the Forest.
- Finances: **Identify and implement new and substantial revenue sources in the near future.** While timber harvesting will always be necessary to provide new research opportunities and a mosaic of age classes and species compositions, it is likely that the resulting revenue will be insufficient to fund important programs on the Forest. Endowment, grants and contracts, and indirect cost recovery from research projects should all be part of the complement of funding sources.

D. Information Technology (IT) Services

Information Technology services have increased over the past four years to meet the needs of new programs (such as DEL), new centers and institutes (such as the Center on Global Change and the Nicholas Institute), and a continually expanding community of faculty and students. Despite a 32% increase in staff, the “customer-staff” ratio for IT services in the Nicholas School (81:1) is one of the highest at Duke, despite computationally intensive scientific programs. For instance, similar ratios in Science

Departments of Trinity College and in the Pratt School are 42:1 and 65:1, respectively.

The success of IT Services in the Nicholas School derives from a strategic decision to favor efficiency and collaboration with OIT over innovation and “going it alone,” and to centralized management under the auspices of the newly created position of an Assistant Dean for Information Technology. All laboratories are now on the same upgrade schedule, and a new desktop replacement program ensures all faculty have computers of sufficient quality. In addition, the bandwidth to the Marine Lab has been upgraded from a T1 to a T3 speed, allowing increased collaboration between divisions. In the past four years, the School has more than doubled the number of video conferences of classes, seminars, and presentations between Durham and Beaufort.

IT services at the Nicholas School have achieved a level of stability and reliability that allows us to ask, “What next?” Currently, we need to expand our multimedia services to allow more course-sharing between the Durham and Beaufort campuses, particularly given the focus on increasing undergraduate enrollment at the Marine Lab. Computer literacy remains a concern; as our networks, hardware, and software grow in sophistication, often the interface with the customer does not, and it may be possible to reduce help-desk calls by increasing education and communication. Web database needs and web programs in general are a rapidly expanding service area and are beginning to require more attention. Although we hope to meet existing demand through outsourcing contracts, additional staff will be needed, particularly as larger enrollments and new faculty hires will push the community:IT staff ratio past the breaking point. Finally, the increase in interdisciplinary centers and the outreach component of the new Nicholas Institute suggests the desire for more web-based collaborative tools, or “social software,”

a possible area for IT service innovation and expansion. If we create paths for faculty and staff to collaborate over the internet with global partners, we will see more recognition of the Nicholas School and Institute.

Geospatial Analysis Program

Geospatial Analysis (including geographic information systems (GIS), satellite remote sensing and spatial statistical analysis) plays a critical role in the professional development of Nicholas School students and the research of its faculty across an expanding range of environmental management, marine and earth science disciplines. The Nicholas School is currently well known for its leadership position in this field and it sees growing demand for instruction in geospatial analysis methods and technologies for professional and doctoral level students. In order to keep pace with this demand, the Nicholas School will need to continue to expand the school-wide “Geospatial Analysis Program” so that a central institutional structure can better meet the teaching and research needs of the school in this area.

The geospatial analysis program currently provides a comprehensive curriculum with training in the fundamentals of geospatial analysis as well as specialized tracks aligned with high-demand areas within the school. The current tracks include:

- Geospatial Analysis for Conservation Management
- Geospatial Analysis for Coastal & Marine Management
- Geospatial Analysis for Water Resources Management

The Geospatial Analysis Program also offers a popular graduate certificate program with more than ~20-25 MEM and Ph.D. students successfully completing the program each year with likely growth occurring in this area.

The Geospatial Analysis Program will continue to develop and expand:

- Professional MEM, and graduate *geospatial analysis* curricula;
- Professional non-degree, distance learning instruction & certificate programs;
- Research support for geospatial analysis (e.g. data and software libraries);

The Geospatial Program must develop the following new areas:

- specialized course tracks to include high-demand environmental social science applications (e.g. land-use planning, energy policy, environmental health).
- course offerings, geospatial technical support, and technical teaching facilities at the Marine Lab campus.
- linkages to other programs on campus (e.g. Civil and Environmental Engineering, Public Policy, Business)
- standardized geospatial data libraries and intranet technical services to support research activities.
- high-visibility textbooks and laboratory manuals for publication.
- undergraduate course offerings.

The geospatial analysis program is currently supported by two Professor-of-the-Practice positions and two staff positions. A third search for a faculty member to join the School in fall 2006 (see page 26) will allow the program to meet current core demand and maintain our positive trajectory in this area.

VII. Space

No issue is of greater importance than the *need to unify the location of the Nicholas School operations in Durham—The Division of Environmental Science and Policy, The Division of Earth and Ocean Sciences, and the Nicholas Institute*. Co-location of these units will allow the maximum interaction between their missions of research, education and outreach, remove the final intellectual barriers that have separated some disciplines with different histories, and foster new interactions between

all groups. These entities currently occupy roughly 73,000 net usable square feet in the Levine Science Research Center (LSRC) and the Old Chemistry Building on the Duke Campus. With projected growth of these programs and of the Nicholas Institute, we estimate the need for more than 160,000 square feet, as detailed in the Program Statement for the construction of Nicholas Hall (Appendix I). The new building should include space for various Centers that are affiliated with the Nicholas School, including the Center for Environmental Health (Appendix J), modest growth of faculty laboratories, and increased classroom and computation facilities for students. Conference and office facilities must be included for the Nicholas Institute.

Nicholas Hall must also be a model for “green” architectural design and construction. Many colleges and universities have added new buildings with various levels of LEEDS,¹⁵ with the new building for the Bren School at UC Santa Barbara receiving the highest (platinum) rating. The CIEMAS buildings of the Pratt School received a silver rating, and in keeping with its mission, the Nicholas School should incorporate the highest levels of innovation, environmental sensitivity, and energy efficiency in the design of its new facility.

VIII. Funding and Finances

A. Extramural Funding

In Fiscal Year 2005, the School expenditures included nearly \$15 million in research grants and contracts (Figure 6). Some current major research projects include:

¹⁵ LEEDS is the Leadership in Energy and Environmental Design rating system of the U.S. Green Building Council

- examination of the long-term exposure of a southern pine forest and its growth response to high levels of atmospheric carbon dioxide
- studies of the effects of the long-line fishing industry on “bycatch” species in the oceans
- studies applying geospatial technology to the mapping of disease and exposure to environmental toxins, particularly among children.

Major sources of government funding include the US Department of Energy, the Environmental Protection Agency, the National Institutes of Health, and the National Science Foundation. Major support from private foundations has come from the Gordon and Betty Moore Foundation, the Pew Foundation, the Alfred P. Sloan Foundation, and Andrew Mellon Foundation. Although all faculty members receive some level of extramural support, the distribution of support among faculty is highly skewed, with 20% of the faculty generating 53% of the overhead (ICR) to the School. The operation of the *R/V Cape Hatteras* from its home port in Beaufort on behalf of the National Science Foundation generates nearly 40% of the ICR of the DUML.

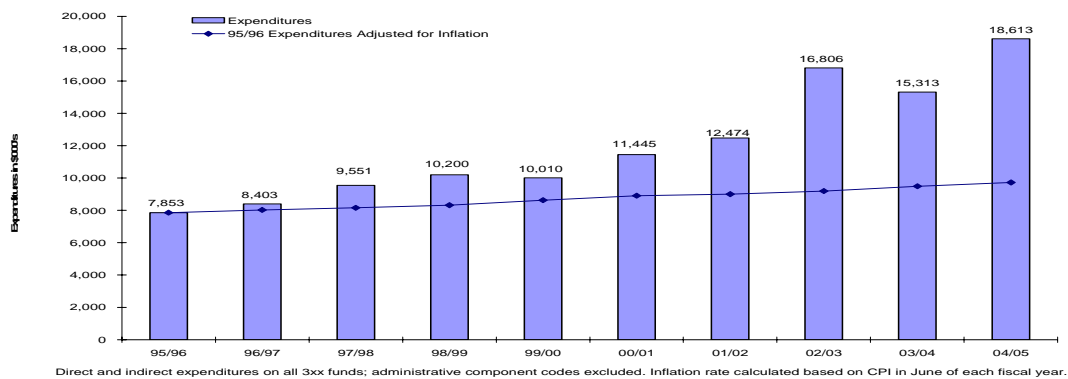


Figure 6. Trends in research grants to Nicholas School faculty, compared to inflation, during the past decade. (Office of Research Support)

Research activity generates \$2.5 million in indirect cost recovery (known as ICR or overhead) available to cover the associated costs of research within the School. Although total research grants have increased substantially during the past six years, ICR has grown more slowly as a result of an increasing fraction of grants that are derived from sources that pay limited or no overhead (Figure 7). Without forsaking the importance of grants from private foundations, *a major strategic goal of the Nicholas School during the next five years is to compete successfully for extramural grants from government agencies, so that ICR revenues to the School can grow to an effective overhead rate of 35%, compared to the current value of 20%.*

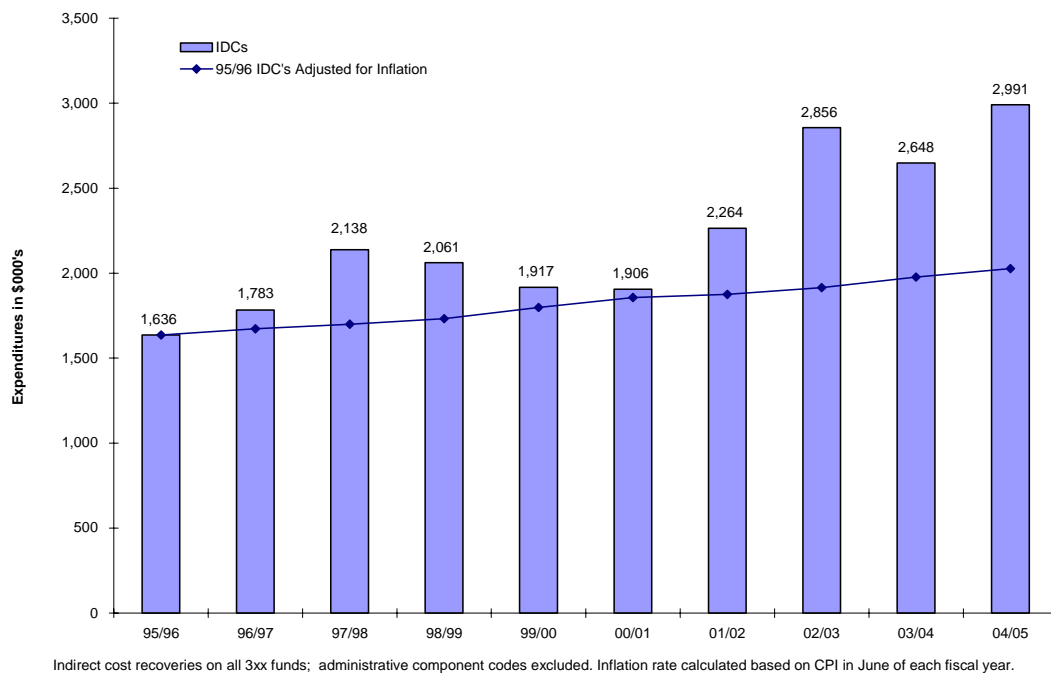


Figure 7. Trends in Indirect Cost Recovery (IDC, aka F&M) during the past decade. (Office of Research Support)

B. Finances and Financial Projections

Revenues to operate the Nicholas School derive from restricted sources, such as research grants and income from restricted endowments, and from unrestricted sources, such as tuition and indirect cost recoveries (Figure 8). A substantial fraction of the School's unrestricted revenue derives from MEM tuition, and is therefore subject to year-to-year fluctuations based on enrollment. The School also receives a payment from Trinity College to cover the costs of undergraduate instruction, based on a formula that is driven by enrollment numbers.

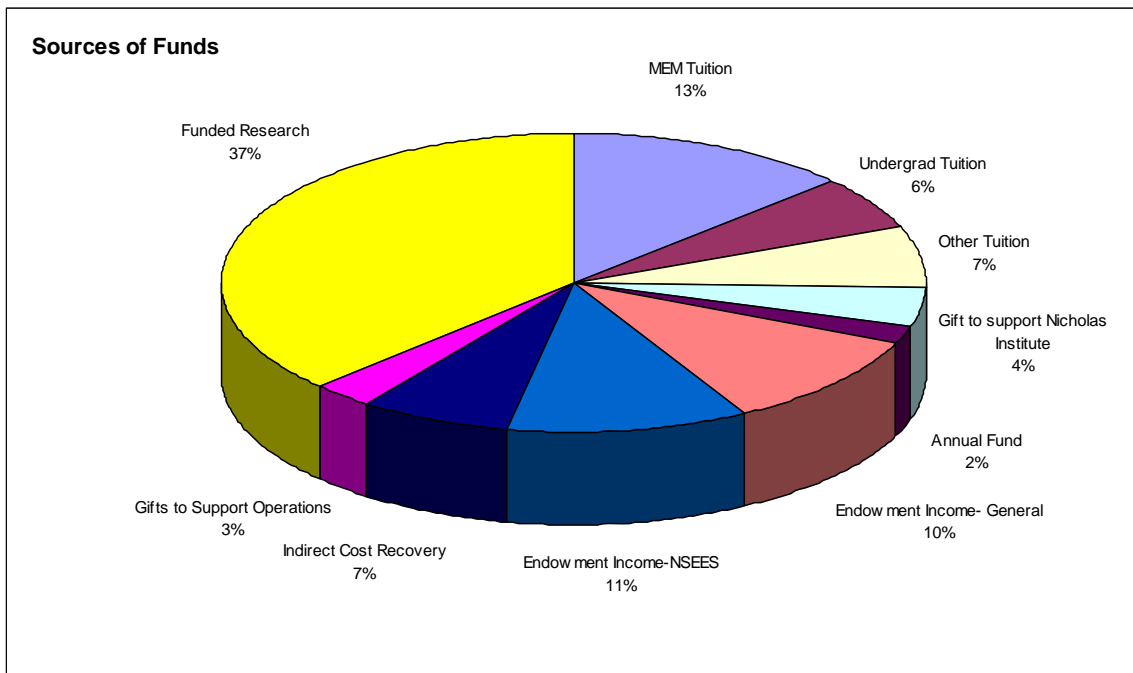


Figure 8. Actual, final operating revenues for the Nicholas School and Nicholas Institute for 2004-05

Approximately 22% of the revenue from MEM students is returned to students in the form of financial aid. Revenues from endowments established to provide financial aid, largely to MEM students, have increased consistently over the past six years, so that

the provision of financial aid has been a declining demand on unrestricted School resources (Figure 9). Although large training grants are not normally found in the environmental sciences, the School must strive to secure some form of major extramural funding for its PhD programs during the next decade.

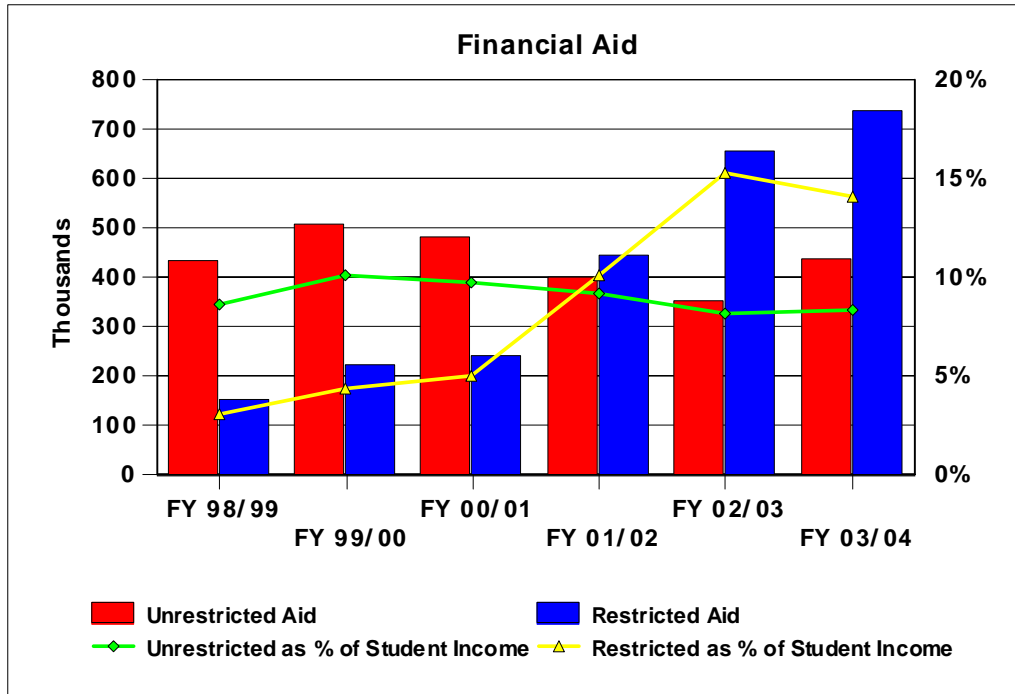


Figure 9. Payments and sources of financial aid to Nicholas School students

School expenses (Figure 10) are dominated by the direct costs of research and by instructional expenses, largely faculty salaries. Considering the total of undergraduate

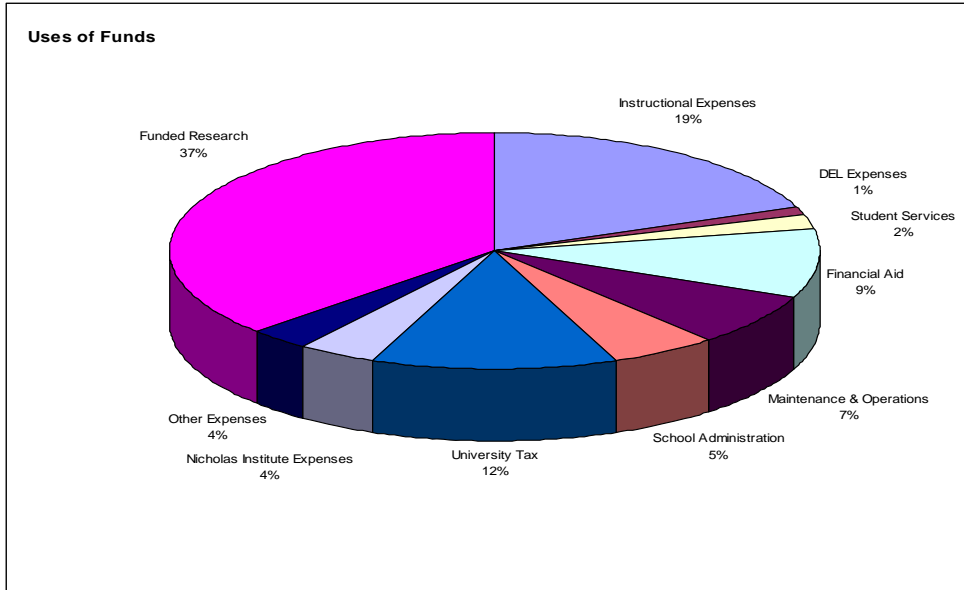


Figure 10. Actual, final operating expenditures in the Nicholas School and Nicholas Institute for 2004-05

majors, MEM students, and doctoral students, the student/faculty ratio in the Nicholas School is about 7.0. This ratio is low compared to competitor schools (Figure 11) and other units on the Duke campus. For example, the student/faculty ratio is 9.0 for undergraduates in Trinity College and 16.0 for students in the Law School. A major challenge in budgeting for the Nicholas School is that a large fraction of its expense is allocated to faculty salaries, which are relatively constant from year to year, while a large fraction of its unrestricted revenue is derived from MEM students, who show elastic demand relative to tuition increases.

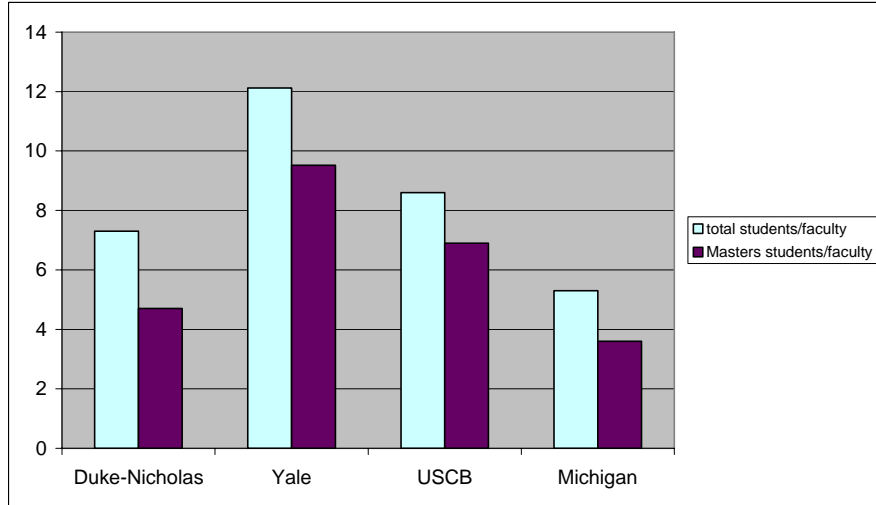


Figure 11. Student/faculty ratio in peer-group professional schools of the environment during 2004-05 academic year.

With implementation of this plan, long-range projections show a financial deficit for the School, declining in the more distant years as new faculty establish their research programs and begin to generate indirect cost recoveries (Table 2)¹⁶. As soon as we can occupy Nicholas Hall, the projected deficits will be much lower, since there will be no debt service on space occupied by the School. Meanwhile, we hope that funds from the Strategic Initiative Program (SIP) of the Provost’s Office can help cover the budget shortfall, especially start-up costs for new faculty, so that we may proceed with the exciting program of faculty development that we have proposed.

¹⁶ Table 2 shows the Nicholas School budget without revenues or expenses derived from extramural grants, which accounted for 37% of the annual budget in FY05 (Figures 8 & 10).

TABLE 2

STRATEGIC PLAN FINANCIAL SUMMARY
FY2006-07 through FY2010-11

	FY07	FY08	FY09	FY10	FY11
<u>REVENUES</u>					
UNDERGRADUATE TUITION	(2,724,353)	(3,140,466)	(3,736,875)	(4,462,691)	(5,172,442)
GRADUATE TUITION AND FEES	(2,091,587)	(2,168,953)	(2,233,145)	(2,478,791)	(2,726,670)
MASTER'S TUITION AND FEES	(6,031,950)	(6,399,950)	(6,664,500)	(6,931,080)	(7,208,323)
EXECUTIVE EDUCATION TUITION	(286,271)	(291,895)	(297,477)	(309,376)	(321,751)
DEL TUITIION	(484,500)	(530,000)	(552,000)	(574,080)	(597,043)
ENDOWMENT INCOME	(5,323,672)	(5,699,175)	(5,905,076)	(6,105,916)	(6,316,098)
ANNUAL FUND	(900,000)	(950,000)	(1,000,000)	(1,050,000)	(1,100,000)
NET IDC RECOVERY REVENUES (TOTAL SCHOOL)	(2,286,030)	(2,577,132)	(3,057,589)	(3,781,818)	(4,306,409)
MISC. REVENUES (BOAT, LAB RENT)	(88,794)	(79,394)	(80,658)	(84,691)	(88,925)
UNASSIGNED INCOME FROM UNIV.	(4,031,801)	(4,031,801)	(4,031,801)	(4,031,801)	(4,031,801)
TOTAL REVENUE	(24,248,958)	(25,868,766)	(27,559,121)	(29,810,244)	(31,869,463)
<u>EXPENSES</u>					
INSTRUCTION	7,952,788	8,745,248	9,398,343	9,987,554	10,324,939
INFORMATION TECHNOLOGY	640,424	657,979	742,102	764,365	787,296
EXECUTIVE EDUCATION	286,271	291,895	297,477	306,401	315,593
DEL OPERATING COSTS	458,487	434,859	445,356	458,717	472,478
MASTER'S STUDENT FINANCIAL AID	1,525,405	1,558,100	1,606,662	1,662,461	1,720,365
UNDERGRADUATE FINANCIAL AID FROM ENDOWMENTS	98,000	101,000	108,000	114,000	120,000
TOTAL ADMINISTRATIVE & OPERATING	1,472,907	1,487,643	1,501,247	1,546,284	1,592,673
GRADUATE TEACHING ASSISTANTS	1,000,400	1,031,710	1,062,494	1,172,488	1,284,437
GRADUATE AWARDS	2,100,413	2,198,900	2,265,731	2,492,304	2,741,535
STUDENT SERVICES	773,550	791,248	812,243	844,733	878,522
FACILITY COSTS	2,210,353	2,285,356	2,365,343	2,436,303	2,509,392
SMALL BOATS	177,706	180,845	183,866	189,382	195,063
EXTERNAL AFFAIRS	645,415	659,995	674,509	694,744	715,587
COMMUNICATIONS	571,067	583,518	595,957	613,836	632,251
FULLY ALLOCATED COSTS FROM UNIVERSITY	5,351,824	5,648,166	5,951,790	6,249,380	6,561,848
DEBT SERVICE ON LSRC	1,158,004	1,169,584	1,181,280	1,181,280	1,181,280
MISCELLANEOUS APPROPRIATIONS	270,389	248,328	208,783	208,783	208,783
TOTAL EXPENSES	26,693,403	28,074,374	29,401,183	30,923,015	32,242,043
BOTTOM LINE NET DEFICIT	2,444,445	2,205,608	1,842,062	1,112,771	372,580

C. Development:

The Office of External Affairs manages fundraising and development activities for the Nicholas School, including alumni outreach programs and activities of the Nicholas School Board of Visitors, the Marine Lab Advisory Board, and the Alumni Council. The Nicholas Annual Fund has shown a decadal increase in both the number of donors and the amount of gifts (Figure 12). The close of the 2005 fiscal year resulted in a record Annual Fund total, more than three quarters of a million dollars.

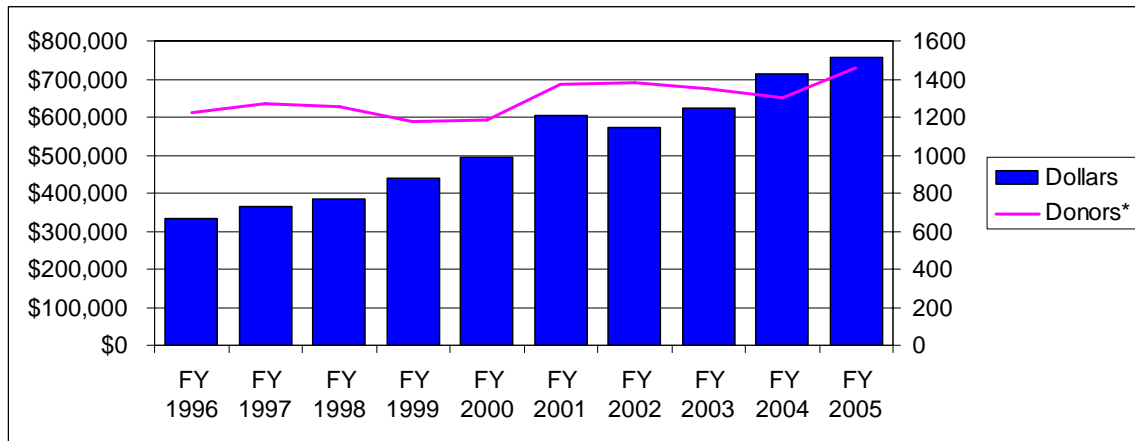


Figure 12. Donors and total contributions to the Nicholas School Annual Fund, 1996-2005

Beyond the Annual Fund, the Nicholas School has also shown an increase the number of individuals providing leadership gifts and substantial pledges of commitment for the School (Figure 13). During the 2005 fiscal year, four (of 12) Signature Venture Fund matches¹⁷ were closed, allowing the School to establish several new \$1,000,000

¹⁷ Provided by an anonymous donor, these offer a \$250,000 match to any new endowment gift of \$750,000

endowments. Fiscal year 2005 ended with the largest total of pledged gifts (\$7 million apart from the Nicholas family gifts) during the last ten years, thus beginning to fill the “pipeline” for substantial capital infusion in the future.

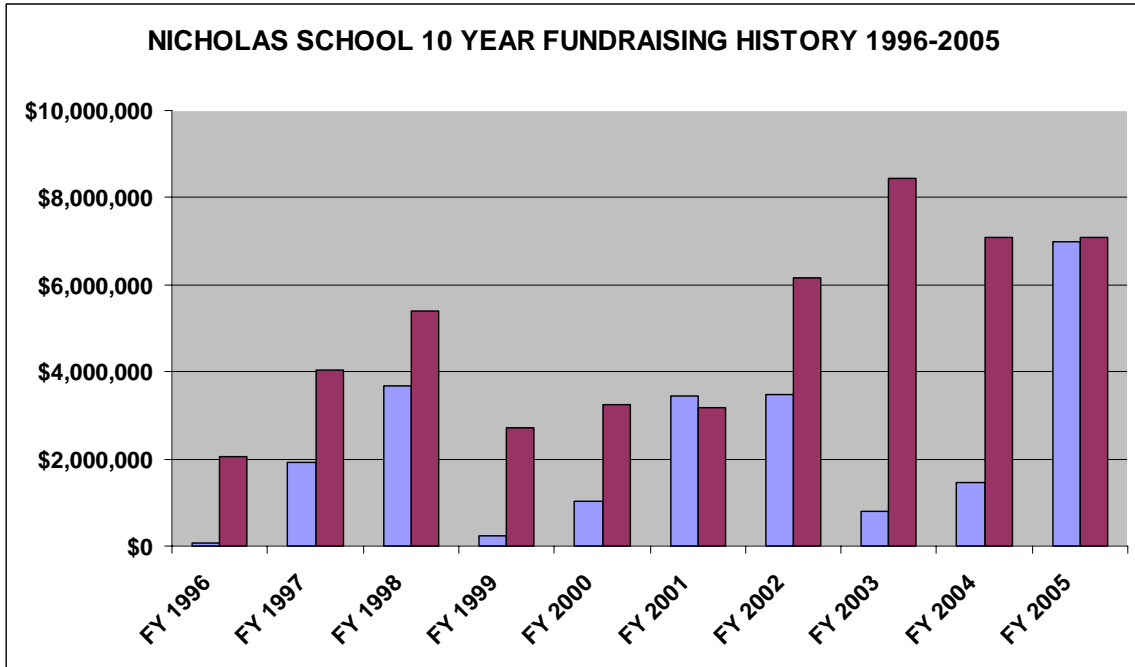


Figure 13. Total gifts (purple) and pledges (light blue) to the Nicholas School, 1996-2005, not including gifts and pledges from the Nicholas family.

The Nicholas School aims to raise \$45 million during the next five years. The External Affairs Office will work to maintain the growing success of the Annual Fund but will shift efforts to provide more focus on increasing the number of leadership level gifts to the school. To help increase philanthropic opportunities, more undergraduate Duke alumni who have environmental interests should be engaged. Developing relationships with alumni in the fields of medicine, finance, and energy who may have spent time at the Marine Lab, served as a Stanback Fellow, or taken an environmental

course, or alumni who have an established interest in the environment are examples of the types of people who may be open for partnership with the School.

The design and construction of Nicholas Hall may also be a tool to offer recognition opportunities for future endowment donors. Specific rooms and facilities in the building can be used to leverage naming opportunities for donors of other endowments and gifts to the School.

The Nicholas School goal to raise \$5 million for fellowship support, in conjunction with the University's Financial Aid Initiative, will help underwrite some of the expense of financial aid for Nicholas School graduate (MEM and PhD) students. Leadership gifts for fellowships will provide the prestige of having one of the "best and brightest" students as a named fellow, and major donors for financial aid will gain recognition as a part of the larger University effort.

Appendix A: Faculty Accomplishments

National Honors:

Members of the National Academy of Sciences

William H. Schlesinger

John Terborgh

Fellows in the American Academy of Arts and Sciences

James S. Clark

Stuart L. Pimm

William H. Schlesinger

John Terborgh

Fellows in the American Association for the Advancement of Science

Richard T. Barber

Norman L. Christensen

Richard Forward

Curtis Richardson

John Terborgh

Fellows in the American Geophysical Union

Richard T. Barber

Gabriel Katul

Orrin Pilkey

William H. Schlesinger

Fellow, Soil Science Society of America

Curtis Richardson

William H. Schlesinger

Fellow, Geological Society of America

Peter Malin

Fellow, the Wetlands Society

Curtis Richardson

Presidential Young Investigators, NSF Career, or equivalent (National Science Foundation)

James S. Clark

Emily Klein

Susan Lozier

Cindy Van Dover

MacArthur Fellow
John Terborgh, 1992

Pew Fellows in Conservation and the Environment
Stuart Pimm, 1993
John Terborgh, 1992

Society Presidents (elected):

American Society for Limnology and Oceanography
Richard Barber, 1986-88

The Coastal Society
Michael Orbach, 1998-2000

Ecological Society of America
William H. Schlesinger, 2003-04
Norman L. Christensen, 2007-08

National Institute for Water Resources
Kenneth Reckhow, 2000-02

The Wetlands Society
Curtis Richardson, 1987-88

National Awards

American Agricultural Economics Association,
Quality of Research Discovery Dissertation Award, Martin D. Smith, 2004
Outstanding Dissertation Award, Martin D. Smith, 2002

American Geophysical Union,
The Macelwane Award, Gabriel Katul, 2002

American Political Science Association,
Lynton Keith Caldwell (Book) Prize, Erika Weinthal, 2003

Ecological Society of America,
W.S. Cooper Award, James S. Clark, 1988
George Mercer Award, James S. Clark, 1991

Environmental Law Institute
National Wetlands Award, Curtis J. Richardson, 2006

The Geochemical Society,
F.W. Clarke Award in Geochemistry, Emily Klein, 1999

International Studies Association,
Chadwick Alger (Book) Prize, Erika Weinthal, 2003

National Academy of Sciences,
Daniel Giraud Elliot Medal, John Terborgh, 1996

Society for Risk Analysis,
Chauncey Starr Young Risk Analyst Award, Jonathan Wiener, 2003

National Conservation Awards

Albert Starker Leopold Award, National Park Service
Norman Christensen, 1991

100 Champions of Conservation, National Audubon Society
John Terborgh

Edward T. LaRoe III Memorial Award, Society for Conservation Biology
Stuart L. Pimm, 2006

Scientific Fellow, National Wildlife Conservation Society
John Terborgh

National Boards of Directors/Trustees

The Conservation Fund
Norman L. Christensen

The Coral Reef Alliance
Randall Kramer

Environmental Defense
Norman L. Christensen

Resources for the Future
Norman L. Christensen

The Surfrider Foundation
Michael Orbach

Union of Concerned Scientists
Stuart L. Pimm

The World Wildlife Fund
John Terborgh

Appendix B Center for Energy and Environment

In coming years, how our society supplies its energy demand will play a critical role in global economic growth, the health of the planet and the world's geopolitical stability. It is quite possible that our attempts to secure energy in a manner that is affordable, abundant and clean will be the most important and difficult challenge faced by human society in the 21st century. As an institution that has continually placed itself in a position to tackle tough challenges, Duke University can—and should—be part of the solution.

The Nicholas School proposes a new interdisciplinary center for the study of energy and its impact on our society and our natural environment. This new *Center for Energy & Environment* will build on the existing energy initiative at the Nicholas School which, in approximately two years since its inception has successfully launched a master's level curriculum in energy, fostered nascent partnerships with Pratt, Fuqua and the Nicholas Institute, and raised over \$3 million in external funding, including endowments for two full-time faculty positions. The creation of this Center is a critical next step to enable Duke to build a robust presence on the issue of energy. It would provide the organizational framework that is needed to build on the initial success of the Nicholas School's energy initiative and serve as a focal point for gathering relevant expertise from across the university. The need for organizational support from the Center will be especially important in interdisciplinary activities with no clear mechanism for collaboration.

Specifically, the Center will:

- Bring together faculty from various Duke schools and departments with experience relevant to energy.
- Serve as a centralized point of contact for external organizations interested in partnering with Duke on interdisciplinary energy research.
- Partner with the Nicholas Institute of Environmental Policy Solutions to investigate questions of importance to decision-makers in government and business.
- Support educational initiatives at both the graduate and undergraduate level.
- Advance collaboration on energy issues with local groups, especially UNC and NC State.
- Develop and coordinate various energy-related activities at Duke

Rationale

Energy is a crucial ingredient in our modern way of life, and the manner in which we use energy has tremendous implications for our economy, our society and our natural environment. Yet energy-related challenges abound. Already, constrained energy supplies are bumping up against steadily increasing demand. Developing nations,

especially China and India, are seeking a greater share of finite energy resources to fuel their economies and lift their people out of poverty. Geopolitical events are impacting the global trade in energy and raising concerns about national security. And increasing global concern over the threat of climate change has joined long-standing concerns about the impact of the energy system on air quality and local ecosystems.

These trends indicate the many challenges and opportunities arising from the dynamic intersection between energy and the environment. Recognizing and acting on these issues will require innovative thinkers and leaders who understand the energy system and the important interconnections between policy, markets, technology and the environment.

Strategic Vision and Duke Advantages

The Center on Energy & Environment will maintain a broad perspective on the current energy system and future alternatives, with a special focus on the intersections between traditional disciplines. It will support research and education, and seek active collaboration with energy sector organizations and leaders, from business, government and NGOs. It will provide students and research sponsors with a comprehensive understanding of the fundamental trends shaping our energy system over coming decades and the tools necessary to assess the various strategies for transitioning our society to a sustainable energy future.

While other universities have programs focused on energy, most are narrowly focused on specific energy sectors (e.g. petroleum) or single disciplines (e.g. only science or only policy or only business). Further, most emphasize technical research over education . Only a handful address energy in a comprehensive manner, and few of these, if any, focus on training future leaders to manage the complex interactions between business, policy and the environment.

Duke University brings a number of unique advantages to bear on the issue of energy and environment. First, the university is home to top-level schools in a variety of disciplines, including law, policy, engineering, business, medicine, and environment, and university administration is strongly supportive of interdisciplinary activities. Given the fact that it is designed to integrate science, policy and economics, the Nicholas School is particularly well suited to lead such an initiative. Duke also has exceptional supporters, especially amongst its alumni, who are highly-placed in the energy industry and have shown a willingness to share their time and effort to help develop an energy initiative at Duke. Finally, Duke has a sterling reputation as an educational institution, and our students (undergraduate and graduate) have the potential to quickly reach positions of influence on all sides of the emerging energy debate.

Center Activities

To accomplish this strategic vision, the Center will focus on the following activities:

Encourage faculty collaboration

In putting together its nascent energy curriculum, the Nicholas School found that Duke has numerous faculty with expertise in energy and related areas scattered through the University. Furthermore, the Nicholas School has recently received a generous gift from Jeff and Martha Gendell to endow two new, energy-specific faculty positions. And while not “faculty” in the traditional sense, Duke can also benefit from the substantial practical expertise of its alumni and supporters in the energy sector.

An important role of the Center on Energy & Environment will be to serve as a gathering point for this diffuse expertise, pooling faculty from across the university with common research and educational interests and objectives. Such an organizational framework is especially important as new faculty with energy expertise are hired, both at Nicholas and other schools. As part of this role, the Center can deploy targeted funds to access teaching resources both inside and outside the university.

Facilitate external partnerships

With increased attention to energy challenges has come an increased interest from public and private-sector organizations in sponsoring research and training/hiring well-qualified employees. Organizations such as General Electric, Occidental Petroleum, and Duke Energy have already expressed an interest in supporting energy-related activities at Duke University. While specific schools can solicit partnership based on their specific areas of expertise, external partners—especially those interested in interdisciplinary research—may value a centralized point-of-contact for their interactions with Duke.

Partner with Nicholas Institute

Energy is one of the areas of emphasis for the new Nicholas Institute of Environmental Policy Solutions, and the Nicholas School’s current energy initiative has already joined with the institute in organizing events and developing coursework. A Center for Energy & Environment would be a resource for the Nicholas Institute, providing expertise to support the Institute’s research into specific, current issues. When the Institute’s attention is turned to other issues, the Center would provide a more permanent home for Duke’s energy expertise.

Support Educational Initiatives

In the past two years, the Nicholas School has developed a full concentration in Energy & Environment that will be offered to its Master of Environmental Management students starting in the fall of 2006. The Center for Energy & Environment would supplement and expand this curriculum to target students throughout Duke, at both graduate and undergraduate levels. At the graduate level, the Center will take advantage of existing joint-degree programs with MBA, MPP and JD programs (as well as a proposed joint-degree with Pratt’s Master of Engineering Management program) to encourage students to combine a broad understanding of energy with specific expertise in business, law, policy or engineering. The Center will also support the development of energy-related

classes at other Duke graduate programs. At the undergraduate level, the Center will seek to encourage upper-level undergraduates to participate in current graduate-level energy courses, and also to develop and offer undergraduate-specific energy courses, leading to the eventual development of an undergraduate certificate or concentration in energy.

Encourage Local Collaboration

Local universities have various energy activities, especially NC State and UNC Chapel Hill, and there is strong interest in inter-school collaboration. For example, this past fall UNC and the Nicholas School jointly sponsored a series of events discussing the coming transition in our energy system that was well attended by students and faculty from both schools, as well as the general public. The Center for Energy & Environment would engage with energy groups in local universities to share expertise, pool resources and coordinate activities. Given the lack of centralized organization of energy activities at other local universities, the Center would put Duke in a leadership role amongst local academic institutions in joint energy initiatives.

Outside of academia, Duke could partner with numerous local organizations focused on energy. For example, the North Carolina state government recently created a NC Climate Change Commission. (Nicholas School Dean Bill Schlesinger is a member of this commission.) As another example, multiple interest groups in North Carolina have begun to push biofuels as a potential tool for economic development—both in agriculture and in technology. The emerging local effort to develop biofuels could tap into Duke’s expertise in forestry, ecosystems, water, biotechnology, entrepreneurship and more.

Coordinate Energy Activities at Duke

The Center for Energy & Environment would serve as an umbrella organization for the wide variety of energy-related activities that currently exist or could be developed at Duke. These vary from student groups at various schools, to events, to activities being undertaken by Duke’s facilities management to reduce energy consumption. In addition to serving as a clearinghouse to promote collaboration and efficient use of resources, the Center would also develop its own activities targeted to the broader Duke community. This would include field trips to bring students in contact with energy leaders, both locally and nationally (e.g. Houston, Washington DC, etc.)

The Need

The Nicholas School’s energy initiative has made great progress in the past two years, developing coursework, raising money and building the foundation for partnership inside and outside the university. Further organizational support is the critical ingredient necessary to build on this momentum and ensure continued success. A Center for Energy & Environment would fully leverage Duke’s current (and future) expertise in areas related to energy, coordinate educational programs of interest to students from across the

university, and make Duke an attractive destination for students and external partners interested in energy.

Center Administration

The Center's internal organization would consist of a faculty director, an advisory board, a coordinator, an administrative assistant, and work/study students. The faculty director would be responsible for the overall direction of the Center and oversee most research and educational activities. Initially, this role would be served by Lincoln Pratson, who has been leading the Nicholas School's current energy initiative. The advisory board would consist of faculty from across Duke's campus that have an interest in energy. This board would set specific objectives, and monitor the Center's performance against these objectives. The coordinator would manage the day-to-day operations of the Center, with a focus on the execution of specific initiatives. The administrative assistant would offer general support and facilitate communication between internal and external partners. As necessary, the Center would use work/study student help to assist in specific projects.

Benchmarks

Important measures of success for the Center include:

- Number of Duke schools and academic units involved in educational and research activities
- Success developing sponsored partnerships (funds raised and execution of objectives)
- Projects executed in partnership with the Nicholas Institute
- Students (undergraduate and graduate) trained within supported educational programs
- Joint activity with local universities and other local groups
- Attendance and feedback on public events (speakers, symposia, etc.)

Budget

The primary budgetary requirements are

- administrative staffing as discussed above
- resources to purchase faculty time, both from within Duke and also from external contractors
- support for energy events, including field trips

Appendix C: A Water Initiative at Duke

1. Background

As a prominent center of scholarship in the developed world, it is incumbent upon Duke to marshal significant intellectual resources and focus them on the most pressing international problems. Above all the other major problems facing the world today there is a clear confluence of three crises: ***water-energy-health***. Hence, we propose a centralized water initiative at Duke. However, given the strong interconnections between these three problems, we call for a water initiative that lives as a part of larger efforts in water, energy, and global health.

At Duke we have significant strengths in the climate and hydrological sciences, in water quality engineering, and in environmental policy and law. Recent faculty additions in the Nicholas and Pratt schools have further expanded these strengths and Duke's stature in this field has risen accordingly. The problems discussed herein demand a broad interdisciplinary approach; in fact, the funding agencies have responded by investing in thematic solicitations that are highly inter-disciplinary and often multi-institution. Many of these solicitations demand a certain breadth of scope – such as requiring collaboration of both physical and social science investigators, or inclusion of international collaborators. This requires an investment by any institution hoping to take a leadership role in the development of solutions.

A secure supply of clean water is essential for life. At first glance this should not seem a big concern, with 75% of the earth's surface covered by water. However, more than 99% of the water is saline, frozen, or found too deep in the earth to be of use. Worldwide, it is estimated that over one-half of the accessible freshwater is already appropriated for human use¹. The problem with water availability, however, is not in the long-term average distribution of water, but rather in understanding and preparing for the dramatic fluctuations in its supply and quality. This deeply interdisciplinary problem spans the expertise of climate scientists, hydrologists, engineers, policy analysts, urban planners, and environmental lawyers.

There is a growing realization that the scale and frequency of water-related disasters is increasing. In the 1990s alone there were an estimated 280,000 deaths worldwide due to drought, and a quarter-million more deaths from other water-related disasters². In fact, nearly 90% of the total deaths due to natural disasters in the 1990s came from hydrometeorological events. The level of risk from such disasters is determined by a combination of the vulnerability of the people and infrastructure and the probability of the event. Hence, it is understandable that over 95% of the fatalities have been in the developing world – regions, in fact, where both the populations and vulnerability continue to increase. The additional tendency for the greatest population growth of the developing world to be in dense urbanized regions -- where the flood and water quality risks are magnified -- further exacerbates the vulnerability of these populations to water driven disasters.

One can only wonder what the future may hold for drought fatalities in these regions, when the increased vulnerability of a growing urban population is confronted with a changing climate that is likely to include a greater probability of extreme hydro-meteorological events. With the rapid population growth in Africa and Asia it is expected that by 2025 up to 20% of the world's population is likely to be found in water-scarce countries. This is reason for concern as the impact of natural disasters to the economies of developing countries is arguably helping to perpetuate the wealth disparity between developed and developing countries. For example, the drought in Zimbabwe of the 1990's has been tied to a -11% change in GDP and the recent floods in Mozambique associated with a -23% change in GDP².

In recognition of these issues, there is intense activity by US and international organizations recognizing the urgency of these problems and calling for organized efforts to address these concerns. The U.S. Global Change Research Program (USGCRP) launched a global water cycle initiative³, which stressed the over-arching need to identify how natural processes and human activities influence the distribution and quality of water within the Earth system, and the extent to which future changes are predictable. The EPA plan focuses on the critical security issues for drinking water, especially with respect to acts of terror. The UNESCO efforts are highlighting the need to provide decision makers with improved tools for sustainable use of water and mitigation of water-based natural disasters.

This proposed Duke initiative will develop an integrated approach to water problems: from science, through engineering, to policy and management. We focus the approach on the common denominator of *uncertainty and risk*. The value in such an approach can be seen by considering contemporary problems and discussions at several different levels. When dealing with a complex system such as the atmosphere, it is all but essential to speak in probabilistic statements of potential outcomes, whether this is the probability of a global warming that would lead to a certain rise in sea level, the probability of an intense storm such as Katrina, or the probability of a region encountering a devastating drought in the design life of a water supply reservoir. Similarly, at the other end of the discipline spectrum, when drafting urban development plans or environmental regulations, it is necessary to jointly consider the probabilities associated with the regional water cycle fluctuations, the probabilities of how the built environment and society will respond to these events, and the underlying uncertainties in economic and financial markets. As an example, the inability (or unwillingness) to deal with scientific uncertainty is arguably at the center of the tension between the US government and many other countries with respect to taking actions for reducing greenhouse gas emissions.

2. Elements of the Initiative

Research: We propose to organize interdisciplinary research efforts along a clear set of dominant problems:

- *Hydrometeorological extremes*: Probabilistic structure of extremes (e.g. droughts and floods); Forecasting actual extremes and their essential characteristics;

- Merger of data and models for robust prediction; ‘Fingerprinting’ the initiation of extremes.
- *Interconnections of ecological and hydrological variability and change.* How human impacts to the water cycle affect the ‘goods and services’ of both terrestrial and aquatic ecosystems.
 - *Human health issues of water:* Microbiological issues of water treatment; Water transport as a disease/contaminant vector; Implications of accidental and malicious toxic releases.
 - *Water implications of energy policy:* Impacts to water cycling from increased atmospheric CO₂; Impacts to water supply from engineered solutions to carbon-sequestration; Impacts of hydroelectric projects in developing countries on water supply, agriculture, and disease vectors (e.g. bilharzia and malaria); impact of dam removal projects.
 - *Sustainable development:* Vulnerability of communities to hydrometeorological extremes in the context of a changing climate; Effect of climate variability on sustainable land use in semi-arid regions.
 - *Risk-based policy formulation:* Water quality management regulatory programs and urban planning policies that appropriately incorporate predictive uncertainty;
 - *Decision making and management for natural hazards in the face of uncertainty:* human value tradeoffs (economic vs. environmental vs. social) and societal risk-attitudes in setting coastal and river margin land zoning policies
 - *Water and poverty:* Access to clean, affordable water supplies is essential for reducing poverty and expanding economic opportunity in much of the developing world. Raising the priority of water management among national governments and finding innovative ways to finance and deliver water services is crucial to alleviating poverty.

Education: In tandem with the research efforts we propose a set of educational elements. Stemming from Duke’s role in training tomorrow’s leaders and the fact that Duke is becoming increasingly visible from an international perspective, we focus here on training tomorrow’s international leaders. Hence, at the same time that we engage international problems on a broader scale we must rethink our educational programs. We propose to start a campus-wide dialogue on these issues through a set of inter-school undergraduate courses:

- *Hydrometeorological hazards: From Risk to Policy to Engineering*
- *Leadership during disasters*
- *Sustainable development: A joint study of water-energy-health*

Faculty Development: To complete the needed expertise on campus we propose the addition of three new faculty hires between the Nicholas and Pratt schools.

- *Climate and the Global Water Cycle*
- *Water Management in the Developing World.*
- *Risk in Hydrologic, Environmental, and Economic Engineering.*

Fostering Interdisciplinary Efforts: Here we present a set of elements designed to serve as catalysts for conceiving interdisciplinary research collaborations, for securing the preliminary results needed to win extramural support, and for facilitating Duke's leadership of multi-institution efforts.

- *Initiative Executive Director and Staff Support*
- *Travel Grants for Undergraduate Research Projects* in developing countries (with our partner institutions, such as Moi University in Kenya for which NSOEES already has a Memorandum of Understanding)
- *Annual Workshop* (exploring water-energy-health intersections)
- *Visiting Scholar Program* (to host developing world scholars who are working on either a water-energy or water-health project).
- *Sabbatical program for Duke Faculty* (to spend a semester in a developing country working on a pressing water related problem).

3. Initiative Management and Measures of Success

The Duke Water Initiative will begin its life as an entity that straddles across the Nicholas and Pratt Schools and will then grow to include elements of Trinity, Public Policy and Law. This initiative will have broad and measurable impact on Duke. The faculty will be positioned to capitalize on the emerging funding opportunities that seek to invest new resources in problem-driven solicitations that are highly inter-disciplinary. Beyond the expected increase in extramural funding, the integrated publications are certain to be of great impact. This large increase in highly cited papers will help propel members of our faculty into the National Academies of Science and Engineering and our graduates into leadership roles in academia, industry, and public service. But, more importantly, the benefits to global health and welfare are something in which Duke will take great pride and through which Duke will gain much respect from the world at large.

4. References

1- Postel, S.L., G.C. Daily, P.R. Ehrlich, 1996, Human Appropriation of Renewable Fresh Water, *Science*, 271(5250): 785-788.

2- United Nations/World Water Assessment Programme, 2003, UN World Water Development Report: Water for People, Water for Life. Paris, New York and Oxford, UNESCO (United Nations Educational, Scientific and Cultural Organization) and Berghahn Books.

3- USGCRP Water Cycle Study Group, 2001, A Plan for a New Science Initiative on the Global Water Cycle.

Trophic Dynamics/Food Webs

Evolutionary ecology tends to focus at the individual or population level for a particular species. By contrast ecosystem ecology tends to focus on processes of ecosystem function rather than on particular species. Scientists studying trophic dynamics/food webs operate at the interface of these two fields and can provide linkages for understanding the larger ecosystem context for species of interest as well as clarifying when ecosystem function depends upon particular species. This research will be integral to transitioning from species-based management toward ecosystem-based management. Research areas might include (but is not limited to) experimental or modeling approaches to estimating interaction strengths, energy, or material flows in coastal/marine food webs, food web dynamics, and effects on ecosystem function. The candidate's interests should complement existing strengths in ecology, organismal biology, and conservation biology.

Fish Biologist/Ecologist

Fishes are now widely recognized as important consumers who may play significant roles in the structure and function of marine ecosystems. Many species also have been subjected to extensive exploitation by humans, in some cases reducing their biomass by a factor of ten or more. Representing the most diverse group of marine vertebrates, they occupy a wide variety of habitats and employ a bewildering array of life history strategies. Scientists and managers need to better understand the role of fishes and fisheries in marine ecosystems. What is the impact of overfishing on the genetics, growth, production, and resilience of marine fish populations? What is the impact of overfishing a guild of marine fishes on the function of marine ecosystems? Can fisheries be recovered and sustained? Research areas might include (but is not limited to) life history and ecology of marine fishes, spatial and genetic structure of marine fish populations, effects of fisheries on the distribution, genetics, growth, and survival of particular species, as well as the effects on fishing on habitats and ecosystems. The candidate's interests should complement existing strengths in ecology, organismal biology, and conservation biology.

Coastal and Marine Social Scientist

One of the major thrusts in faculty development within the CSSP Division for faculty resident at the Marine Lab has been in the social sciences. The social sciences are an integral part of the Marine Conservation theme, which requires roughly equal expertise in the biophysical and social sciences to be effective, and presently two of the current eleven faculty resident at the Marine Lab are social scientists – one cultural anthropologist and one resource/environmental geographer. The new social science position would focus on the human dimensions of public policy in the coastal zone, as defined by the upper reaches of the watershed to the limits of the Exclusive Economic Zone, with particular interests in place-based natural resource management, Geographical

Information System skills, and working with a wide variety of professionals from different nature, physical and social science disciplines. The specific area of research expertise would be open, but could include estuarine and marine managed areas, integrated coastal zone management, or human ecology and a variety of disciplines. This third social science position would create a 'critical mass' of social science expertise at the Marine Lab, and would allow a much broader range of social science research to be performed and courses to be offered, particularly at the undergraduate level.

Marine Environmental Toxicology

Estuaries, tidal marshes and the coastal ocean provide essential habitats for plants and animals including threatened, endangered and commercially important species. All these essential habitats and species are impacted by anthropogenic inputs, inputs which in turn affect the health of the humans who interact with those habitats and species. We envision expanding our expertise in the area of oceans and human health and environmental toxicology to build on the school's existing strengths in Physiology, Toxicology, Marine Science and Conservation Biology and Policy. Our intent with this position is development of a research program based at the Marine Lab that provides links and collaborative opportunities with existing programs such as the Integrated Toxicology Program and the Medical School. We seek a broadly trained ecological physiologist/environmental toxicologist with strengths and interests in multicellular organisms. The ideal faculty member would be one whose interests are in coastal and marine environments and with expertise in contaminants, ecological risk assessment, or population biology.

Appendix E: Center for Marine Conservation

The Strategic Opportunity

We propose a strategic initiative in support of developing research and educational opportunities related to the new Center for Marine Conservation at Duke University (<http://www.marineconservation.duke.edu/>). The Center is an interdisciplinary consortium in the Nicholas School of the Environment and Earth Sciences focusing on research, education, and outreach in marine conservation. Recognizing the interdisciplinary and often global nature of marine conservation, we seek to integrate across the natural and social sciences and to engage international partners and NGOs. We focus on solving environmental problems in marine systems and incorporating science into regional, national, and international policy-making. Faculty and center associates provide an unparalleled range of expertise and experience from both the natural and social sciences, as well as experience with integrating science into policy in a variety of marine systems (Appendix). The Center also serves as the marine arm of the Nicholas Institute for Environmental Policy Solutions (NIEPS), providing government officials with the tools and approaches that will enhance their ability to implement ecosystem-based management in the oceans.

Recent reports from the Pew Oceans Commission (2003) and the U.S. Commission on Ocean Policy (2004) point to the many problems facing marine ecosystems, and call for a new level of integration among researchers and managers engaged in marine science and policy. Furthermore, we've seen increasing interest in these issues from prospective undergraduate, professional, and graduate students, the general public, and from regional, national, international researchers and resource managers. Until now research in marine conservation has been funded primarily by private foundations including The Oak Foundation, Pew Charitable Trusts, David and Lucile Packard Foundation, Gordon and Betty Moore Foundation, Alfred P. Sloan Foundation, Lenfest Foundation, and The Curtis and Edith Munson Foundation as well as by donations from individuals and a number of smaller foundations. Interest and support in marine conservation is growing. For example, the Moore Foundation recently approved a new 10.5 year, \$140m+ Marine Conservation Initiative to support research in this area. To date, only limited federal funding has been available from agencies such as the Environmental Protection Agency, the National Oceanic and Atmospheric Administration, the Office of Naval Research, the National Science Foundation, and the National Aeronautics and Space Administration. Both the Pew Commission and the U.S. Commission on Ocean Policy have called for substantial increases in federal funding for research and management in marine systems.

Duke University is in an ideal position to respond to this opportunity due to the unique confluence of individuals from the key disciplines on our faculty and in the region. Our faculty is experiencing increased success in attracting resources for research, education, and outreach from potential sponsors, including private individuals, large and small foundations, state and federal governments (Appendix). We currently hold grants from Sloan Foundation, Moore Foundation, Oak Foundation, NSF/ONR/NOAA and others. We are currently in discussions with Packard Foundation and with the Office of Naval Research.

Center Administrative Structure

The Duke Center for Marine Conservation is directed by Dr. Larry B. Crowder with the assistance of a full-time center associate, Ms. Debbie Pease. The Center is also supported by an

Executive Committee that includes Duke Faculty: Andy Read, Pat Halpin, Marty Smith, Mike Orbach, and Richard Barber, as well as two NGO presidents: Karen Eckert, WIDECAST, and Carl Safina, Blue Ocean Institute. The Center Director reports directly to the Dean of the Nicholas School of the Environment and Earth Sciences. The Center for Marine Conservation is now housed in the boathouse at Duke University Marine Laboratory.

Focus of the Strategic Initiative: Place-based Management of Marine Ecosystems

Both the U.S. Commission on Ocean Policy and the Pew Oceans Commission targeted ecosystem-based management as a primary policy goal for marine systems in the United States. Implementing marine ecosystem-based management is by its nature a place-based approach—we support a transition from managing individual species or sectoral activities, toward managing all human activities that impact particular marine ecosystems including the coastal zone, watersheds, estuaries, continental shelves and the open sea. The Center faculty is uniquely qualified to address the key issues for developing a place-based approach, and ultimately ocean zoning, for the management of these systems. Duke is particularly well positioned to generate the analyses needed to support the implementation of place-based management. Key elements of our approach include:

4. *Developing and using geospatial analysis tools to integrate, display, and analyze spatially explicit data for dynamic oceans.* Data include dynamic oceanographic information, animal position and movement, as well as human activity and usage in coastal ecosystems. Current geospatial analysis tools are inadequate to fully integrate the physical, biological, social, economic, and governance data. Development of necessary marine geospatial analysis tools is already underway at Duke.
5. *Collecting, cleaning, and archiving spatially-explicit data on the physical, biological, social, economic, and governance features of coastal and ocean ecosystems.* Duke researchers are already accumulating physical and biological data sets from around the globe. But a fully-integrated system should also accumulate appropriate social scientific, governance, and policy overlays. Accumulating, cleaning, and preparing this data for integrated analyses is a challenging, but critically important task that has been initiated by the Center researchers.
6. *Developing new biophysical and social scientific analyses in support of policy development for integrated place-based management of coastal and marine ecosystems.* Duke researchers have conducted critical initial research on place-based approaches to understanding the biophysical ecosystem, economic analyses of place-based management with respect to fisheries, legal and policy analyses, and comprehensive analyses of the potential for place-based management and ocean zoning in the sea.

We recognize that elaborating the concepts and developing the tools of place-based management provides the educational milieu for a new generation of researchers and environmental managers. This strategic initiative assumes the Center researchers can raise their own specific research funds, so our request is focused on funds that would build new collaborative opportunities among Center faculty as well as enhance education and outreach programs, particularly in the international realm.

Our proposed budget includes support for the center associate, communications, and travel for development—but the bulk of this request is in support of students. We request support to recruit five Center Ph.D. students each year for the next three years. The Ph.D. students would be funded to work collaboratively with two or more Center faculty. Faculty requesting support for

an incoming student would prepare a brief proposal outlining the proposed collaborative research as well as potential sources of funding which could support the evolving collaboration beyond the initial year. These funds would allow us initiate a Research Training Group in Marine Conservation and could be used to leverage funds from both Federal (NSF IGERT, pre-proposals due March 27, 2006) and private foundations (possibly Oak, Packard, Moore).

Finally, we request funds to recruit and support outstanding undergraduates in *Marine Science and Conservation*. This small, highly selective undergraduate program would provide elite applicants to Trinity or Pratt, a world class career start, positioning them for leadership roles in marine conservation and policy. Students entering this program might ultimately choose to pursue a professional (CEM) degree, perhaps in the 3/2 program, or a Ph.D. in Marine Conservation. The expectation is that these funds would enable students interested in *Marine Science and Conservation* to spend one or more semesters and summer sessions with center personnel at the Duke University Marine Laboratory in Beaufort. Funding from the Provost's Strategic Initiative would be used to fund five entering students for each of the next three years and to provide leverage for the solicitation of grant funds from private foundations and donors. This funding would be used to support the development of this program to include elite undergraduate students from around the world; we will focus on developing support for a total of about 15 top students per year. Students will be expected to produce the equivalent of an honors thesis in their area of expertise.

We will measure our success via global visibility, high level publications, forging new and enduring partnerships with NIEPS as well as national and international NGOs and researchers, development of new courses and/or degree programs, as well as increasing external grants and gifts for research, education, and outreach in Marine Conservation. Another measure of success would be an increase in collaboration among Center faculty, associated students, and external partners. The Center will steer a course toward sustained funding from a variety of government agencies, private foundations, and individuals.

Appendix F: Faculty Hiring: Nicholas Institute for Environmental Policy Solutions:

The following presents alternative approaches and estimated timelines for hiring research scholars to carry out the Institute's mission. A key challenge for the NIEPS will be to accomplish major research projects on an aggressive timetable, while engaging Duke faculty (who may have pre-commitments to teaching and research in the near term). If the NIEPS operates by hiring all new staff, it will lose its connection to the university and to the wealth of faculty research. But if it relies only on existing faculty, the NIEPS may not be able to develop its projects quickly enough. Thus, some combination of existing faculty and new hires will be essential.

Hires in conjunction with Nicholas School and Other Units (Regular Rank Faculty):

Nicholas Institute Professorships: tenure-track or tenured positions, at all levels, requiring approval of Provost and two Deans, and faculty vote in two (joint appointment) schools. At least a 1-year hiring process.

Research Professor (or Professor of the Practice): regular rank faculty, at all levels, requiring approval of Provost and dean, faculty vote in Nicholas School. 3-5 year appointments, 1 year hiring process unless search is waived.

Faculty buy-outs (existing faculty): 1 or 2 semesters, negotiated with approval of the Dean and Division Chair (or the Dean of another School), arranged at least one semester in advance to allow the relevant Dean to cover teaching needs.

Direct Hires by NIEPS¹⁸

Visiting Professors: Individuals holding faculty appointments at other universities; requires approval by Dean and Provost (no faculty vote), 1-2 year appointment, 1 semester hiring process.

Research Scientists: Appropriate title for experienced scholars with an established record of accomplishments. Research scientists are classified as non-regular rank (non-voting) faculty. Approval by Dean (no faculty vote). 3-year renewable appointments, 1 semester hiring process

¹⁸ The Institute for Genomic Sciences and Policy was recently granted permission by the Academic Council and Board of Trustees to hire non-tenure track faculty (research professors) directly without going through a faculty unit. While this sets a precedent for research institutes to hire faculty independently of departments and divisions, such an arrangement may not be necessary for the Nicholas Institute given its close relationship with the Nicholas School, but the question will be revisited as the Institute matures.

Research Associates: Generally applied to post-doctoral researchers. Research associates are classified as staff. Approval by Dean (no faculty vote). 2 year renewable appointments, 1 semester hiring process

Consultants and subcontractors. The NIEPS may hire experts as consultants or subcontractors, non-resident, for partial contributions to projects. Approval by NIEPS Director.

Appendix G: **Proposal for a Distinguished Professorship in Environmental Ethics and Theology at Duke University**

Dean William Schlesinger (Nicholas School) & Dean L. Gregory Jones (Divinity School)
May 2005

The proposal recognizes that the Nicholas School of the Environment and Earth Sciences and the Divinity School at Duke University have both reached a crucial juncture in terms of faculty development. The Nicholas School has a distinguished faculty well equipped to address issues in environmental science and policy; now it must also reflect on the ethical, theological, and philosophical issues that grow out of our best attempts to foster environmental preservation. The Divinity School faculty currently focuses on deepening the theological understandings of the churches and raising up strong moral leadership. It is important that church leaders also be able to engage in a broad conversation with scientists and humanists about what it means to sustain life and health for all the creatures of God. We therefore propose to create a joint Distinguished Professorship in Environmental Ethics and Theology.

Fundamental questions need to be addressed concerning the role of humans in the biosphere. The Bible affirms that humans are to “exercise dominion,” to live on the earth as faithful representatives of God’s benevolent sovereignty. Yet increasingly it is evident that our planet’s health is in grave danger—the atmosphere is “running a fever” (global warming), our soils and rivers, even our oceans are imperiled—and that human activity is the primary source of its ill health. New developments in agriculture have enabled the human population to increase by four billion people in the last half century, yet drastic reductions in seed variety for all major food sources, widespread “contamination” by genetically modified seed, and the “Green Revolution’s” total dependence on petroleum-based fertilizers and herbicides raise grave questions about future food security. Proper answers to the questions of human environmental ethics are fundamental to how our society formulates and applies policies for environmental preservation—regionally, nationally and worldwide.

Over the second half of the last century, important movements have developed around what is often called “environmental ethics,” and there is now a body of literature that merits and needs critical attention. Poets and writers such as Edward Abbey, Annie Dillard, Gary Snyder, Barry Lopez, and David James Duncan have continued in the tradition of American nature writing established by Thoreau. Philosophers such as Holmes Rolston, Baird Callicott, and Van Rensselaer Potter have made important contributions to a philosophical idiom for considering the human place in the world. Vandana Shiva, Carolyn Merchant, and Rosemary Radford Ruether have explored from various angles the historical and contemporary connections between exploitation of women and of nature. Christian ethicists and theologians such as Larry Rasmussen,

Richard Fern, and Sallie McFague have all written critical theological works exploring various dimensions of the environmental challenge. Moreover, a very impressive body of new agrarian literature—stemming from the work of Aldo Leopold—has attracted a wide audience, both secular and religious. The best known and most influential of the new agrarians is the poet, novelist, essayist and farmer, Wendell Berry.

Several Duke faculty members are already giving some attention to these issues and to this growing body of literature, but for none of them is environmental ethics the central focus of his or her teaching, research, and writing. We believe that the proposed Distinguished Professorship would strengthen our two Schools, and further, provide a kind of intellectual leadership that would benefit the University as a whole. Among universities with professional programs in environmental studies (others are Yale, Michigan, and the University of California in Santa Barbara), such an appointment would be unique. We envision that this scholar would, for example, enable students in the Masters of Environmental Management program to set their studies of environmental science and policy within the larger context of the role of humans as stewards of life on our planet. Within the Divinity School, this professor would prepare religious leaders to articulate, through preaching, liturgy, and teaching, the need to care for God's creation, and help them to identify concrete practices that the church should initiate and advocate. In both Schools, the Distinguished Professor would equip doctoral students for research, scholarship, and teaching in this vitally important area.

Three years after first proposing this Professorship, the Divinity School and the Nicholas School have this Spring jointly sponsored two related projects. Prof. Michael Northcott of the University of Edinburgh, who has wide experience teaching on three continents, served in a visiting professorship at both Schools. His course in Ethics and Environment drew students from the Divinity School, the Department of Religion, and the Nicholas School. The two Schools also sponsored a series of lectures on Ethics and Environment. The large and varied audience attending these lectures, as well as the enthusiastic evaluations for Prof. Northcott's course, demonstrated how much interest there is—among students, faculty, and the general public—in this kind of intellectual exploration.

Appendix H Professional Masters Degree in Forestry (MF)

A Strategic Plan for Forestry at Duke: A Global and Interdisciplinary Vision
January 17, 2005

Contributors: Lynn Maguire, chair; Norm Christensen; Judd Edeburn; Bob Healy; Karen Kirchof; Sarah LaPlante; Ram Oren; Cindy Peters; Dan Richter; Dean Urban; with help from current students, alumni, NS Board of Visitors, NS Education Committee

The changing face of forestry

The geopolitical, economic, societal and environmental contexts for forestry in the 21st century will be very different from those faced by past generations of foresters.

- Global climate change, with potentially large but currently unpredictable impacts on forest productivity and functionality, habitat values, and world trade patterns, will change both the bio-physical environment of forests and the social demands for forest services, such as sequestration of atmospheric carbon.
- New patterns of human settlement have increased the urban-forest interface and created new conflicts with management of timber, wildlife, fire, watersheds, parks and wilderness.
- A rapidly increasing number of non-profit land conservancies are interested in managing forestland for complex combinations of objectives, from forest protection to generation of revenue.
- Forest-based businesses face new environmental challenges, including demands for product certification and protection of biodiversity.
- The structure of international trade in forest products is changing rapidly. Global trade shifts include the rising economic development of India and China (large consumers but lacking in fiber), and U.S. producers facing challenges such as lumber imports from Canada, competition in pulp and chip markets from South America, Asia and eastern Europe, as well as export of recyclable fiber from the U.S. to mills in the Far East.
- Integrated fiber companies in the U.S. are divesting tens of millions of acres of forestland, much of it to investors and timber management organizations that are not in the manufacturing business.

These new contexts have profound implications for university teaching and research in forestry. At Duke we focus on forests and forestry for their economic, societal, environmental and aesthetic values and because forests and their management are such powerful global drivers of an array of environmental services. This focus for forestry

supports Duke University and Nicholas School initiatives in global and multidisciplinary research and education.

Vision statement for forestry at Duke

Forestry at Duke's Nicholas School integrates natural and social science to manage the world's forests for evolving goals and multiple stakeholders. Our program emphasizes analytic, systems-level approaches to train forward-looking forestry professionals who will become leaders and interdisciplinary problem-solvers in government, business and non-profit sectors.

The current MF program: substantial value, very low cost

Statistics on the MF program and recent polls of current MF and MEM students and recent graduates reinforce the forestry faculty's belief that the MF degree adds substantial value to the Nicholas School's educational programs at little incremental cost to the School. Since 1999 the School has graduated 33 MF recipients, some of whom also received MEM degrees. The MF program has as many or more students than some other professional programs (such as Environmental Health or Global Environmental Change), and it has few or no faculty who are not also fully engaged in other professional teaching and advising (e.g. in ecosystem management and conservation). In addition, courses designed for the MF program (e.g., the forestry traveling seminar, silviculture, vegetation sampling) also serve MEM students, who state that the MF program enhances their access to applied courses and field experiences. Only one contract course is taken predominantly by MF students, and its cost to the school is unusually low. It would be wonderful to increase the size of the MF program somewhat, which could probably be done through better advertising to attract applicants and through better financial aid to increase yields of admitted students. However, even at its current size, the MF program more than pays for its very low incremental costs.

There is a rich interaction between MF education and forest research and PhD instruction. Forest research is a major enterprise of the Nicholas School with at least 18 Nicholas School faculty conducting research in forest systems worldwide. MF students regularly work as research assistants on projects in the Duke Forest and elsewhere, and four out of 33 recent MF graduates have gone on to PhD programs. Nicholas School PhD graduates working in both natural and social science aspects of forests and forestry now hold faculty positions in forestry departments at North Carolina State, Georgia, and Oregon State, to name a few, as well as research positions with the US Forest Service, other US agencies and international aid organizations that work in forestry.

Recent graduates report that the Duke MF degree is recognized worldwide and confers legitimacy, particularly in international forestry, forest land trusts and industry. They also believe that the Duke MF's emphasis on ecosystem management and on forestry in a broad social and environmental context differentiates them from more traditional forestry graduates and opens new employment opportunities. Current students have chosen the Duke MF program, or added the MF degree once here, because of its applied and

technical focus, its emphasis on conservation and ecosystem science, and its blending of resource use and protection goals for forests. The Nicholas School annual graduate survey of alumni areas of career expertise shows that forest management is second only to water quality/pollution in frequency of selection.

Could we reap the same benefits by dropping the MF degree and focusing on forestry in the MEM programs instead? Probably not. The presence of an accredited MF program motivates applied and technical forestry coursework (e.g., applied silviculture, fire ecology, sustainable forestry) that also benefits many MEM students. Without the recognized, and respected, MF degree, Nicholas School graduates probably would not enjoy the same level of success in securing jobs that reflect the new face of forestry. These are compelling reasons to retain and renew the MF degree and to seek SAF re-accreditation in 2008.

Plans for SAF accreditation

We see three alternative responses to our current position in forestry and our upcoming re-accreditation review by SAF. A “business as usual” approach would pursue little change in strategy and would focus on receiving accreditation by meeting current SAF standards. A second option would be to forego accreditation by SAF, in effect taking the position that the SAF standards are of limited relevance to our vision of forestry. A third option would be to work with SAF staff to devise a new model for accreditation, one that recognizes the changing face of forestry, the increasingly multifaceted nature of forest management, and the remarkable success of Duke MF graduates in traditional and nontraditional forestry careers. This approach would benefit Duke in the short term and also benefit the larger forestry community by helping to identify the emerging educational demands for the field. The Nicholas School faculty, students, and alumni endorse this third option.

Implementation of plan

Current strengths

Some of the skills and knowledge needed by MF graduates are already well-represented in courses taught in the Nicholas School, although not all are required in the current MF curriculum.

- Core field skills in forest biology and forest measurement (e.g., Forestry Field Skills, Vegetation Sampling, Forest Ecosystems,)
- A systems approach to forest ecology, management and conservation (e.g., Silviculture, Ecosystem Management, Conservation Biology)
- A larger context for forestry at watershed, landscape and global scales (e.g., Water Quality Management, Hydrology, Soil Resources, Climate Change)
- Social science skills relevant to forest management and policymaking (Resource and Environmental Economics, Business and the Environment, Environmental Policy, Land Use Policy, Environmental Law, Conflict Resolution)

- Structured analysis (e.g., Geospatial Analysis, Environmental Decision Analysis, Applied Regression Analysis)
- Field experiences, both locally and nationally, with forestry as practiced in a variety of public and private settings.

We draw modestly on the more traditional forestry courses at North Carolina State to supplement our curriculum. About one-third of recent MF graduates took at least one course at NCSU, and a handful took more than one.

In education outside the formal curriculum, we are doing a good job placing students in forestry-related internships (and, upon graduation, in permanent job placements) in land trusts, other NGOs, consulting firms and government agencies. The student SAF chapter is an active and venerable force for extracurricular education in the School.

Areas for improvement

We need to bring more focus to communications skills and tools for working with stakeholders, where we have existing resources (e.g., Conflict Resolution, Participatory Techniques, Social Science Surveys, Technical Writing,) but perhaps are not using them effectively in the MF curriculum. Although we provide a comprehensive socioeconomic context for forestry via environmental policy, economics and law courses, many of which use specific examples or cases from forestry, we need to provide more specific training in land conservation and management tools (legal, financial, etc.) used by land trusts with working forests and in the “business” side of forestry, both public and private. We provide some exposure to forestry practice via field trips, but we need to give more attention to management skills such as basic accounting, management of work groups, and project planning.

Our curriculum, and our student body, are highly international, but we need to offer some options specifically tailored to global forestry, including perhaps a course in Tropical Forest Management, opportunities for internships with international forestry businesses and nongovernmental organizations, and an international forestry field trip.

We need to take a broader approach to forest health, including fire ecology, climate change, air pollution and invasive species, as well as pest management.

Although many current forestry courses use the Duke Forest for practical lab work, we can make better and more use of the 7000 acre Forest for MF training, perhaps via a practicum in land acquisition/ownership, administration, and management. Practicum work would include aesthetics, biodiversity, recreation, revenue generation/economics, soil and water resources, invasive species and silvicultural treatments required to meet management objectives. Students would develop integrated management plans and participate in contract administration, prescribed burning, timber sales, GPS data collection and GIS analysis.

We need to address vulnerabilities in staffing of the forestry program. We anticipate adding strength with the Korstian Chair in Forest Management. We must maintain, and enhance, participation of practicing professionals from both traditional and nontraditional forest ventures in our curriculum. Our students have benefited greatly from exposure to contract instructors with long-standing experience in public and private forestry. We need to find ways to continue those benefits, while making sure that we have stable coverage of core forestry courses.

Curriculum action items

1. Review existing courses (both “forestry” courses and others, e.g., resource and environmental policy) for congruence with current SAF curriculum guidelines to decide where we want to modify our courses and where we want to work with SAF on a new approach to meet program needs.
2. Transform current pest management course into a broader forest health course that includes coverage of impacts of air pollution, invasive species, fire and climate change.
3. Implement capstone practicum (perhaps as part of a modular course structure).using the Duke Forest as the venue for integrated resource management planning.
4. Design and implement a management course (to serve other programs as well as forestry).
5. Explore using modules within a semester to cover topics such as land conservation tools, forest modeling, and other topics not represented by semester-long courses.

Summary

In preparing this strategic plan for the MF program, we were impressed by the passionate support and commitment from faculty, current students and alumni. Although intangible, this enthusiasm is an important asset for the School. We want to build on that enthusiasm and on our current strengths by (1) working collaboratively with SAF on re-accreditation of the MF degree; (2) doing a better job of publicizing our strengths in forestry research and education to our academic colleagues, to prospective employers of our MF graduates, and to prospective MF students (perhaps with a forestry research and teaching section on the NS web page); (3) revising our MF curriculum to fit the vision we have proposed and to remedy weaknesses we have identified; and (4) solidifying staffing in the forestry program, perhaps through participation of senior personnel retiring from forest businesses and from government agencies.

Supporting materials available

Recent enrollments in MF courses

Employment history for recent MF graduates

Statistics on recent MF applicants, matriculants, graduates

Input from current students (Sarah’s summary, original emails)

Input from recent alumni (Judd’s summary, original emails)

Statistics and quotes on MF program from spring 05 student survey
Statistics on NCSU forestry courses taken by recent MF graduates
Summary of NS faculty forestry experience
Forestry employment of PhD graduates

**Program Statement
For a New Building to House
The Nicholas School of the Environment and Earth Sciences
&
The Nicholas Institute for Environmental Policy Solutions
August 11, 2004**

Part I. Mission

The Nicholas School of the Environment and Earth Sciences is among the premier educational institutions in the training and preparation of future environmental scientists, leaders in environmental policy, and ecosystem managers. With the recent commitment of \$70 million to establish the Nicholas Institute for Environmental Policy Solutions, our mission has expanded to include a Duke-wide interdisciplinary effort to bring together the best natural science, social science, and policy research to develop independent strategic analyses of and solutions to the most challenging and important environmental issues, and to translate that research into effective policy options for government, non-profit and corporate sectors.

The School is composed of three divisions, which serve doctoral, undergraduate, and graduate professional (master's) students. The Coastal Systems Science and Policy division is headquartered at the Duke University Marine Laboratory in Beaufort, NC. The Earth and Ocean Sciences division in the Old Chemistry Building and the Environmental Sciences and Policy division in the Levine Science Research Center are both on Duke's West Campus in Durham, separated by a 5 to 10-minute walk. The Nicholas gift to create the Institute has expanded the mission of the School to include outreach across campus and beyond the world of academe. It is critical that we bring together the divisions housed on campus as well as the Nicholas Institute to ensure that the foundation for this ambitious interdisciplinary effort is solid.

To realize our objective of becoming the leader in environmental research and teaching and to meet the charge of the Nicholas gift, we must grow strategically. This translates into modest growth in key areas of research. The division of Earth and Ocean Sciences will grow from 14 to 20 faculty, with most recruiting in the field of Energy. Environmental Sciences and Policy will grow from 30 to 34 spread evenly throughout the disciplines. The Nicholas Institute brings special opportunities through a \$10 million matching gift to establish joint-professorships with schools across the University. This will likely translate to an additional 8-12 faculty positions, or endowments to support faculty buy-outs for specific research projects. Directly related to faculty growth is the aggressive recruitment in the M.E.M. graduate program with a projected increase in class size from 110 to 130 and an increase in the PhD population from 120 to 160.

Although our strategy includes deepening the collaborative, interdisciplinary approach to addressing the planet's most pressing environmental issues, our current configuration and space allocation does not support these increased expectations and demands. In fact, the physical separation of divisions hinders internal coordination significantly, and doesn't begin to meet the challenge of the Nicholas gift to the School and the University: to develop a model for collaboration among schools and programs to include the fields of business, law, engineering, divinity, public policy, medicine and economics.

While our current lab and teaching spaces do not meet our present needs, these deficiencies become critical liabilities to the success of the Nicholas Institute and the School's strategic growth. Advances in computer modeling and mapping, for example, have led to exciting new research in climate change and environmental health, and we must increase our capacity to teach and develop such computer applications, as well as to share our work via state-of-the-art multi-media and videoconferencing facilities. Limitations in our current laboratory, teaching, and audiovisual space impede our ability to attract the best scholars and students and to implement future technological change.

In addition to our research and teaching programs, the Nicholas Institute creates new opportunities for the Nicholas School to host a wide array of on-campus forums, seminars, and programs across all sectors, recognizing the need to promote dialogue between corporations, government agencies, and non-profit organizations. Collaboration will include providing residencies for key partners and delivering executive education modules, in addition to hosting events. Collectively, these opportunities require a degree of flexibility in classroom and conference space not available currently.

A final consideration in the planning for a new building is the ability to provide additional community space on the Duke campus for students and faculty to exchange ideas outside the classroom. Our current space configuration actually hinders such an exchange by separating the faculty and students into two physical locations in Durham, without providing adequate community space, such as formal breakout and small conference rooms and informal lounges, reception, and other common areas

In order to facilitate the collaborative, multi-disciplinary model to which we aspire and which has been defined through the Nicholas gift, we must now build a home for the Nicholas School and the Nicholas Institute for Environmental Policy Solutions. We have an exciting opportunity to build a fine example of sustainable architecture at Duke University, and to operate that facility as a green building for its duration.

Part II: Specific Purpose

The success of meeting the missions of the Nicholas School and the Nicholas Institute is directly tied to the accessibility and location of this proposed building. If the Nicholas School and the Institute are to bridge the disciplines of the sciences and the social

sciences, then the physical location of a new building or the addition to an existing building must encourage this activity.

The faculty and students of the Nicholas School and the Institute should be located centrally to allow for more participation within the larger Duke community. With outreach as a central part of the Institute’s mission, there should be adequate parking, and the facility should be accessible to University transportation to accommodate traffic associated with conferences and campus-based executive education.

The Nicholas School currently occupies 73,295 net square feet in the LSRC and Old Chemistry buildings. In the Wilson Associated Architects Program Study submitted in 2002, the proposed growth included an additional 57,684 nsf for a combined total of 126,621 nsf. In a preliminary survey of space requirements for the Nicholas School, including space for the Nicholas Institute for Environmental Policy Solutions and related conference facilities, the current estimate is 160,000 nsf.

The attached program includes approximate 73,765 nsf for the EOS and ESP divisions, or growth of 34,675. This is comprised of roughly 26,895 nsf of wet laboratory space and 46,870 nsf of field and computational space (Section 1.0).

The concept is to arrange Laboratories and Centers in groupings that allow for more collaboration. Additionally, there is dedicated space for Centers and the Nicholas Institute, and shared support for Labs and Centers for a combined total of 31,618 nsf (Sections 2.0 and 3.0) or growth of 22,968 nsf. Classroom space, which includes a 400-seat lecture hall, and multiple classrooms and team rooms (Section 4.0) adds an additional 35,000 nsf or growth of 24,177 nsf. Administration space needs have been reviewed to encourage interaction between students and Enrollment Services, Career Services and Development and Alumni Relations (Section 5.0) and accounts for roughly 7,540 nsf or growth of 1,219 nsf. Special consideration has been made to examine the Community space needs and to find opportunities to maximize student space and flexible Institute space (Section 6.0) to ensure maximum efficiency, our estimates call for roughly 9,490 nsf or growth of 3,438 nsf. Integral to the teaching and research at the Nicholas School is computing (Section 7.0) that includes teaching labs, public computing and support functions for a total of 4,680 nsf.

Nicholas School	Current	Proposed
EOS/ESP	39,090	73,765
Nicholas Institute & Centers	3,513	18,415
Shared Support	5,137	13,203
Teaching	8,823	33,330
Administration	6,321	7,540
Community	6,052	9,490
Unassigned Grad.	4,359	
Computing *		4,680
Total:	73,295	160,093

* Computing was not accounted for in the Wilson Architect survey.

As noted above, the estimated need for the new building is 160,000 net square feet. The estimated timeframe for completion is 36 months including construction. Funding will be obtained through a combination of bond debt and donor gifts.

Part III: Details

The Nicholas School is the oldest school of the environment in the United States, and considers similar programs at Yale, University of Michigan, and the University of California at Santa Barbara to be its peer group. With the addition of the Nicholas Institute, the Nicholas School is now uniquely positioned to outpace our peers with the emerging interdisciplinary focus on major issues such as energy, environmental health, water quality, oceans and wetlands, global change and forestry. Indeed, Duke University has been at the forefront of higher education, leading by example. It seems fitting that the Nicholas School and the University step forward boldly with this building project to shape and even define the future of sustainable design.

Ideally this should be a building that physically bridges the divide between the natural and social sciences, and fosters a new breed of collaborative initiatives, emphasizing the importance of outreach as a means of change. The design, whether contemporary or classic, must invite visitors to Duke and members of the larger University community into the building and encourage them to enter into the dialogue between our faculty and students. Given the physical beauty of the University grounds and the temperate climate, the project should incorporate the outdoors (natural light, outdoor community space, etc) into the design of the building. The landscape and physical placement of the building should exhibit thoughtful incorporation of the very best shading and sun-lighting practices suitable to our climate.

To set out with the goal of simply following Duke University guidelines for sustainable design is not enough. As the Nicholas School of the Environment and Earth Sciences, we have an inherent responsibility to design and build a cutting edge, dynamic building. To state that the building is multi-functional falls short of the array of needs it must meet. We must build flexible, modular research laboratories (wet and dry), we have unique computing needs, and current research and teaching demands more technically advanced classroom and teaching lab space. The building will also need to accommodate community space requirements not only for the students, faculty and staff of the Nicholas School and Institute, but also for those of our collaborative partners at Duke. And finally, the new building will serve as a conference center for partners of the Nicholas Institute. There is no an example anywhere on campus of a building that must accommodate such a broad range of objectives. To do this well, to make a bold statement about Duke University's commitment to sustainable design and to ensure that the building can be operated for its duration as a green building is an ambitious undertaking.

The Bren School at the University of California at Santa Barbara and Oberlin College have opened model buildings, which combine some of the very best examples of sustainable design in higher education. By utilizing the LEED system (United States Green Building Council, Leadership in Energy and Environmental Design rating system [Bronze, Silver, Gold and Platinum] <http://www.usgbc.org>), these schools have endorsed this concept of rating construction, and the Nicholas Hall project should strive to achieve the highest level of certification. It is likely that the Nicholas Hall project and Duke University are well positioned to work in concert with the USGBC to further develop the rating system utilized to better reflect the unique challenges and opportunities that exist in construction on large physical plants like ours.

Part IV: Design Guidelines

It is the intent of the Nicholas School of the Environment and Earth Sciences to follow the Duke University guidelines as well as the networking and technology standards detailed in the August 2003 revision of Duke's "Communication facilities design guidelines for architects and engineers." It is the expectation of the committee that the project would work within the Duke University master plan for building and renovation. Further, the Nicholas School must proceed with the intention of building an excellent example of green architecture, by pursuing LEED Platinum certification.

Program Summary			
DIVISION		Proposed Space	
1.0	EOS/ESP		73,765
1.1	Global Change		15,485
1.2	Water Resources and Surface Processes		10,400
1.3	Geology		4,890
1.4	Energy		8,150
1.5	Conservation and Landscape Ecology		9,780
1.6	Environmental Health		12,650
1.7	Forest Resources and Forestry		6,520
1.8	Env Econ & Policy		5,890
2.0	Centers		18,415
2.1	Nicholas Institute		9,590
2.2	Center for Global Change		320
2.3	Center for Env Genomics		320
2.4	Duke Forest		320
2.5	Center for Wetland Hydrology		320
2.6	Center for Environmental Education		2,505
2.7	Superfund Center		320
2.8	Center for Tropical Conservation		320
2.9	Center for Children's Env. Health		320
2.1	Center for Developed Shorelines		320
2.1	Aldo Leopold		320
2.1	Unspecified		320
2.1	Unspecified		320
2.1	Shared Resources		2,800
3.0	Shared Support		13,203
3.1	Sample Prep Suite		2,460
3.2	Analytical Suite		3,210
3.3	Other Shared Instruments		4,848
3.4	Archival Storage		2,685
4.0	Teaching		33,000
4.1	Classrooms		26,250
4.2	Teaching Labs		4,620
4.3	Teaching Support		2,130
5.0	Admin		7,540
5.1	Dean's Office		570
5.2	Division Chairs		1140
5.3	Business & Finances		560
5.4	Career Services		455
5.5	Enrollment Services		745
5.6	Development		720

5.7	Marketing & Comm.			450
5.8	Environmental Services			160
5.9	Other			2740
6.0	Community			9,490
6.1	Mail/Lockers			240
6.2	Copy/Fax/Storage/Kitchen			660
6.3	Reading Lounge			1,170
6.4	Small Reading Lounge			600
6.5	AV Storage			80
6.6	Interpretive Space (lg)			1,500
6.7	Interpretive Space (sm)			240
6.8	Atrium/Student Commons			5,000
7.0	Computing			4,680
7.1	Admin			1,480
7.2	Computer Work Areas			640
7.3	"on the go" stations			40
7.4	Teaching			2,520
	TOTAL NET AREA			160,093
		Multiplier	1.5	
			4	
	TOTAL GROSS AREA			246,543

Appendix J. A Strategic Vision for Environment and Health Sciences at Duke University

A report submitted by: Richard Di Giulio, Allison Ashley-Koch, Richard Auten, David Hinton, Robert Jackson, David McClay, Marie Lynn Miranda, Joseph Nevins, Curtis Richardson, Kevin Schulman, Dennis Thiele

Goal

To create a structure and set of incentives at Duke University that promotes interdisciplinary research and education at the interface between environmental and health sciences.

Background

Duke University is home to a very top tier Biomedical Center and School of Medicine (DUMC), and to a premier School of the Environment (The Nicholas School). While several faculty from both units have deep interests in the interface between environmental and health sciences, this interface has not been historically a principal focus in either academic unit.

However, it is becoming increasingly evident that the environment plays a critical role in human health, that human activities concomitantly have enormous consequences for the 'health' of ecosystems, and that these two entities are intimately interconnected. A disconnect between human health and environmental scientists is pervasive across American universities and is deeply rooted in cultural and intellectual traditions. Duke University, with porous barriers between academic units, existing interdisciplinary structures related to this area, active promotion of interdisciplinary activities, and expertise in biomedical and environmental sciences, is well-poised to become the leading university in this area, given appropriate resources.

The ongoing genomic revolution provides a profound scientific basis for advancing research and education at this interface. Genomic and proteomic sciences are rapidly enhancing our understanding of similarities and differences among species, populations, ages and sexes, and thus our understanding of genetic contributions to susceptibility to environmental stressors. This gene-environment interaction paradigm underpins modern human environmental health science activities, including those of NIEHS. Duke's Institute for Genome Sciences and Policy (IGSP) and Center for Human Genetics (CHG) are critical existing scientific resources, and the structure of the IGSP serves as a model for a university-wide initiative in environment and health sciences.

In addition to basic science issues related to this area, environmental policy shapes human-environment interactions, for better or worse. Duke has outstanding faculty with environmental policy emphasis in the Nicholas School, Law School, Fuqua School, and Sanford Institute. These assets could be further focused and expanded upon in this initiative. The recently created Nicholas Institute of Environmental Policy Solutions

(NIEPS) could include environmental health as a focal area; the potential for synergy between NIEPS and this initiative is clear.

Potential Focal Areas for the Environment and Health Sciences Initiative

Gene-Environment Interactions. Biological phenotypes, both acute and chronic, are influenced by the genetic makeup of the cell or organism together with environmental influences. The ‘environment’ can range from local hormonal influences within an organism to the contribution of agents from the external space. For instance, exposure to various toxins are important contributors to the risk for human cancer. There are several aspects of human health where the gene-environment paradigm is particularly relevant and where Duke has substantial expertise, particularly on the ‘gene’ side. Research here would include understanding the role of environmental variables on specific disease processes, identifying genetic factors contributing to disease susceptibility, and ultimately how those environmental and genetic factors interact to influence health outcomes. This area of research is key to public health not only in terms of providing more precise predictive values to individuals at risk, but also to establishing more effective environmental interventions.

Potential topics include:

- Cancer
- Pulmonary disease
- Cardiovascular development and disease
- Neurodevelopmental and neurodegenerative diseases
- Infectious disease
- Mental health and well-being

On the ecological side, concerns exist for effects of various stressors on ecosystem health, including identification of sensitive components (e.g., species, populations, life-stages). Examples where an analogous gene-environment approach could help elucidate impacts of human activities on ecosystem health include:

- Water quality
 - Pollution effects on development and cancer in free-living animals
 - Hypoxia impacts in coastal estuaries
 - Habitat fragmentation effects on community/genetic diversity
 - Human impacts on evolution
 - Global climate change and ecosystem responses

A very significant limitation in understanding the role of the environmental contribution to biological phenotypes is the inability to measure their contribution, particularly in a quantitative fashion. In most instances, these contributions are only anecdotal and do not provide a precise measure of the extent to which an environmental exposure might contribute to a phenotype. Recent advances in the development of various ‘omic’ technologies (such as transcriptomics, proteomics, and metabolomics) have now provided

opportunities to measure these environmental effects in vulnerable organisms. For instance, gene expression profiling of peripheral lymphocytes has been shown to identify ‘signatures’ of environmental effects such as radiation exposure. One anticipates that similar analyses using proteomic and metabolic profiling strategies will contribute further information towards this goal. To further Duke’s expertise in this developing area of research, the Department of Psychiatry has hired a new faculty member who has expertise in the area of metabolomics.

Molecular tools within “Systems Biology” are rapidly becoming more powerful and available; these will greatly enhance research in the area of Gene-Environment Interactions. These tools are revolutionizing Comparative Biology and the elucidation of similarities and differences among and within species. This is important to the identification of sensitive subsets, the selection of model organisms for both human and ecological health research, and for understanding fundamental mechanisms of adaptations and impacts.

Interconnections between Human and Ecological Health. An important aspect of this initiative that distinguishes it from other universities involved in human environmental health and/or ecosystem health is its explicit recognition of the intimate relationship between the two.

Examples of the linkage between human and ecological health include:

The human benefits of healthy ecosystems (e.g., clean seafoods, clean air and water; wastewater treatment);

Cycle of desertification and famine associated with human over-exploitation of resources (note relationship to Global Health Initiative);

Effects of human perturbations of ecosystems (such as global climate change, land management activities, water quality) on human disease organisms and vectors;

Opportunities provided by healthy ecosystems for human outdoor physical activities (alternatives to TV, even ACC basketball!);

Accumulation and food chain transfers of persistent chemicals (such as pesticides, mercury, and flame retardants), ultimately impacting top predators (birds, marine mammals, humans);

Natural ‘aesthetics’ and human mental health.

Environmental Health Economics and Policy. A critical goal of this initiative is to perform cutting edge research in both the relevant natural and social sciences, and to enhance interactions between the two. The implications and potential impacts of a scientific understanding of the relationships between the environment and health for

economics and policy, and vice-versa, are enormous. Many critical decisions associated with this area loom currently and in the near future. For example, regulatory policy requires that standards be set to protect vulnerable populations. This kind of legislative language was enacted long before the genomics revolution. Determining what constitutes the relevant vulnerable population to be protected within the context of genetic vulnerability or gene-environment interactions requires sophisticated analysis and nuanced regulatory approaches heretofore undeveloped. By integrating the social and natural sciences, this initiative will place Duke at the forefront of critical environment and health science policy decisions.

Implementation of the Plan

I. Organization

We believe the model represented by the IGSP is one that is very appropriate in guiding the development of an Environment and Health Sciences initiative. Key aspects of this model include the development of a core group (~8) of faculty central to this initiative who are housed together at a location that serves as the initiative's home, together with appropriate support staff. This provides a critical mass of faculty to foster the development of interdisciplinary research activities, the development of critical core facilities, and then to also provide a 'home base' for programmatic activities that include faculty beyond this core group. This latter aspect is critical in building initiatives involving large numbers of faculty across campus.

Plans for a new building for the Nicholas School and NIEPS ("Nicholas Hall") are at an early stage and may be adaptable to this initiative.

II. Physical Facilities and Infrastructure

For this initiative to flourish, several key facility and infrastructure needs will have to be addressed:

Analytical Chemistry and Metabolomics Facility. The lack of an analytical chemistry facility at Duke has impeded many activities related to environmental health and toxicology; most peer institutions with programs in these areas feature such facilities. Metabolomics is an emerging approach for understanding gene-environment interactions, and has particular potential for comparisons among non-traditional laboratory and ecological models. Metabolomic high-throughput platforms (NMR, GC, Mass Spectroscopy) overlap with those employed in more traditional analytical chemistry. The current campus efforts in metabolomics are sent off-site on a fee for service basis. This is not only cost-prohibitive for many researchers, but it also removes Duke from being central to this developing technology.

Non-traditional Animal Model Facility. While some consideration for such models (particularly fish models) has been noted in plans for Nicholas Hall, it is important that state of the art facilities for organisms that do not conform to existing facilities such as the Vivarium are provided and maintained. This new facility would likely interface with the new Center for Evolutionary Genomics within IGSP.

Computational Facility. Data analyses will be very complex, and complete analyses that include comparisons among models, projects and investigators will be important to the development of collaborations among initiative faculty and students. There is not only a need for the physical computational resources, but also for the statistical and epidemiologic expertise. Methodology to detect the complex interactions contributing to environment and health science is in its infancy. This facility would thus serve as a repository for diverse data sets, provide support for statistical, bioinformatic and GIS-associated analyses (as examples), and oversee appropriate comparative analyses.

Importantly, several aspects of these facilities are already well developed in other contexts on campus and need not be re-invented. Rather, a partnership with the EHS initiative would allow expansion and evolution to match the needs of the EHS initiative.

III. Funding Models

We again return to the IGSP as a model for an effective funding structure. Key in this model is the allocation of sufficient resources to enable program development. Although some of this can be achieved through partnerships with departments and schools across campus, it is critical that the EHS initiative brings resources to the table to allow these partnerships to develop. Moreover, an internal funding base will also be critical for program development to a point that will be competitive for outside funding as described below as well as to jump start the process of core facility development. Once these programs and facilities are in place, opportunities for achieving a return on the investment will be feasible.

Significant funding opportunities will be available within the newly aligned goals of the NIEHS where there is now clearly an emphasis on longitudinal health sciences studies that incorporate components of environmental research. In particular, a series of ongoing, major studies in cancer and cardiovascular disease have developed within the IGSP that aim to utilize genomic information to define clinical phenotypes such as disease susceptibility, disease outcome, and drug response. In each case, these studies present substantial opportunities for incorporating environmental contributions to the clinical phenotypes. These initiatives can lead to key funding opportunities through the new goals of the NIEHS, providing a unique opportunity to bring environmental components into these large-scale genomic efforts.

IV. Educational Programs

This initiative will include enhancements to the teaching mission of the university as well. Components of environment and health sciences will be incorporated into existing academic programs with the potential for creating new programs. Potential examples include:

Undergraduate education. Concepts from environmental and health sciences are relevant for multiple major fields of study across campus, including environmental sciences and policy, earth and ocean sciences, biology, chemistry, mathematics, physics, engineering, economics, political science, public policy, sociology, and anthropology. We envision informing high enrollment courses across multiple departments with relevant concepts from environmental and health sciences in addition to designing and offering entirely new courses at the undergraduate level specifically focused on environmental and health sciences.

Professional education. Among the Nicholas School's Master of Environmental Management (M.E.M.) programs is "Environmental Health and Security." The thrust of this M.E.M. program is completely congruent with this initiative. Joint degree programs also exist involving the M.E.M. and professional degrees offered by the Sanford Institute (Master of Public Policy, M.P.P.), Law School (J.D.), and Fuqua (M.B.A.).

A goal of this initiative is to more fully integrate environmental health science into undergraduate medical education. There are opportunities for medical students to pursue electives in occupational/industrial environmental health, to do a research year at NIEHS, or to pursue a Master's degree in public health during the MS3 year at UNC-CH. However, there is at present no integrated approach to environmental health science education during the preclinical 1st year when educational interests are being developed. The development of course content and/or courses in environmental health geared towards M.D. students, and joint degrees in environmental health (e.g., M.E.M. or M.S.) and medicine (M.D.) at Duke are potential options to develop the next generations of leaders in global environmental health initiatives. The Nursing School would represent a natural partner in these new curricular initiatives.

Graduate (Ph.D.) education. Perhaps the existing doctoral program at Duke closest to this initiative is the Integrated Toxicology Program (ITP), in its 25th year of NIEHS support. The ITP draws faculty and students primarily from DUMC (mainly Pharmacology) and the Nicholas School, as well as from Biology and Chemistry in Trinity College. In light of the changing landscape at Duke and NIEHS, as well as this initiative, it is anticipated that the ITP should be restructured and recast as a broader program such as "Environmental Health."

Additionally, this initiative will serve as a springboard to broaden other existing interdisciplinary graduate programs to explicitly include aspects of the three themes of this initiative. These programs include the University Program in Genetics and

Genomics, the University Program in Developmental Biology, and the University Program in Ecology. Other interdepartmental and interdisciplinary opportunities relevant to this initiative exist with the Pratt School of Engineering, particularly the Department of Civil and Environmental Engineering.

V. Current Faculty Strengths and Faculty Development

Faculty with strong interests in environment and health sciences reside in multiple departments and schools across campus. These include:

The Nicholas School: Currently the Nicholas School has four positions directly relevant to this initiative, of which three are tenure-track positions. Expertise of these faculty include: environmental toxicology; carcinogenesis and pathobiology in fish models; genetic and developmental toxicology; environmental and analytical chemistry, children's environmental health and environmental justice; spatial modeling and GIS; In addition, a search is underway in molecular environmental toxicology.

The Institute for Genome Sciences & Policy (IGSP) has developed an infrastructure of scientific programs, as well as a technological infrastructure, that can serve as a model for the development of an Environmental Genomics initiative while at the same time is a valuable resource for programmatic growth. Major programs already underway include efforts in Cardiovascular Genomics and Cancer Genomics – clearly, the development of a program in Environmental Genomics, with faculty positions designated for growth of the program, represents a key opportunity for future growth within the IGSP in synergy with an environmental effort.

Duke University Medical Center: A significant number of DUMC faculty have expertise and research focus on environmental health. One NIH-NHLBI program project that involves eight faculty is focused on the interaction of personal environmental stress, including the 'built' environment, susceptibility genes, and the development of cardiovascular diseases. A second NIH-NIEHS funded program project involving six faculty addresses the role of gene-environment interactions and environmental asthma, a worsening world-wide health problem. Individual faculty are studying the interaction of environmental pollutants like ozone and particulate matter with airway irritability, genetic susceptibility to asthma, or vulnerability of lung development in children.

Center for Human Genetics: The Duke CHG is an international leader in the study of inherited disorders. The 18 faculty investigate genetic and environmental influences on human disease in a uniquely integrated research setting, collaborating closely with experts across Duke campus and world-wide. Many of the faculty have specialized training in genetic epidemiological and pure epidemiological expertise. Current efforts are underway in the CHG to understand the effects of genetics concomitantly with both social and built environmental effects as they contribute to risk for neurodevelopmental, psychiatric, respiratory, ocular, cardiovascular, and infectious diseases. In addition to applying methods to detect interactions between genes and the environment, there are

also active efforts within the CHG to develop statistical methods to detect such interactions. Methods development for gene-environment interactions is desperately needed with the explosion of molecular tools and data that are now available. Thus, a more formal infrastructure to examine the interface between the environment and health would expand and facilitate existing interests in this area that already exist in the CHG.

Department of Pharmacology and Cancer Biology: The departmental faculty interests include estrogenic compounds and their actions on gene expression, mechanisms of chemically-induced neurodegenerative disease and brain development, DNA damage and cell cycle control, uptake, distribution and detoxification of metals and signaling pathways under normal and chemically disrupted states.

Trinity College. Faculty in the Biology and Chemistry Departments study many processes that impinge on environmental and health sciences. These areas include ecology and the health of streams, development of embryos and the mechanisms by which organisms become environmentally influenced, i.e. potential birth defects, tissue wounding and repair, plant pathology and the genetics of systemic resistance. Other interests include systems analysis with a strong focus on gene regulatory networks that govern cell function. Modeling such networks is an emerging strength with the goal of predicting important regulatory functions that might be influenced by the environment, and be causal for disease states. Biology faculty are active in environmental and analytical chemistry, complementing the expertise in the Nicholas School. A Biology faculty member also directs the Center for Evolutionary Genomics, with an emphasis on combining knowledge from model and non-model systems.

Pratt School of Engineering. The Department of Civil and Environmental Engineering includes faculty relevant to this initiative, particularly in the contexts of drinking water and wastewater management (including the development of genomic methodologies), hydrology, air quality and global climate change, hazardous waste management, and transport and fate of and chemicals in the environment.

Sanford Institute of Public Policy. Several faculty members in the Sanford Institute have deep interests and well developed research programs focused on environmental regulatory policy in both the domestic and international arenas. In addition, the department has great research strength in sustainable development and international poverty issues.

School of Law. Duke's law school boasts great strength in environmental law and regulatory policy, with a particular emphasis on air quality issues, risk analysis, and environmental justice. Law school faculty members have been critical to the success of several interdisciplinary applications to the NIEHS focused on environment and health sciences.

These faculty have interests in environment and health sciences, but, in many ways, the full potential awaits the activation energy that would be provided by a university-wide initiative. Thus, in order for this initiative to succeed, additional faculty are required to achieve a critical mass. This is particularly true for the Nicholas School, where the difference in scale between relevant faculty in this unit and in DUMC is great and limits the breadth and depth of interactions possible. In addition, hires in DUMC, Trinity, and other professional schools specifically targeted to this initiative are required.

Currently a search is underway for a senior position in Environmental Health and Genomics. This search was motivated in part by the departure of David Schwartz, now Director of NIEHS. However, unlike Schwartz's position that was in the Department of Medicine, this position is anticipated to be supported jointly by Medicine, IGSP, and the Nicholas School. Clearly the outcome of this search has important implications for this initiative.

Potential additional research areas for positions targeted for this initiative include:

- Environmental Exposure Analysis/Molecular Epidemiology – employs state of the art analytical and/or genomic tools for determining exposures to stressors in humans, animal models, and/or free-living organisms, and linking exposures to adverse outcomes.

- Population Genetics/Genomics – employs molecular approaches to assess long-term, multi-generational effects of environmental stressors in terms of population genetics and diversity, adaptations, fitness costs and related evolutionary consequences of such exposures.

- Environmental Health Policy - a social scientist focused on interface between the environment and human health. This position readily fits with the NIEPS model for shared positions between the Nicholas School and other Duke units.

Environmental Molecular Biology – additional expertise to interface with gene-environment themes, with focus on neurobiology, development, or cancer, and using models applicable to both human and ecological health.

Aquatic/Estuarine Pollution Ecology/Ecotoxicology – studies stressors relevant to initiative, but focused at higher levels of organization, such as population dynamics, community structure and ecosystem function.

- Ecosystem Health and Disease- Assesses the effects that degradation of ecosystem processes, due to pollution or excessive perturbations, has on infectious diseases of natural populations within ecosystems, including transfers to human populations.

VI. Collaboration with Other Universities

The proximity of programs related to environment and human health at UNC, NCSU, and NCCU, as well as the USEPA and NIEHS situates this initiative in a rich context for growth and development – making our research programs more competitive for funding and our educational programs more attractive to the best students. However, this initiative explicitly interfacing environmental health and human health, and linking traditionally disparate academic units, is unique among these universities and other peer universities.

Appendix K. **Proposal for a Ph.D. Program in Coastal Systems Science & Policy**

I. Background & Rationale

This proposal describes a Ph.D. program within the Coastal Systems Science and Policy (CSSP) Division of the Nicholas School of the Environment and Earth Sciences. Faculty in the CSSP Division currently mentor students in three Ph.D. programs:

the Nicholas School's Ph.D. Program in the Environment
the University Program in Ecology (UPE)
the University Program in Integrated Toxicology (ITP)

The proposed CSSP Ph.D. program is intended to better serve graduate students studying marine biology and marine conservation biology and policy. It is intended to replace the Nicholas School's Ph.D. Program in the Environment as the academic home for most Ph.D. students whose advisors have primary appointments in the CSSP Division. It is also intended to complement, but not replace, the existing UPE and ITP programs. Thus, Ph.D. students working with CSSP faculty members will still have three potential programs to choose from, depending on their research interests and career goals. The proposed CSSP Ph.D. program is comprised of two tracks. The first track, similar to the current Ph.D. program in Environment, is in *Marine Biology*. Students entering this track will work in a variety of fields, including the ecology, biochemistry, physiology and behavior of marine plants and animals. This track will ensure that Duke continues to play a prominent national role in the training of future academic researchers working in the field of marine biology.

The second track is designed to meet the needs of a growing number of faculty and students working in *Marine Conservation Biology & Policy*. This track will take advantage of the newly formed Duke Center for Marine Conservation (<http://marcons.env.duke.edu/>). The recent reports of the Pew Oceans Commission (2003) and the U.S. Commission on Ocean Policy (2004) both point to the many problems facing marine ecosystems and call for a new level of integration among researchers and managers engaged in marine science and policy. We wish to build on the recognition of these issues by policy makers and to harness the rapidly increasing interest in this field from prospective Ph.D. students.

The combination of these two tracks will allow us to build on our emerging strengths in marine conservation while retaining our traditional strengths in marine biology. Furthermore, the establishment of a separate Ph.D. program in the CSSP Division will rationalize administrative responsibilities that are currently divided between the Durham and Beaufort campuses. The financial administrative work associated with Ph.D. students working with CSSP faculty members is already based in Beaufort; we seek to gain a degree of administrative independence for this program commensurate with the other responsibilities of the Division.

II. Relationship to Existing Programs

1. Programs at Duke

As noted above, the new Ph.D. program is intended to complement the existing UPE and ITP programs and to provide a new academic home for students working in the areas of marine biology and marine conservation biology and policy. At the present time four CSSP faculty members are actively involved in the UPE program and another three participate in the ITP program. We anticipate that our level of commitment to these two programs will continue unchanged.

Ph.D. students in the marine biology track will likely take advantage of the expertise and courses offered by the Biology Department in the Trinity School. Faculty members in Biology have long served on the supervisory committees of past and present Ph.D. students and we expect that this tradition will continue in the future. Many graduate level courses are cross-listed between Biology and the Nicholas School, reflecting the close relationship between these two academic units.

Some students accepted for the doctoral track in conservation biology and policy may require intensive training in economics, political science or another social science. Some of this expertise is available in the CSSP Division and elsewhere in the Nicholas School, but students in this track may also wish to take substantial course work elsewhere at Duke. In particular, students may take classes in the Departments of Economics, Political Science, or Public Policy Studies and the School of Law. Specific academic requirements will be established by the student's committee, as described below.

2. Programs at Other Institutions

We compete for Ph.D. students with several other excellent U.S. graduate programs in marine biology. Foremost amongst these are the Scripps Institute of Oceanography, UC Santa Barbara and Stanford University. In general, the Duke program is smaller than these other programs, both in terms of the number of participating faculty and number of students. Perhaps the closest parallel to the Duke program is found at the Hopkins Marine Station, a field station of Stanford University. The intimate mentoring and research experience offered at Duke University Marine Laboratory is one of the primary features that attracts Ph.D. students to study marine biology at Duke.

Duke is one of the international leaders in the emerging field of marine conservation biology & policy. Our primary competitor is the new program in marine biodiversity and conservation at Scripps. Both the proposed CSSP Ph.D. track and the Scripps program propose to train students to work directly at the interface of science and policy whilst, at the same time, ensuring a strong disciplinary training. The formalization of a CSSP track in marine conservation biology and policy will help us to compete more effectively with the Scripps program.

III. Resources Needed for the Program

No additional resources are required for the establishment of this Ph.D. program. The CSSP Division has all the resources required to administer the program and to support Ph.D. students. A Director of Graduate Studies in the CSSP Division currently administers the Ph.D. students in Environment who are advised by faculty members with primary appointments in CSSP. The work of the Director is facilitated by the part-time assistance of several administrative staff members resident in Beaufort.

Current CSSP Ph.D. students working in marine biology or marine conservation biology and policy are supported by research assistantships, teaching assistantships or endowed fellowships. We do not anticipate any change in the level or sources of support for Ph.D. students in the new CSSP Ph.D. program.

IV. Students

Faculty with primary appointments in the CSSP Division currently advise 28 Ph.D. students. Approximately five new students are admitted each year to provide a relatively even standing age distribution of students over the five-year course of the program. Of these students, eight are currently enrolled in the UPE program, two in the ITP program and the remaining students are in the Nicholas School's program in the Environment. We anticipate that these 18 students would participate in the proposed CSSP program, perhaps with one or two additional students who are currently enrolled in UPE.

There is a large demand for these programs from potential Ph.D. students. Despite dissuading the vast majority of potential applicants, we receive 30-40 applicants for a very small (2-3) number of positions each year, not including the applicants to the UPE and ITP programs. The pool of potential students is deep for both tracks in the proposed CSSP program. For example, during the fall of 2005 we received more than 60 enquiries in response to an advertisement for two Ph.D. students to work on a project to examine the by-catch of sea birds, sea turtles and marine mammals.

Most current Ph.D. students in the CSSP Division are U.S. citizens, although we also have students from Canada (5), Latin America (2), and the Caribbean (1). We would like to increase the diversity and international representation of our graduate student population by using the new Keohane Fellowships and external sources of support to achieve this goal.

Our past Ph.D. students have gone on to careers in academia, government and non-governmental agencies. We expect to see a continued strong demand for the graduates of this program.

V. Structure of the Program

Faculty

Participating faculty in both tracks will consist of members of the graduate faculty having appointments in the CSSP Division. Only faculty with primary appointments in the CSSP Division may chair Ph.D. student supervisory committees. Appointments of new graduate faculty will be made by the Dean of the Graduate school upon recommendation of the Director of Graduate Studies.

Admissions

At the time of application, students can chose to apply to either program track. Financial responsibility for all admitted students is the responsibility of the CSSP Division. Students must identify a potential faculty advisor prior to admission; admission is predicated on the approval of the faculty advisor. Therefore, student applicants will be strongly encouraged to contact potential faculty sponsors prior to submitting an application.

Program Description

Both Ph.D. tracks represent research-intensive degree programs. The information below is intended to supplement the requirements of the Graduate School

The basic requirements for both programs are prescribed by the Graduate School:

1. Payment of six semesters of full-time tuition
2. A supervisory committee that oversees the student's program of study
3. Preliminary examination
4. Completion of at least one academic year in residence
5. Training in the responsible conduct of research
6. Completion of a dissertation and presentation of a final seminar
7. Final Examination

Curriculum in Marine Biology

The PhD degree in Marine Biology is designed to prepare students for careers in university teaching and research. This degree program requires students to concentrate their study and research within a well-defined subject area. The academic requirements for this course of study will vary depending on the subject area, background of the student and availability of resources.

The curriculum of each student in the Ph.D. track in Marine Biology is determined by the students supervisory committee. Doctoral students in marine biology emphasize research as the major part of their degree programs. Consequently, there are no formal course

requirements in this program. Instead, the committee, chaired by the student's faculty advisor, will recommend required any required course work and help to shape the student's research program.

Doctoral students in Marine Biology typically spend one or two semesters taking graduate level classes on the Durham campus before moving to Beaufort to complete their research; however, residence in Durham is not a requirement.

Curriculum in Marine Conservation Biology & Policy

This PhD degree in marine conservation biology and policy is designed to ensure that students receive detailed training in a particular discipline of marine natural or social science, while at the same time are exposed to sufficient inter-disciplinary knowledge that they are able to synthesize information from both the social and natural sciences and apply that information to policy-making. Students in this curriculum will be prepared for careers either in university teaching or research, or outside of the university involving the application of science to policy-making.

Students enrolled in the Ph.D. track in Conservation Biology and Policy must complete two core courses offered by Program Faculty. The first course will introduce students to current concepts in Marine Conservation Biology and Policy. We envision this as an integrated course that will survey conservation biology, policy and law. This will be a graduate-level class, open to Ph.D. and masters students with a cap of 15. This course could be offered under the existing ENV 209.

The second course will be a small group case study format, in which faculty act as advisors to individual students or small groups of students. Advisors and students will meet on a weekly basis. The topics for student working groups in this course would be selected based on the intersection of faculty expertise and student interest. Potential topics would be introduced at the end of ENV 209.

Additional interdisciplinary competency will be ensured by requiring that students show competency in a second field relevant to the interdisciplinary aspects of their thesis research. This additional breadth would be identified by the student's advisory committee.

Building on the above requirements, the remainder of the curriculum for each student will be determined by the student's supervisory committee. Doctoral students in marine conservation biology and policy typically spend one or two semesters in Durham taking graduate level classes on the Durham campus before moving to Beaufort to conduct their research; however, residence in Durham is not a requirement.

Committee Membership

The committee should consist of at least three members of the Nicholas School and, typically, one representative from outside the Nicholas School, as approved by the

Graduate School. The requirement for three School faculty can be satisfied by committee members with primary, secondary, or adjunct appointments. Additional committee members can be appointed, but the committee should not exceed five individuals. Once formed, the committee should meet at least once a year to review the student's academic progress.

Certification

After appointment of the Ph.D. committee, a certification meeting is held, at which time the initial program of study is approved. This certification meeting should be held no later than the student's third semester, unless agreed to by the committee and approved by the Director of Graduate Studies.

Preliminary Examination

Each student must pass an oral preliminary examination that is intended to demonstrate the student's readiness to conduct original research. This exam should be taken no later than the student's fifth semester. At least one week prior to this examination, the student should provide each committee member with a brief (10 to 15 page) proposal, describing the research to be conducted. The proposal should be approved by the faculty advisor before it is distributed to the committee. The proposal should serve as the starting point for the oral exam, but the content of the exam is unrestricted. The oral examination is conducted by the entire supervisory committee; successful completion of the exam requires the affirmative vote of the committee chair (the student's supervisor) and not more than one negative vote. If the student fails the oral examination, the committee may recommend to the Graduate School that the student be offered a second examination, to be taken no sooner than three months after the date of the first exam. The vote of the committee at a second exam must be unanimous. Failure of the second exam terminates eligibility for further work on the Ph.D. degree. Upon successful completion of the exam, the student advances to Ph.D. candidacy. The committee may require separate written examinations, to be taken in addition to the oral examination.

Teaching Requirement

All Ph.D. students are expected to serve at least one semester as a teaching assistant, seminar leader or lecturer. Students who are supported by teaching assistantships will satisfy this requirement as part of their financial aid responsibilities. Other students must still fulfill this requirement.

Foreign Language Requirement

There is no formal requirement for proficiency in a foreign language. A student may be required to demonstrate such proficiency by their committee if it is required for their research program.

Dissertation

Each student must submit a dissertation, describing the results of original research and conforming to the requirements of the Graduate School. Each member of the supervisory committee should be given a draft of the dissertation at least one week prior to its submission to the Graduate School. The final copies of the dissertation must be submitted to the Graduate School one week prior to the final oral examination. It is the responsibility of the student to ensure that all appropriate forms are submitted to the Graduate School. A copy of the 'Guide for Preparation of Theses and Dissertations' is available from the Director of Graduate Studies.

Final Seminar

Each student is required to present a public seminar prior to their final examination. It is recommended that this seminar is scheduled on the same day as the Final Examination, to ensure that all committee members have an opportunity to see the results of the students research first-hand.

Final Examination

The final examination allows each Ph.D. student an opportunity to defend their dissertation at an oral examination conducted by their supervisory committee. The student should contact the Director of Graduate Studies to schedule this exam at least two weeks in advance of its proposed date. Successful defense of the dissertation requires the affirmative vote of the committee chair and not more than one negative vote. If the student fails the final examination, he or she may be permitted a re-examination, pursuant to the approval of the committee, the Director of Graduate Studies and the Dean of the Graduate School. The second examination may not be taken sooner than six months from the date of the first. Failure in the second examination bars the candidate from further work towards the Ph.D. degree.

Student Support

Financial support of Ph.D. students in these two tracks will be the responsibility of the CSSP Division. Students will be supported with teaching assistantships (with Divisional funds), research assistantships (with support from external grants), external fellowships (NSF, NIH, etc.) or by endowed fellowships. Students in their final year of study will be given priority for endowed fellowship support to facilitate completion of their dissertation. It is *expected* that students will complete their programs of study in *no more than five years*. Students who are supported by CSSP funds (teaching assistantships or endowed fellowships) will *not* continue to receive CSSP funding after their fifth year of study. Assignment of teaching assistantships and endowed fellowships will be made by the Director of Graduate Studies, following consultation with the Chair and faculty of the Division.

Administration

The Ph.D. tracks in Marine Science and Conservation Biology and Policy will be administered by the Director of Graduate Studies (DGS) for the CSSP Division, appointed by the Dean of the Graduate School. Administrative support to the Director of Graduate Studies will be provided by the CSSP Division. An executive committee, consisting of the DGS and one member from each track will serve as the admissions committee.



Appendix L. PROPOSAL FOR THE
DUKE ENVIRONMENTAL LAW & POLICY CLINIC

January 24, 2006

Introduction

Subject to the highest rate of population growth in the United States, the Southeast's natural environment is suffering loss of open space, watershed pollution, air pollution, biodiversity loss, and environmental health risks as never before. To address these challenges, the Duke Law School and Nicholas School of Environment & Earth Sciences propose to launch an interdisciplinary Environmental Law & Policy Clinic at Duke University. With a problem-solving focus, the Clinic's supervised students will work with clients on pressing environmental challenges in North Carolina and the Southeast. The Clinic will ensure greater environmental protection in the region and train the next generation of environmental leaders.

A Region Under Environmental Threat

The Southeast is blessed with a stunning range of natural treasures. From the green heights of the Appalachian and Smoky Mountains through rolling woodlands to the wide coastal plains, broad estuaries, and famed barrier islands, the Southeast's environmental richness is a fundamental part of the region's identity. Indeed, the Southeast boasts the most extensive river systems and the greatest biological diversity of any region in the country. These attractive natural features, however, have played a large part in making it the country's fastest growing region. The unrelenting scale of development in recent years has placed the natural environment in the Southeast and North Carolina, in particular, under unprecedented pressures. The current threats to the environment are daunting, as the brief descriptions below make clear.

Loss of open space

Well over one million acres of North Carolina forests have been lost since 1990, primarily from urban sprawl. Half of the state's original wetlands have been lost to development and conversion to cropland. Ninety percent of its mountain marshes have been lost since 1982. The story is the same throughout the Southeast, where more timber is cut and the rate of wetlands loss is greater than anywhere else in the country.

Watershed pollution

Since 1991, North Carolina has been the fastest growing hog producer in the country. Manure from the state's over 10 million hogs contributes directly to the excessive nutrients and algal blooms suffered in the state's river systems. In 2003 alone, there were 43 major fish kills in the state, resulting in over 3.6 million dead fish.

Air pollution

Nearly one-third of North Carolina's counties exceed the legal ozone standards. The region's two great national parks – the Great Smoky Mountains and the Shenandoah – are also the two most polluted in the nation. In the summer months, vistas from overlooks in the Great Smoky Mountains that can reach a spectacular 100 miles on clear days more often dissolve into haze within 15 miles.

Loss of biodiversity

The Southeastern river systems are the most diverse temperate aquatic ecosystems in the world. Half of North America's fishes and 40% of its aquatic insects reside in the region. Eight of the 21 most endangered ecosystems in the U.S. are located in North Carolina. Yet, in a recent national assessment, seven Southeastern states' ecosystems were classified in the "extreme risk" category.

Environmental health risks

Largely as a result of coal-fired power plant emissions, mercury levels are rising throughout eastern North Carolina. Ten of North Carolina's waterways regularly post fish consumption warnings. From 1995 to 2002, over 27,500 North Carolinians showed elevated levels of lead in their blood. Roughly 17% of children in North Carolina suffer from asthma, and up to 17% more suffer asthma symptoms yet are not diagnosed by physicians.

Population growth in the Southeast is expected to increase significantly through 2020, adding two million people, a 26% increase in North Carolina alone. This cannot help but further drive the already accelerating rate of development in the region.

The Promise of an Environmental Law & Policy Clinic at Duke

Global Expertise

Duke University is one of the strongest academic centers for environmental law, policy and science in the world. The Nicholas School of Environment & Earth Sciences has become perhaps the nation's very best professional and graduate school of the environment, with distinguished faculty across the range of environmental fields. Faculty expertise ranges from environmental economics, policy analysis and decision analysis to environmental toxicology, coastal ecology, conservation biology and hydrology. The Marine Lab in Beaufort has a global reputation for marine conservation. Duke Law School now has three of the country's top scholars in environmental law, as well as faculty in related areas such as property and land use, products liability and mass litigation, and animal rights. And Duke has just launched the Nicholas Institute for Environmental Policy Solutions, linking the Nicholas School, Law School, and other Duke faculty across campus.

Training Tomorrow's Environmental Leaders

There is a changing of the guard under way in the environmental field. The leaders who shaped much of environmental law over the last 35 years are changing their roles in the organizations they founded and guided. As the new generation of environmental advocates steps into leadership positions, it drives home a fundamental justification for the Duke Environmental Law & Policy Clinic. If we care about *long term* environmental protection, then far more important than cases filed today will be the lawyers, scientists and policy analysts that we train and who will be well prepared when they become tomorrow's leaders.

Many students attend Duke specifically because of its depth and breadth in environmental law and policy. Enrollment in the basic Environmental Law course has grown in recent years, with up to half of the students cross-registered from the Nicholas School. The student Environmental Law Society has grown apace, and the interdisciplinary *Duke Environmental Law & Policy Forum*, the journal founded in 1991, publishes two issues and holds a major conference each year. The joint-degree program between the Law School and the Nicholas School boasts more students than at any other top school in the nation. Graduates of Duke have gone on to distinguished careers in private law firms, businesses, research organizations, nonprofits, and government agencies.

Environmental problem solving is necessarily interdisciplinary. Meaningfully addressing environmental issues requires legal skills, scientific knowledge, and policy expertise. With the increasing influence of globalization on environmental impacts both at home and abroad, environmental professionals can no longer focus only within our borders. There is a growing demand for graduates who combine a broad array of skills. Duke does very well in providing educational opportunities in law, science, and policy that are both theoretically sound and practically based, but it can become even stronger – indeed, unique – by fostering interdisciplinary problem-solving experiences where students from different schools work

together to solve real-world problems. The most effective way to do so is through well-developed experiential learning in a clinic setting.

In the Clinic, students will apply scientific skills – collecting and assessing data, performing and critiquing quantitative methods, effectively presenting their findings – and develop legal skills such as counseling, negotiation, legal reasoning, and brief writing. Beyond strengthening environmental protection in the Southeast, there are three important educational benefits from the proposed Clinic. First, the work of the Clinic will enable students to integrate the law and other disciplines, and to develop various practical skills that are not learned in traditional forms of classroom instruction. Second, contributing to solutions of serious environmental problems will provide a sense of purpose to students, who sometimes feel caught in an irrelevant, academic bubble, and thus motivate them and help them focus their attention on the goals they had when they entered law school. Third, hands-on education in environmental issues will help to instill in students a commitment to these issues as they develop as professionals, thus increasing the number of lawyers who work on these issues and also strengthening the public voice on environmental issues.

Duke Law School has long been committed to community engagement, leadership, and teaching students through practical experience. It opened one of the country's first law school clinics in 1931, the Duke Legal Aid Clinic. The Death Penalty Clinic was created in 1995, the AIDS Legal Assistance Project in 1996. Since then, the Law School has created additional clinics in the areas of international human rights, wrongful convictions, children's education law, community economic development law, low-income taxpayer appeals assistance, and animal law.

The Clinic's Design

Uniquely Interdisciplinary

The Duke Environmental Law & Policy Clinic will be interdisciplinary, involving students from both the Law School and Nicholas School, as well as students occasionally from the Sanford Institute of Public Policy and other units on campus. Through actual cases involving both legal and technical issues, students from different disciplines will work together, employing their respective skills in law, policy and science, to craft a significant work product that addresses their clients' needs.

The importance of an interdisciplinary approach for the Environmental Law & Policy Clinic may seem self-evident, given the importance of science, law and policy in successfully understanding and resolving environmental disputes and given Duke's environmental strengths across the University. But such a Law School/Environment School clinic with a full-time staff and independent litigation capacities would be unique among American universities.

Problem-Solving

The Duke Environmental Law & Policy Clinic will litigate when appropriate while recognizing that lawsuits are not the only way to help clients resolve issues. In some cases, solutions lie in getting parties around the table early enough to build trust and reciprocity, and engaging contributions from scientists, social scientists, and other experts to help analyze the

problem and identify creative new options. Duke's Environmental Law & Policy Clinic will be a client-based problem-solver, using a variety of research, advocacy, and negotiation tools.

Nicholas School students will develop their skills in scientific analysis, conflict resolution and participatory processes. Law students will enhance their training as transaction-designers, diplomats, and entrepreneurs, as well as litigators. Such a multi-skill approach will offer greater service to clients and more diverse training to students.

When the best interests of a client call for litigation, students from both law and environmental backgrounds will work together to develop their case planning, client counseling, negotiation, brief drafting, scientific analysis and advocacy skills. The goal is for students to learn that they can represent a party and also act as problem-solving facilitators by providing credible data analysis, creative policy solutions, and rigorous legal analysis. Thus students in the Clinic, under faculty supervision, will also participate in non-litigation settings, whether participating in administrative hearings (such as before regulatory agencies, city councils or zoning boards), helping local groups prepare responses to initiatives on land use issues or legislation affecting client interests, or researching the scientific and legal issues implicated in specific disputes. Open space protection is becoming increasingly important, for example, and the Clinic will assist local and regional land trusts in development of land protection measures and transactions. This approach to problem-solving seeks to provide under-represented environmental constituencies the sort of representation that better funded interests routinely receive

Local Problems – Local Solutions

The Clinic will focus primarily on local and regional conflicts because this is where it has the most to offer, both to students learning to be problem-solvers and to the community. At the same time, local problems are often manifestations of environmental conflicts with national and international scope. Where this is the case, the new Nicholas Institute for Environmental Policy Solutions, which will address national to international scale issues, will nicely complement the work of the Clinic. For example, the Nicholas Institute might be working on national policies for coastal zone management, while a client of the Clinic might be a North Carolina coastal community concerned about land management plans that threaten local ecology.

There is a great need for expert support and for creative problem-solving to address local environmental problems. The latent demand for the kinds of services the Clinic will offer is readily apparent, as we have learned from speaking with local environmental organizations. No other Carolina universities offer an environmental law and policy clinic. The local offices of the Southern Environmental Law Center (SELC) and Environmental Defense provide excellent advocacy services in the region, but SELC has ten attorneys in North Carolina and Environmental Defense only one. Given the continuing development in the Southeast and scope of environmental problems, far more requests for assistance are expected than these groups or the Clinic will be able to provide. Potential clients include local Riverkeepers such as the Neuse River Foundation and the many community groups affiliated with Duke's Children's Environmental Health Clinic. The Clinic will work to build close relationships and generate referrals from the Natural Resources Defense Council's offices in Washington and New York, the local office of the SELC and Environmental Defense, local environmental groups and the North Carolina Bar Association's Section on Environmental Law (which includes many Duke alumni).

Cost-Effective

While a primary motivation for creating the Duke Environmental Law & Policy Clinic is educational – providing the very best training for future environmental leaders – the clinic will also provide highly cost effective results. It will be able to harness a unique combination of expertise directed at solving local problems at low cost by leveraging student resources and by taking advantage of Duke’s technical strengths in areas as diverse as wetlands ecology, forest management, and toxic substances.

Clinic Staffing and Budget

We anticipate that the Clinic will be located alongside the other clinics on the first floor of the Law School’s new wing. Once the new building for the Nicholas School and the Nicholas Institute is completed, it will move to that building. Jointly directed by the Law School and Nicholas School, the Clinic will be directed by a licensed attorney who has handled a range of environmental disputes in court and through negotiation. The Clinic Director will have three responsibilities: (1) identifying clients and issues to address (subject to board approval); (2) supervising teams of Duke students who, with advice and support from Duke faculty, will provide rigorous science, legal, and policy analysis to support Clinic cases; and (3) teaching problem-solving skills to these students. Depending on resources, it is intended that an additional instructor would be hired to train a greater number of students in the Clinic. The Clinic would follow the format of Duke’s existing clinical offerings, comprising 4-5 credit hours per semester and requiring 100 hours of clinical work. We also anticipate periodic seminar sessions with leading environmental advocates.

The advisory board will be chaired by the Duke Law alumnus and co-founder of NRDC, John Adams, with permanent membership of the Dean of the Nicholas School, the Dean of the Law School, and the Director of the Nicholas Institute. The board will also include members from Duke and from the broader community. Based on clinical programs at other schools, we anticipate that the Clinic’s annual support costs (assuming two full-time attorneys, staff, rent, equipment, consultants, insurance) will total approximately \$300,000.