GRADUATE PROGRAM OF HYDROLOGIC SCIENCES SELF STUDY

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EXECUTIVE SUMMARY

The Interdisciplinary Graduate Program in Hydrologic Sciences (HSP) is one of the best and most successful graduate programs at UNR. The HSP currently has 78 full time graduate students seeking degrees in Hydrology and Hydrogeology. The HSP is the largest graduate program, both in terms of student numbers and participating graduate faculty (66), on the UNR campus in the sciences and engineering.

The HSP is ranked 8th in the nation by the U.S. News and World Report, tied with M.I.T. and the University of Illinois, Champaign-Urbana. This tradition of excellence goes back forty years, to the beginning of the program. Since that time, the program has graduated 316 M.S. students, and 75 Ph.D. students. The HSP is responsible for 6% of the total number of Ph.D. awarded by UNR since 1961, the year of the first PhD. granted.

As a program, we have an enviable record, yet we are not satisfied, because we know we can be better. In 2001, the HSP set as a goal in its 2001 Strategic Plan to be counted among the top four programs in hydrologic science in the nation. The strategy for this goal was to form a Department of Hydrologic Sciences, encompassing both the undergraduate programs spread across the campus, and the graduate programs currently administered by the Hydrologic Sciences Program. This goal was supported by a significant majority of the HSP faculty. The goal was reiterated in the 2003 Strategic Plan, along with an intermediate set of goals designed to strengthen the teaching components. The need for a department was, and remains, clearly defined by the limitations of the academic structure to allow for the growth and improvement that we see as both necessary and possible at UNR.

The current academic structure of HSP is relatively simple but has led to difficulties in implementation:

- The HSP is responsible for the curriculum, degrees and students
- The departments are responsible for the faculty and the courses

To elaborate: the HSP faculty has control over which students are admitted to the program, they create the curriculum (from existing courses in existing departments) for the HSP students, and it is the Director and HSP faculty who approve theses and dissertations. No faculty lines are connected directly to the HSP, but faculty reside within individual departments, the Desert Research Institute and the USGS. This means that departments and DRI are responsible and have the most input into new faculty hires, rather than the HSP. Although HSP faculty obviously have considerable control over the courses they offer, these courses must be approved, and meet the needs, of their individual departments, which may not have the same focus as that needed by the HSP.

This structure has allowed the Hydrologic Sciences Graduate Program to reach national status, but it has been relatively stagnated there for the last decade. The majority of its nationally recognized faculty are full professors, with insufficient infusion of "young Turks" in Hydrology at UNR. The most significant growth of young faculty has been from outside UNR; through DRI and the U.S. Geological Survey along with support from the NRES department via the replacement of one position (L. Saito) and the addition of a new aquatic ecologist (S. Chandra) in NRES. Geological Sciences added 0.5 FTE faculty (Tyler) in 2000.

In 2003, the HSP revised its Strategic Plan to include a second, less ambitious and interim plan designed to provide new faculty to develop growth in critical and emerging areas of hydrologic sciences. While a majority of faculty support the formation of a new Department of Hydrologic Sciences, there was unanimous support for the interim plan if a department could not be formed. The components of this plan are listed below:

a) Allocate three new FTE to be used by the program and allow the Director and HSP Faculty to partner with departments to jointly build strength. These positions would be shared with departments/units to build both HSP and departmental strengths in for course content and research expertise.
b) Increase the FTE from 0.25 to 0.50 for the Program Director to better reflect the amount of time that it takes to direct this very large and complex program.
c) Permanently increase to $120K the amount of money available for teaching by DRI faculty and other outside faculty and include COLA and merit yearly.
d) Develop and implement an administrative structure for interdisciplinary programs that allows for their formal participation in the allocation of faculty hires and replacement.

As of this writing, the UNR administration and the University Planning Council (UPC) has chosen not to develop a Department of Hydrology. There has been some progress however in recent months as the UNR administration has approved a new position to serve as Director of the HSP. The national search has been initiated for a new HSP Director and with the planned inclusion of the HSP within UNR's Academy for the Environment, the structure for a more formal participation of the HSP in new faculty hires within departments may be realized.

A complete copy of the 2003 HSP Strategic Plan is contained in Appendix A

THE PATH FORWARD

The HSP expects to continue to be a vital and strong graduate program on the UNR campus. In its current form however, the HSP cannot proactively respond, due to its current administrative structure, to changes in the discipline or faculty departures. Rather, the HSP reacts and fills expertise and experience in an ad hoc manner. It has been primarily for this reason that the HSP has focused its strategic plan on the formation of a department. Secondarily, the formation of a department would allow the effective coordination and marketing of undergraduate degrees in watershed science and

hydrogeology. Thirdly, the formation of a department would allow for more effective and cohesive student and faculty office space.

Competition for top quality applicants will also significantly increase as regional programs such as UC-Merced, Oregon State University, Colorado School of Mines and Utah State University ramp up their water resources programs. Already UNR faces strong competition for graduate students from such top schools as the University of Arizona, New Mexico Tech, UC-Davis and others. With additional western universities developing strong water resource programs, we are likely see a decline in student acceptance of research and teaching assistantships unless the HSP's visibility is increased.

While the HSP is likely to retain the formation of a Department as its long term goal, it is unlikely to occur in the short term. Rather, the HSP will now be a part of, and managed under, the new Academy of the Environment. The integration of HSP under the Academy of the Environment is designed to improve the process of hiring new faculty positions aligned with both department and HSP needs. It is also designed to more effectively integrate and utilize DRI faculty for teaching and advising. The Academy will have advisory input to the university Provost for new and replacement faculty positions and the HSP hopes that this will lead to more focused hires in the areas of hydrology and water resources. However, no faculty positions will be allocated to or through the new Academy for the Environment.

The HSP identified in 2003, three areas of expertise needed for new faculty in the next five (5) years. These are: Watershed Modeling, Groundwater Remediation and an Alpine/Snow Hydrologist. Of these three positions, only the Alpine/Snow Hydrologist position is supported in Departmental strategic plans (NRES Department, medium priority hire). In 2004, several key faculty have or are planning to leave the HSP and the current Director will be stepping down to assume new duties at UNR. A national search has just begun for a new director of the HSP. It is hoped that the External Review process will assist the HSP in critiquing the existing position requests and providing guidance for the future.

Additionally, the HSP identified in 2003, several key recommendations related to curriculum, space and recruiting. Some of these recommendations have either been acted upon, or external boundary conditions have negated their appropriateness. These have been deleted from this self study. Those that remain are summarized below:

- Development of joint appointments with DRI faculty to insure continuity in teaching.
- Development of funding and teaching arrangements with the U.S. Geological Survey, both through the Carson City District Office and the Minerals Research

Branch co-located on the UNR campus. Addition of $10K/year for the next 2 years for short course offerings through the USGS.

- Procurement of office space for US Geological Survey faculty to use for co-location, during time spent at UNR, or during teaching times.
- Short term review of curriculum and course offering schedules with the goal to more evenly distribute core and 700 level hydrology-related courses in the fall and spring semesters. Specific proposals include moving one of the four core courses to a spring rotation.
- Review of the system of thesis, dissertation, comprehensive examination and professional paper courses, with the possibility of developing these courses as Hydrologic Science courses, to support those faculty in which no such course exists in their home department.
- Development of an undergraduate major in Watershed Science. This is currently under study in the NRES Department and is fully supported by the HSP.
- Curriculum review of the existing Hydrogeology undergraduate degree and consideration of upgrade to Engineering ABET accreditation, i.e. produce a hydrogeology undergraduate capable of becoming a registered engineer.
- Consideration of consolidation of both of these degrees under a single Department of Hydrologic Sciences. This would be the optimal arrangement for the long term success and growth of hydrologic sciences on the UNR campus.
- Continued discussions with departments interested in water policy and water economics. The Hydrologic Sciences Program initiated discussions with the Dept. of Applied Economics over a new focus in water resources economics, but the department has now proposed a separate doctoral program in Resource Economics. Further discussions should also include the Department of Geography and the University of Nevada, Las Vegas.
- Development of joint course offerings between Atmospheric Sciences and Hydrologic Sciences Graduate Programs.
- Addition of 2 new graduate student offices immediately and one per year for the next 3 years to meet existing needs and hoped for growth.
- Development of a Hydrology student resource and communication space in LMR 160. Remodeling of this space into student offices and a student resource center will allow students to work more closely together. Some work has proceeded in this area, although this space was almost lost to hydrology in December 2003.
- Development of dedicated teaching laboratory space for subsurface hydrology, including soils, vadose zone hydrology and ground water hydrology.
- Equipment needed for the future includes; boat and trailer, geophysical equipment, dedicated computer lab**.**
- Development of an international internship program with student and faculty exchanges and a continued strengthening of the existing intern programs with

Washoe County. Exchange of UNR/UNLV faculty for 1 semester course offerings and guest lectures or the addition of videoconferencing courses. Formalization of the Director's release time at 0.5 FTE, from the current 0.25 FTE.

Other activities that have come to light since the 2003 Strategic Plan include:

- Review and revision of Program By Laws.
- Search committee formation for new Program Director faculty position

1. PROGRAM OVERVIEW

1.1 PROGRAM HISTORY

The Graduate Program of Hydrologic Sciences (HSP) was founded in the early 1960s on the UNR campus to train graduate students in the study of hydrogeology and surface water hydrology. The Program has graduated 304 MS and 71 Doctoral students. Since 1961, the year of the first doctoral degree granted at UNR, the Program has been responsible for over 6% of the total number of doctoral degrees at UNR. With 75 full time students enrolled in 2004, the HSP is the largest graduate program in the Sciences and Engineering on the UNR campus. A historical perspective of the program is well summarized by Dr. Stephen Wheatcraft's recent article the student publication, the *Aqua Clara* and is provided in Appendix E.

The Graduate Program of Hydrologic Sciences is one of only two graduate programs on the UNR campus nationally ranked by *U.S. News and World Report*. Based upon the most recent analysis for the discipline of Hydrogeology, the program is tied for 8th along with MIT and the Univ. of Illinois. No ranking category is available for the more general area of Hydrology, however of the schools ranked in Hydrogeology, our program, along with the University of Arizona (ranked #1), Stanford (#2) and MIT (8th) are the only programs to offer comprehensive programs in both ground and surface water hydrology. Table 1 shows the most recent ranking (1999) from *U.S. News and World Report*.

Ranking	University
1	University of Arizona
2	Stanford University
3	University of Wisconsin–Madison
4	New Mexico Institute of Mining and Technology
5	Penn State University–University Park
6	University of Texas–Austin
7	University of Minnesota–Twin Cities
8	University of Nevada–Reno
8	Massachusetts Institute of Technology
8	University of Illinois–Urbana-Champaign

Table 1. Current ranking of Hydrogeology programs nationwide from 1999 survey.

Currently, there are 78 full time graduate students enrolled in HSP, with 48 Masters students and 30 doctoral candidates. There are 65 faculty on the graduate faculty of HSP, with 42 of those faculty actively advising one or more graduate students within the last year. HSP is the largest graduate degree program at UNR in the sciences or engineering, both in terms of student numbers as well as faculty participation

The HSP consistently attracts the highest caliber graduate student applicant pool at UNR due to its reputation. HSP routinely has a fall applicant pool of 45-75 students. Over 85% of HSP students received their undergraduate degrees from outside of Nevada. The HSP has been very successful in recruiting students from eastern U.S. universities and also routinely competes for the same students as those universities listed in Table 1.

1.2 PROGRAM MISSION AND OBJECTIVES

The Graduate Program of Hydrologic Sciences (HS) is a multi-disciplinary program created to train graduate students, in the diverse field of surface and subsurface aqueous environments. This diversity includes the study of aqueous geochemistry, contaminant transport (surface and subsurface), global climatic change, groundwater hydraulics, plant/water interactions, remote sensing, soil physics, rock physics, water and environmental policy, surface water hydrology, and water resources engineering. The curriculum is designed to guarantee a breadth of experience through a shared foundation core, while leaving ample time for concentration in either Hydrology or Hydrogeology.

The fundamental objectives of the Hydrologic Sciences Graduate Program are simple:

- To produce the highest quality Masters students for professional employment in the private/public sector, and
- To train the highest quality doctoral students for academia and the public/private sector.

The future goals of the program were articulated in its 2003 Strategic Plan as:

- To elevate our national standing to be recognized as one of the top 4 Hydrology Programs in the United States.
- To develop a coherent and viable undergraduate program in the areas of watershed science and hydrogeology.
- To increase collaboration with the related disciplines of Resource Economics, Geography, Environmental Science, Civil/Environmental Engineering, Atmospheric Sciences, and Biology, DRI, the USGS and the Univ. of Nevada, Las Vegas.

1.2 ADMINISTRATIVE STRUCTURE

The program is interdisciplinary, with faculty from:

- the College of Agriculture, Biotechnology and Natural Resources,
- the College of Science (Mackay School of Earth Science and Engineering and the Science Departments),
- the College of Engineering,

- the Desert Research Institute and
- the U.S. Geological Survey.

Faculty are elected to the HSP Graduate Faculty by a vote of the existing faculty. As of February 2005, the HSP has 42 graduate faculty core members (those faculty actively advising students or having advised a student within the last year) and an additional 24 cooperating faculty, making it the largest interdisciplinary graduate faculty on the UNR campus. Core faculty are defined as faculty who are or have advised a student in the last year; cooperating faculty have not but wish to participate in the Program.

HSP offers MS and doctoral degrees in 1) Hydrogeology and 2) Hydrology. The degrees and requirements for degrees are designed by the faculty of the HSP and must meet or exceed those required by the Graduate School. The HSP is responsible for admissions requirements, applicant review and student orientation. The Program has a director (stated but not codified in the director's contract documents at 0.25 FTE) and a full time program administrative secretary. The Director receives an $8,000/year stipend.

The Program provides access to Doctoral students for faculty in the following departments where no Ph.D. program is available: Natural Resources and Environmental Science (NRES), Biology, Applied Economics and Statistics, Nevada Bureau of Mines and Geology, the Desert Research Institute and Mathematics.

The HSP historically was administered via line management through the Center for Environmental Science and Engineering (CESE) and on to the Dean of the Graduate School. As of September 2004, the HSP director reports through the newly formed Academy of the Environment. As of this writing, the administrative responsibilities of the Academy of the Environment and the Graduate School have not yet been clearly defined. Appendix B contains the Academy of the Environment's approved proposal and those sections pertaining directly to the HSP have been highlighted. As will be noted, there are ambiguities in the text regarding management of HSP by the Academy, but it is the intention of the university administration that the HSP and other interdisciplinary graduate programs will report through the Academy.

Internal management of the HSP is primarily the responsibility of the Program Director who is, in turn, supported by a Program Administrative secretary. Over the past decade, the Program Directors have generally relied upon ad-hoc committees for all major issues such as curriculum, examination procedures, and course offerings. Reliance on ad-hoc committees results from the interdisciplinary nature of the program and the competition for faculty time between departmental committees (where merit and annual evaluation is conducted). The Director assigns a small faculty group to examine an issue, and report back to the entire faculty at a faculty meeting and/or by electronic voting. The committee structure is open to all faculty with the intention to develop a sense of "ownership" of the program by the faculty. With the exception of student admissions issues, one or more student representatives are always assigned to these committees.

Over the past 3 years the HSP has used this process successfully for

- updating the Hydrology curriculum,

- refining the mathematics prerequisites and required math courses,
- developing a doctoral qualifying examination procedure and
- developing two strategic plans (2001 and 2003).

1.3 HSP/DEPARTMENTAL/UNIT STRUCTURE

The HSP relies upon the cooperation of departments and units for its entire academic program This includes course offerings, student advising and student office space. The primary support from departments is course offerings, student advising and student office space. The majority of graduate course are offered from the Geological Sciences Department, the NRES department and the Civil and Environmental Engineering Dept. Students take thesis and dissertation credits from their advisors department, with students advised by DRI faculty historically taking these credits from Geological Sciences. The breakdown of advising by unit is: DRI (34), NRES (22) Geological Sciences (11), USGS (4), Applied Economics (2), and CEE, Nevada Bureau of Mines and Geology, Geography and Mathematics each with one student. A complete listing of Departments and Units participating in the HSP is provided in Appendix C.

Assuming a 15 credit load per year, the 75 HSP students currently generate 1,155 student credit hours for the University. HSP student advising is considered in department faculty evaluation identical to those students following departmentally based degrees. However HSP students are not tallied within their advisor's department at the college level (One of the HSP Graduate Director's principal responsibilities is to council departments in the area of course offerings and to insure, through negotiation, that courses critical to the HSP students are offered on a regular , predictable and non-overlapping schedule. The Director has been successful in reducing course scheduling conflicts in recent years, and has moved some specialty courses to balance spring and fall offerings. However, the Director has no authority to assign course offerings by UNR faculty. Currently, the a majority of courses are offered during Fall semesters. In spite of efforts to balance course offerings between Fall and Spring, this remains an issue. The Director is exploring the option of offering at least one of the 4 core courses to the Spring semester.

Since the HSP does not have any course prefix available to it, the Program Director also negotiates with department chairs the offering of courses taught by DRI faculty and other HSP funded specialty courses. Desert Research Institute faculty and members of the community routinely teach graduate level courses on the UNR campus and HSP traditionally offers most of these courses through the Department of Geological Sciences and Engineering. The majority courses are specialized 700-level courses designed to fill specific needs. Nine courses are on a regular rotation and listed below by semester offered. Additional "one-time" courses have been offered when funding and interest are available. The rotation and course offerings supported by HSP funds are given in Table 2a and 2b. below:

DRI TEACHING ASSIGNMENTS-Even Years			
Course #	Title	Semester	Instructor
GEOL 641	Process Geomorph	Fall 2004	Bullard
GEOl 786	Isotope Hydrology	Fall	Thomas
NRES/GEOL 614	Hydrologic Fluid Dyn.	Fall	Warwick
ERS 701D/GEOL 702Z	Field Methods in Hydro	Spring 2005	Susfalk (0.5)
GEOL 781	Advanced Surface Water Hydrology	Spring	Boyle
GEOL 785	GW Modeling	Spring	Pohll
GEOL 702S	Remediation Tech.	Spring	Jacobson (0.8)
GEOL 702S	Remediation Tech.	Spring	Dellebarre (0.2)
GEOL 702S	Water Supplies in Dev. Countries	Spring	Fitzgerald/Tyler

Table 2a. DRI course offerings for even years, such as Fall 2004 and Spring 2005.

DRI TEACHING ASSIGNMENTS- Odd Years			
Course #	Title	Semester	Instructor
GEOL 641	Process Geomorph	Fall 2005	Bullard (0.5)*
NRES/GEOL 614	Hydrologic Fluid Dyn	Fall	Warwick
GEOL 702J	Stochastic Hydrology	Fall	Pohll
GEOL 702J	Adv. Fluvial Geomorph	spring	Bullard/Adams
ERS 701D/GEOL 702Z	Field Methods in Hydro	Spring	Susfalk
GEOL 781	Advanced Surface Water Hydrology	Spring	Boyle
GEOL 785	GW Modeling	Spring	Pohll
GEOL 702S	Water Supplies in Dev. Countries	Spring	Fitzgerald/Tyler

Table 2b. DRI course offerings for those academic years starting with an even year such as Fall 2004 and Spring 2005

The HSP returns the support from the departments and units in several ways: Teaching Assistantships, FTE generation, bridge funding for students, access to outstanding student applicants as well as a sense of "home" for the students spread across the campus., The program supplies to the Dept. of Geological Sciences and Engineering two (2) teaching assistants (for Introductory Groundwater and Environmental Geochemistry) and one (1) teaching assistant to a course cross-listed between Natural Resources and Environmental and Geological Sciences (Hydrologic Fluid Dynamics). A fourth TA is now provided to NRES for NRES 482/682, Small Watershed Hydrology. These TA positions are used yearly as recruiting tools. The assistantships require only one semester of Teaching Assistant duties, with the second semester and summer funding to be used by the student to work with his/her advisor to develop or augment a research project leading to a thesis or dissertation. HSP currently has funding for up to 5 TA's and uses the fifth position for bridge funding or support to faculty who may not have assistantships available at the beginning of the semester.

2.0 GRADUATE COURSES AND DEGREE PROGRAMS.

2.1 GRADUATE PROGRAM ORGANIZATION, OBJECTIVES AND EFFECTIVENESS

2.1.1 Research and Societal Needs

HSP began and maintained a focus in hydrogeology through the early 1990's, coincident with a societal focus of ground water availability and ground water pollution. HSP maintains a strong faculty base in traditional ground water hydrology studies, but is relatively weak in the areas of ground water remediation technology when compared to other nationally recognized programs.

Beginning in the 1990's, the discipline of hydrology has expanded significantly to include surface water and ecologically orientated issues, such as those found in the restoration of Lake Tahoe, and the role of climate change on water resources and water economics and policy. Faculty expertise has grown somewhat in these areas through one hire each in NRES, Geography and Civil Engineering since the mid 1990's. The Hydrology curriculum requirements have been recently revised to produce a student with more skill sets in the area of surface water modeling, water quality assessment and watershed restoration.

The majority (63%) of HSP students enrolled are following the Hydrology degrees, 28% are pursuing Hydrogeology degrees. The remaining 8% are legacy students and remain enrolled in the Hydrology/Hydrogeology track. This represents a significant shift from hydrogeology in enrollment from the last several decades and indicates that students are adjusting to pressing societal needs. However, the HSP faculty distribution remains weighted more towards groundwater hydrology at this time.

2.2. DEGREE OVERVIEWS

The Graduate Program of Hydrologic Sciences administers two separate degrees (Hydrology and Hydrogeology) at both the M.S. and Ph.D. levels. There is a single, required, foundation core for both Masters and doctoral candidates that includes a one-semester credit hour seminar along with one course each in groundwater, hydrologic fluid dynamics, and environmental chemistry. Beyond this foundation core, each degree has separate and additional required coursework. A grade of B- or better is required for each of these classes and these classes can only be retaken once. The core courses are listed below:

NRES/GEOL 614	**HYDROLOGIC FLUID DYNAMICS (3)+**
GE 684	**GROUND WATER HYDROLOGY (3)**
GEOL 616	**ENVIRONMENTAL GEOCHEMISTRY (3)**
GEOL/ERS 782	**HYDROLOGY/HYDROGEOLOGY SEMINAR (1)**

A non-thesis Masters option is available in both Hydrology and Hydrogeology and is an appropriate alternative for those students with significant experience in project management and report writing, while maintaining the high standards of a Masters of Science Degree. The non-thesis option is generally considered a terminal degree and is not recommended for those students planning to complete a Doctoral degree. The Professional Paper (2 credits) should demonstrate the student's ability to integrate technical state-of-the-art knowledge into a document suitable for professional review and publication. Topics may be of an applied nature and must be approved by the student's Graduate Committee. A ready-to-submit manuscript must be approved by the major advisor prior to the final defense.

Masters students must pass a qualifying examination to complete their programs. This consists of a proposal presentation and a public defense. Doctoral candidates are required to pass a three part qualifying examination, a comprehensive examination and a public dissertation defense. These examination requirements are summarized in Appendix D.

2.2.1 Master of Science in Hydrology (31 credits Plan A, 32 credits Plan B)

The Master's of Science in Hydrology degree allows flexibility to allow students to follow one or more of the broad areas of surface water hydrology and to allow for specialization. Additional requirements for the degree include a course in watershed hydrology to provide an overview/introduction of surface water processes and one or more specialization courses in surface water hydrology. The Master's of Science in Hydrology degree allows flexibility for students to follow one of two areas of emphasis in surface water hydrology (Hydraulics/Geomorphology or Hydroecology/Water Quality) or to design their own area of emphasis from the available coursework.

Students can pursue a Masters of Science degree either with Plan A (thesis) or Plan B (non-thesis option). Because of the diverse nature of the skill sets needed by students,

additional credits beyond the University minimums are required. The Masters of Science Plan A degree in Hydrology require a minimum of 31 credits beyond the Bachelors degree, of which at least 18 credits (including up to 6 credits of thesis) must be at the 700-level. For the non-thesis option (Plan B), a minimum of 32 credits is required; at least 15 of which must be at the 700-level (including 2 credits of Professional Paper)

In addition to the shared core described above, the following course is required:

ERS 682	**SMALL WATERSHED HYDROLOGY (4)***

*CE 364 Engineering Hydrology or equivalent may be substituted with consent of the student's advisor

At least one of the following is also required:

CE 698	**PRINC. OF WATER QUALITY MODELING (3)**
CE 610	**HYDRAULICS OF OPEN CHANNELS (3)**
GEOL 781	**ADV. SURF. WATER HYDROLOGY (3)**
NRES 785	**ADVANCED LIMNOLOGY (4)**
GEOL 702J	**FLUVIAL GEOMORPHOLOGY (3)**

2.2.2 Doctor of Philosophy Degree in Hydrology (72 Credits)

Candidates for the Ph.D. degrees in Hydrology must satisfy all general requirements of the Graduate School. The Doctoral degrees in either Hydrology or Hydrogeology require 73 credits beyond the Bachelors degree, successful completion of a qualifying examination after the first year of study and 1 credit of Comprehensive Examination (Appendix D). The Comprehensive Examination credit may count toward the required 30 credits of 700-level coursework. The Hydrologic Sciences Graduate Program does not generally accept students with only Bachelors degrees directly into the Doctoral degree programs; rather these students are first accepted into the Master's Program and may be considered for the Doctoral degree after one year of study.

2.2.3 Master of Science in Hydrogeology (30 credits Plan A, 32 credits Plan B)

Student education and research examine the occurrence and processes associated with subsurface water transport. Specific areas of emphasis include but are not limited to: ground water contaminant transport, geochemical evolution of ground waters, nutrient transport processes in soils and ground water, vadose zone hydrology and numerical simulation of ground water, geochemistry and reactive transport.

Students can pursue a Masters of Science degree either with Plan A (thesis) or Plan B (non-thesis option). . The Masters of Science Plan A degree in Hydrogeology require a minimum of 30 credits beyond the Bachelors degree, of which at least 18 credits (including up to 6 credits of thesis) must be at the 700-level. For the non-thesis option (Plan B), a minimum of 32 credits is required; at least 15 of which must be at the 700-level (including 2 credits of Professional Paper).

In addition to the shared core described above students following the Hydrogeology degree track (either MS or Doctoral) are required to complete **two** of the following four courses:

GEOL 716--------- Low Temperature Aqueous Geochemistry
GEOL 783--------- Groundwater Hydraulics
GEOL/NRES 784— Vadose Zone Hydrology
GEOL 786--------- Contaminant Transport in Groundwater Flow Systems

2.2.4. Doctor of Philosophy Degree in Hydrogeology

Candidates for the Ph.D. degrees in Hydrogeology must satisfy all general requirements of the Graduate School. The Doctoral degrees in either Hydrology or Hydrogeology require 72 credits beyond the Bachelors degree, successful completion of a qualifying examination after the first year of study and 1 credit of Comprehensive Examination. The Comprehensive Examination credit may count toward the required 30 credits of 700-level coursework. The Hydrologic Sciences Graduate Program does not generally accept students with only Bachelors degrees directly into the Doctoral degree programs; rather

these students are first accepted into the Master's Program and may be considered for the Doctoral degree after one year of study.

2.3 EXAMPLE PROGRAMS OF STUDY AND COURSE SEQUENCES

There exists a large body of graduate level courses in the Hydrologic Sciences at the University of Nevada, Reno and students are encouraged to develop, with the guidance of the their advisor and research committee, a Program of Study that best suits their needs and interests. Listed below are several "Example Curricula" for several areas of specialization within those degrees offered by the Hydrologic Sciences. These examples have been designed for a Master's candidate entering the Hydrologic Sciences Graduate Program with 1 year of undergraduate Chemistry and Physics, and Mathematics through three semesters of Calculus and allowing completion in 2 years of study. In some cases, previous upper division coursework is assumed. These example Programs of Study satisfies the requirements of the Hydrologic Science Graduate Program and those of UNR's Graduate

HYDROGEOLOGY	
Year 1 Fall	Credits
GE 684 Intro Groundwater Hydrology	3
GEOL 616 Env. Geochemistry	3
MATH 767 Mathematics for Earth Sciences (will this still be offered?)	3
Year 1 Spring	
GEOL 783 Groundwater Hydraulics	3
GEOL 785 Intro. Groundwater Modeling	3
ERS 622 Soil Physics	3
Year 2 Fall	
GEOL 784 Vadose Zone Hydrology	3
GEOL/ERS 782 Hydrology Seminar	1
GEOL 786 Groundwater Contaminant Trans	3
GEOL/ERS 614 Hyd. Fluid Dynamics	3
CE 368 Fluid Mechanics Laboratory	1
Year 2 Spring	
ERS/GEOL/CE 797 Thesis	6
ERS 701D/GEOL 702S Field Methods in Hyd.	3

HYDRAULICS and GEOMORPHOLOGY	
	Credits
Year 1 Fall	
ERS 682 Small Watershed Hydrology	4
MATH 767 Mathematics for Earth Sciences (same here – still offered?)	3
ERS/GEOL 614 Hyd. Fluid Dynamics	3
CE 368 Fluid Mechanics Laboratory	1
Year 1 Spring	
GEOL 781 Adv. Surface Water Hydrology	3
CE 689 Water Resource Engineering I	3
GEOL 702J Fluvial Geomorphology	3
MATH 758 Time Series Analysis	3
Year 2 Fall	
GEOL/ERS 782 Hydrology Seminar	1
CE 610 Hyd. Of Open Channels	3
GEOl 742 Sediment Transport ***or***	3
GEOL 743 Alluvial Fan Hydrology	3
Year 2 Spring	
ERS/GEOL/CE 797 Thesis	6
ERS 701D/GEOL 702S Field Methods in Hyd.	3

HYDROECOLOGY and WATER QUALITY	
	Credits
Year 1 Fall	
ERS 682 Small Watershed Hydrology	4
GEOL 614 Env. Geochemistry	3
MATH 767 Mathematics for Earth Sciences	3
Year 1 Spring	
CE 698 Princ. Of Water Qual. Modeling	3
ERS 785 Adv. Limnology ***or***	3
ERS 640 Wetland Ecology	3
CE 771 Bioremediation ***or***	3
GEOL 702S Remediation Technology	3
Year 2 Fall	
ERS 740 Water Qual Modeling II ***or***	3
ERS 765 Biogeochemical Cycling	3
ERS/GEOL 614 Hyd. Fluid Dynamics	3
CE 368 Fluid Mechanics Laboratory	1
GE 648 Groundwater Hydrology	3
GEOL/ERS 782 Hydrology Seminar	1
Year 2 Spring	
ERS/GEOL/CE 797 Thesis	6
ERS 701D/GEOL 702S Field Methods in Hyd.	3

HYDROCHEMISTRY	
Year 1 Fall	Credits
GE 648 Groundwater Hydrology	3
MATH 767 Mathematics for Earth Sciences	3
GEOL 614 Env. Geochemistry	3
Year 1 Spring	
CE 698 Princ. Of Water Qual. Modeling	3
GEOL 716 Geochem. Modeling ***or***	3
GEOL 719 Low Temp. Aq. Geochem	3
CE 771 Surface and Colloid Chemistry ***or***	3
CE 771 Bioremediation ***or***	3
GEOL 702S Remediation Technology	3
Year 2 Fall	
ERS/GEOL 614 Hyd. Fluid Dynamics	3
CE 368 Fluid Mechanics Laboratory	1
ERS 765 Biogeochemical Cycling	3
GEOL/ERS 782 Hydrology Seminar	1
GEOl 780 Isotope Hydrology ***or***	3
ERS 702 Soil Chemistry	3
Year 2 Spring	
ERS/GEOL/CE 797 Thesis	6
ERS 701D/GEOL 702S Field Methods in Hyd.	3

2.3.1 Other Educational Programs

In addition to traditional course work, the HSP supports a variety of hydrology-related activities and clubs. A seminar series, consisting of 4-6 lectures per semester from nationally and internationally recognized speakers is supported by the HSP. Support for visiting speakers comes from the operating budget provided by the Graduate School, the Desert Research Institute and, up until this year, from the Mackay School of Mines and the Department of Natural Resources and Environmental Sciences. A beer and snack social follows each seminar and is supported by a local consulting firm (Tetra-Tech, EMI.). These seminars are open to the public and represent an important aspect of the cohesiveness developed amongst students. Appendix E lists the scheduled seminars for the Spring of 2005.

Students are also encouraged to attend regional and national meetings. In the past 3 years, the HSP has supported student travel up to $500 for students presenting at national meetings and $300 for students not presenting but wishing to attend.

The HSP students also publish a newsletter, Aqua Clara, twice per semester. The Aqua Clara features new student introduction, news from alumni, recent faculty and student peer reviewed publications as well as stories of interest to students, faculty and alumni. The Aqua Clara student editor receives $500/year as support and the newsletter is distributed to students, faculty and alumni. Recent issues are contained in Appendix E

Several student organizations are also supported by the HSP including a student chapter of the American Water Resources Association and the Student Association for International Water Issues. Summaries of these clubs are provided in Appendix F.

2.3.2. Relation to Undergraduate Programs

The HSP does not offer any undergraduate degrees and has no formal role in undergraduate education. The University offers a B.S. in Hydrogeology through the Department of Geological Sciences and an option in Watershed Science (within the new degree of Environmental Sciences) in the Department of Natural Resources and Environmental Sciences. Studies are being conducted by faculty in that department to determine if a separate undergraduate major in Watershed Science should be proposed. Both undergraduate degree programs have low enrollment (6-12 in each major or option) and neither has received significant recruiting efforts in the last decade. Undergraduate students have no formal interaction with the graduate students in the Hydrologic Sciences Program although many informal efforts are underway (seminar announcements, field trips, social functions, mentoring, etc.)

2.4 GRADUATE STUDENTS

2.4.1. Student Applicants

Admission of new students is governed by admission standards coupled with the requirement of each incoming student to have an advisor step forward. We expect an undergraduate grade point average of at least 2.75, or an average of at least 3.0 for courses taken during the last half of the undergraduate program. International students who are not UNR graduates must have at least 3.0 grade point averages. For those seeking a Master's degree, we require the product of the combined GRE (verbal and quantitative) and GPA must exceed 3,000. For those seeking to be a doctoral candidate, this product must exceed 3,300. The use of GRE scores in combination is no longer recommended by UNR's Graduate School and the HSP will be considering revising these combinatorial metrics in 2005. All students must have at least one year each of chemistry and physics, calculus (through differential equations), and at least one class of probability and/or statistics.

Student applicant files are assembled in late September (Spring admission) and late January by the Program Administrator. Student files are first reviewed by those faculty

receiving Teaching Assistants from the HSP (Tempel, Wheatcraft, Saito and Warwick), followed immediately by full access to all faculty. Hard copies of the applicant files are traditionally sent to the USGS office in Carson City and the Las Vegas DRI office to facilitate rapid review.

Faculty contact directly with students is encouraged and a faculty meeting is held in late October and late February to match advisors with potential students. Preference for advising is given in the following priority: "teaching assistant", "advise with funding" and "advise without funding. In some cases, students can receive multiple offers of funding and are then allowed to choose their advisor. To expedite the process, informal offer letters are sent immediately and directly to students from the HSP, with a formal letter from the Graduate School at a later date. A second and sometimes third round of offers are generally made in late March and late April if needed.

Over the past 3-4 years, the total number of applicants to the program has declined from approximately 80/year to approximately 45/year. However, the applicant quality has significantly improved. Applicants from Tier I and II schools have also dramatically increased In 2003, ~20% of the applicants scored over 1400 in the combined GRE verbal and quantitative, while in 2001, only 10% scored over 1400. Figure 1 shows the distribution of applicant GPA since 1996, showing that since 2001, ~40% of all applicants have GPAs exceeding 3.5.

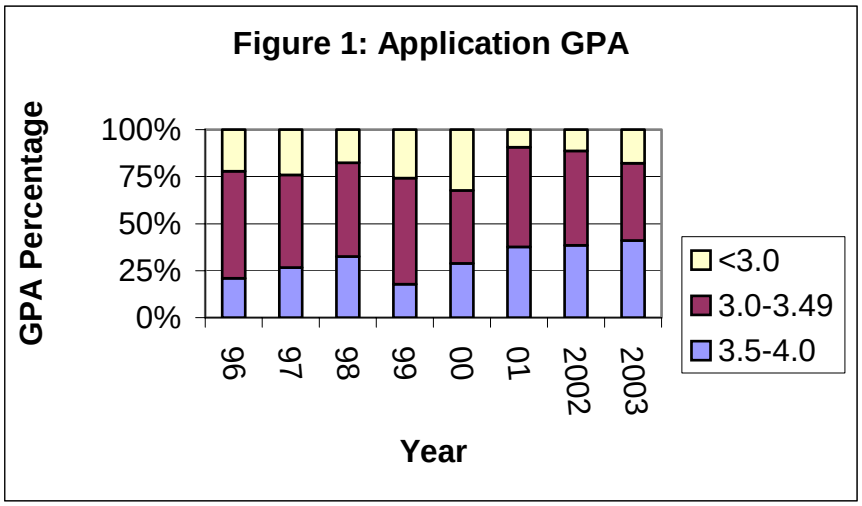

Figure 1. Distribution of HSP applicant grade point averages.

2.4.2 Enrollment Trends

Enrollment declined from a high of ~90 students in 1995 to 60 in 2000, although there has been an increasing number of faculty associated with the program (Figure 2). The decline in enrollment is, in large part, the result of the departure and/or retirement of several faculty who carried large numbers of students in the program. Since 2001, enrollment

grew slowly and in 2004, enrollment significantly increased to 78 students as recruiting efforts were more successful. In addition, there was a decline in graduations in 2004 however it is believed to be an anomaly. The stabilization and slow growth is the result of aggressive recruiting efforts and recruiting of faculty to join the graduate faculty from the USGS and the Desert Research Institute.

The diversity of the program is modest, in spite of recruitment efforts for under-represented groups. Currently, the 27% of the student population is female, with the remainder being male.

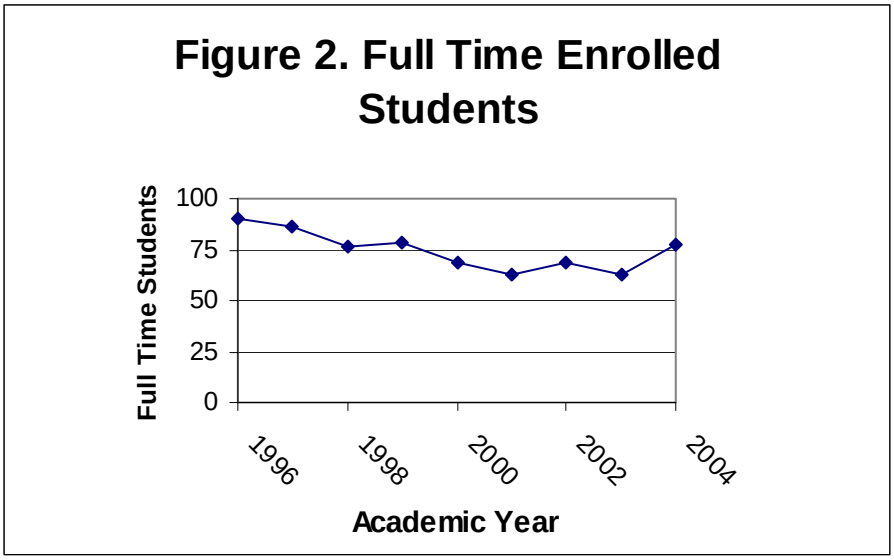

Figure 2. Time history of full time (MS and doctoral) student in the HSP.

Currently 43% of these students are pursuing graduate degrees in Hydrogeology and 53% in Hydrology (. The geographic distribution of students shows that 28 states and 7 nations are represented in our student admissions between 1996 and 2001, a much larger representation than many graduate programs on the campus.

2.4.3 Advising, Funding and Graduation Trends

As of February 2005, the HSP had 78 full time students enrolled, of which 28 are doctoral candidates and 47 are Master's candidates. These 78 students are advised by 35 faculty for an average advising load of 2.3. The minimum number of students advised is one, with a maximum number of advisees of 6 by three of the faculty. A complete listing students and their advisors is given in Appendix G.

Figure 3 shows the current (Fall 2004) distribution of advisors from contributing departments and units. Desert Research Institute faculty currently advise approximately 50% of the total students enrolled, with NRES and Geological Sciences making up the remaining majority.

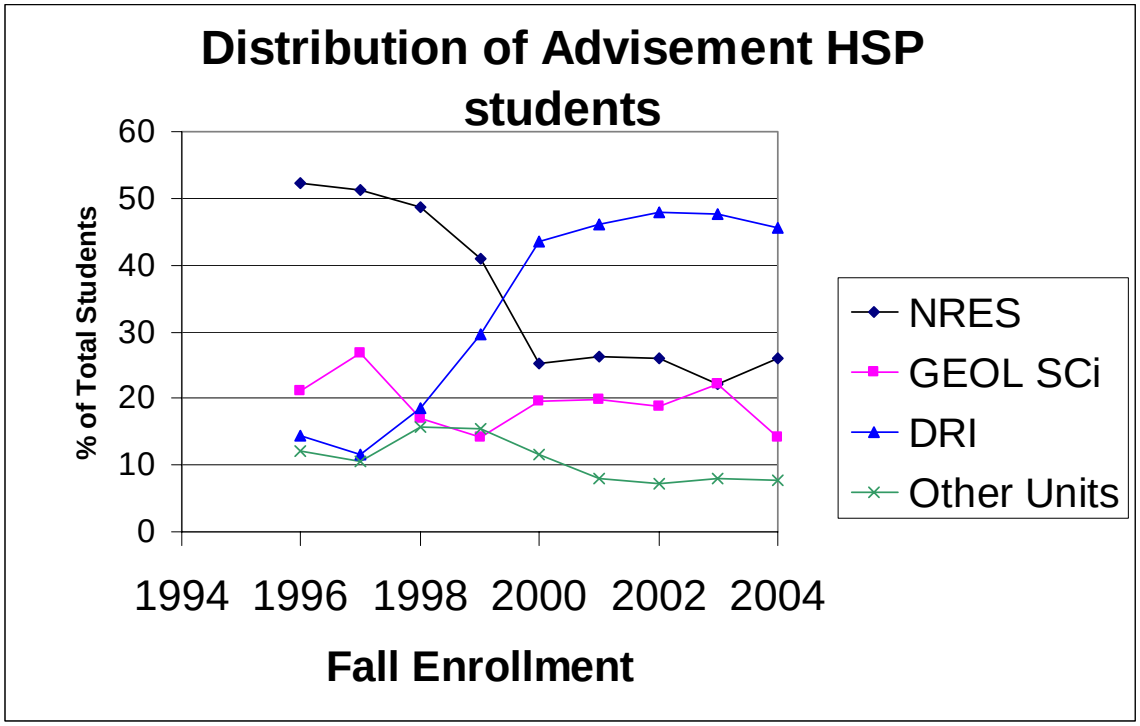

Figure 3. Student advisement trends by Department/unit.

During residence at UNR, HSP students are almost exclusively funded on research grants. In September 2004, 68% of students were funded on research grants, 5% on Teaching Assistantships and 27% were unfunded. The majority of these unfunded students (22% of the 28%) were working full time in the community in the field of hydrology.

Assistantships vary between departments and units depending upon research grants and type of support. Students supported on Teaching Assistantships through the HSP receive $16,000/year (MS) and $17,000/year (doctoral) as well as tuition waivers. TA's are typically assigned only one class per year, with the remaining time allowed for research. Salaries will increase to $17,000 and $18,000/year in 2005. Assistantships at DRI are $16,000/year for MS and $18,000/year for doctoral, with the potential for full time funding during the summer months.

Figure 4 shows the number of MS and doctoral degrees granted since 1996. On average, the program graduates 18-20 students per year, with a slight decrease in doctoral degrees granted over the last two years. Appendix H lists all graduating students since 2000 (recording of thesis/dissertation titles began in 2000) along with their thesis/dissertation titles, degree granted and advisor. Since 2000, HSP has graduate 82 MS and doctoral candidates.

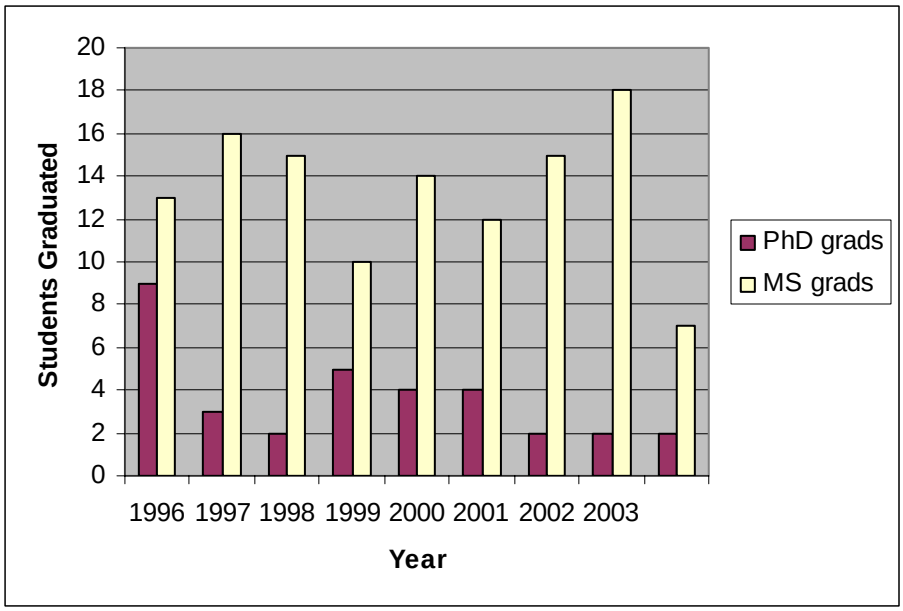

Figure 4. Student graduation rates from HSP. 2004 showed a slight decline in graduation and appears to represent an anomaly.

The time to graduation has declined in the last several years due primarily to coordinating the curriculum and timing of course offerings. Figure 5 shows the residence time of the 2002/2003 graduates, the last year this statistic was calculated. .

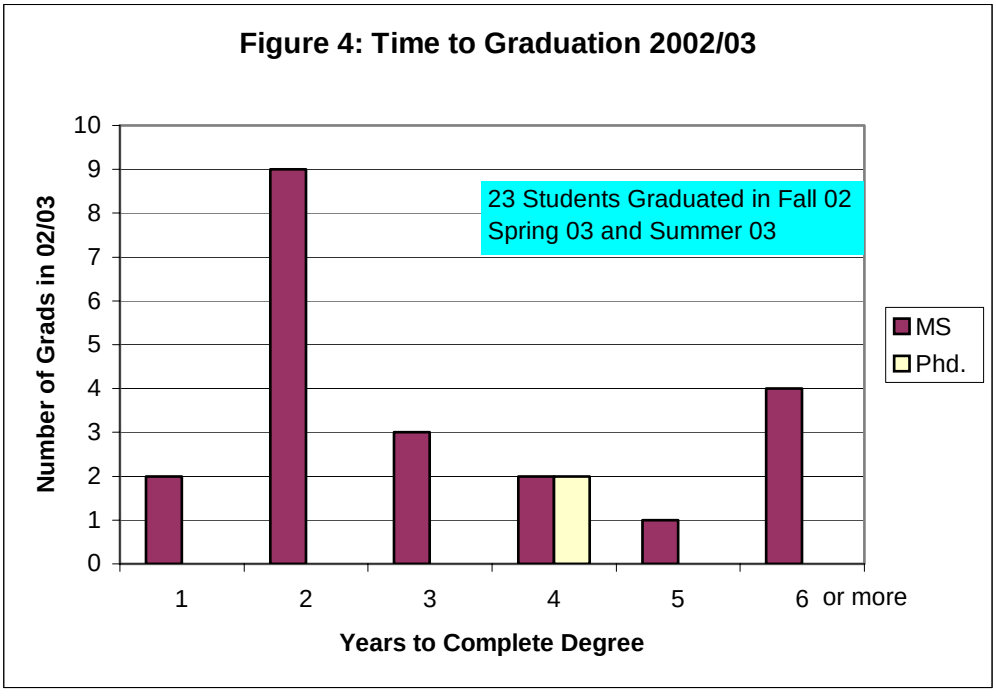

Figure 5. Calculated time to graduate for MS and doctoral students.

2.4.4 Doctoral Student Statistics

The doctoral candidate pool is diverse but can be broken down into two general categories: 1) candidates of graduate assistantships or financial aid and 2) candidates working full time in the profession of hydrology. Of the 28 doctoral candidates currently enrolled, approximately 10 students are at or have exceeded the university's time limit for study and the majority of these students are working full time in the community. The HSP has always tried to accommodate these professionals and, as a partial result, the time to complete a doctorate degree in the HSP is for each student, the advisor and the Director discuss and agree if an extension should be requested from the Graduate School.

2.4.5 Student Placement and Success

The HSP maintains a database of alumni that includes required information regarding alumni address and contact information. Optional data includes employer information and as a result, the HSP does not have complete information on its graduate's state of employment or employer. Updates to the alumni list are made when alumni notify the Program Office of changes of address. Table 3 documents the distribution of employers of alumni graduating since 1998 as determined from the data base and the director's and faculty corporate knowledge.

Academic Or Research	Consulting / Private Ind.	Graduate School	Federal Government	State Gover	Local Gover	N G O	Unknown
16	38	11	19	8	5	5	12

Table 3. Summary of HSP graduates since 1998. The majority of students find employment with environmental consulting firms, federal agencies such as the USGS or academic and research laboratories.

Graduates from the program at the MS level routinely enter the private or government sector. In the last 3 years, 100% employment has occurred for all MS graduate students in their chosen field. Only 5% of these graduates were native-Nevadans, yet ~40% of our MS graduates in the last 3 years obtained hydrology positions in Nevada as their first post graduate job. Many MS graduates from the program have gone on to successfully complete doctoral degrees at other institutions.

At the doctoral level, students from UNR are placed in academic positions (Texas A&M, Oregon State, Ohio State, Univ. of Oklahoma, University of Idaho, University of Nevada, Las Vegas, Univ. of Illinois, University of Missouri, Univ. of Wisconsin-Kenosha, Old Dominion University, Virginia Polytechnic Institute, UNR and the Desert Research Institute), government (U.S. Geological Survey, So. Nevada Water Authority) or the private sector.

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2.4.6 Evaluation and Assessment

Student research and productivity is measured in standard ways through classroom and as well as thesis and dissertation examination processes. The examination processes for all degrees is summarized in Appendix D and represents a relatively standard approach to graduate education. In 2002 and 2003, the University of Nevada, Reno required outcome-based assessment plans be developed for all degree programs at the University. After review by the Assessment Office on campus, approved assessment plans were to be implemented in 2004.

The HSP developed four assessment plans (one for each of its degrees) and submitted these plans for review in 2003. The key element of the plans utilizes an assessment form to be completed along major milestones of a student's progress through graduate school. After minor revisions suggested by the Assessment Office, the plan was initiated in Spring 2003 on a trial basis. During the trial period, faculty reported to the Director that there appeared to be little value in the assessment form. The HSP Assessment Plans have not been implemented rigorously since early 2004 and should be revisited and reviewed by both the external review committee and faculty for improvement. The approved Assessment Plans are included in Appendix I.

3.0 FACULTY

3.1 Faculty Distribution

The faculty of the HSP are self defined, i.e. faculty request membership in the faculty and are voted on by the existing core faculty. The contributing departments have been defined previously. Areas of faculty depth in HSP include: subsurface contaminant transport, vadose zone hydrology, biogeochemical cycling in watersheds, inorganic ground water quality, geochemistry, paleohydrology and surface water nutrient dynamics. Deficient areas with respect to faculty expertise and/or classroom instruction include: ground water remediation, hydrometeorology and snow hydrology.

The HSP maintains two "classes" of faculty, defined by their level of involvement in the program. "Core faculty" are defined as faculty who are or have in the past year, advised a student in the HSP. Cooperating faculty are those faculty who have been voted or grandfathered into the graduate program, but who have not met the criteria for voting status. The HSP does not have specific requirements for graduate faculty status, but rather defaults to those of the Graduate School for Graduate Faculty status. The Graduate School states that faculty employed by UNR, DRI and UNLV may serve in all capacities of graduate education in the HSP; those faculty from the UNLV, USGS or other such organizations have only the restriction of co-chairing student committees. In these cases, a UNR or DRI employed graduate faculty member must serve as a co-chair of either an

MS or doctoral student committee. A terminal degree (Ph.D.) is required to serve on the Graduate Faculty.

Since 1999, the graduate faculty has grown from ~50 to as high as 72. Currently the count stands at 68 due to faculty departures. A brief summary of all graduate faculty are listed in Appendix J. Large increases in graduate faculty have come from the Desert Research Institute and the U.S. Geological Survey. UNR's component of faculty, including new hires since 1990, continue to be focused on subsurface hydrology, with a small but talented group of surface water hydrologists and watershed scientists in NRES and Civil Engineering. DRI faculty associated with HSP span a wide range of the hydrologic spectrum. The atmospheric component of hydrology (precipitation, climate, etc.) has little representation in the HSP faculty, however a large body of courses is available through the Graduate Program of Atmospheric Sciences, housed in the Physics Department.

In the last two years, four groundwater faculty from the U.S. Geologic Survey District Office in Carson City have joined the graduate faculty in Hydrologic Sciences and the USGS has continued to support and train graduate students. These new faculty represent a significant area for potential new classes, hands-on training for students and short course offerings provided funding and operating agreements can be developed. Collaboration between the USGS and the University of Arizona in the late 1960's led to the development of the top Hydrology school in the United States and is a good model for UNR to follow.

Unfortunately, in spite of enrollment and national trends, the HSP program has lost significant faculty expertise and energy in the past 2 years. From UNR, Drs. Meerschaert (Mathematics) and Shaw (Water Resource Economics) have left in the last 6 months, while Drs. Benson, Hu, Hassan, Tracy and French have left or are leaving the Desert Research Institute. Drs. Benson, Hu and Hassan were central to the doctoral program of the HSP as the majority of their students were Ph.D. candidates. Dr. French was critical to the surface water teaching component, and was responsible for three 700-level hydraulics and hydrology modeling courses. At this time, only one of Dr. French's courses has been reassigned successfully (GEOL 781).

The HSP does not have a mechanism in its By-Laws for removing a faculty member from its membership; however this has not posed a significant issue in the last decade. Faculty tend to be self-regulating, with faculty removing themselves voluntarily.

3.2. Research, Scholarly Productivity and Awards

As an interdisciplinary program, HSP does not keep detailed accounting of research grant awards, publications or faculty awards. Rather these data are maintained by departments and units. Given that most students are funded on research assistantships, faculty research productivity appears to be healthy. Listed in Appendix K is a partial listing of faculty and student peer-reviewed journal and book chapter publications since 2002.

This is not a complete list, but was provided by faculty for publication in the HSP publication, Aqua Clara.

HSP students have been consistent winners of university-wide research competitions. In addition, HSP students have been awarded outstanding student poster/presentation at several recent AGU meetings. Faculty awards include several Fellows of the Geological Society of America (Wheatcraft, Karlin, Tyler, Wells, OTHERS?), and the Soil Science Society of America (Johnson and Tyler).

4.0 PROGRAM RESOURCES

The HSP relies upon faculty and departments for resources such as analytical capabilities, computing resources,

The program does usually buy computers at the end of the year for student offices.
The Program has access to the following financial resources during 2004/2005 Academic Year:

- In 2003/2004, the Graduate School budgeted ***$***152,928 for all program activities (exclusive of those below) including secretarial support, TA's, travel, director's stipend and office operations. The majority of these funds are used to support teaching assistantships and research assistantships used in recruiting. In 2003/2004, 9 students received assistantships or partial assistantships from these funds. These funds are NOT used for supporting teaching either through DRI or LOAs, however.
- FTE ($106K in 2004) support DRI faculty in teaching hydrology and hydrogeology courses at UNR. Beginning in 2003, these funds are now directly allocated to the Program. In the past, they had been under the budgeting process of the Mackay School of Mines. These funds are used to teach courses in the following departments: Geological Sciences, Natural Resources and Environmental Science and Biology. .
- The CESE has typically supported one additional course by DRI faculty. Support is promised for 2003/2004 but as CESE no longer exists, negotiations are underway to continue this support through the Academy of the Environment.
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Appendix L contains a budget breakdown for 2004/2005 academic year.

The Program has the following space resources during 2004/2005

- LMR 267 used for HSP office.
- LMR 265 serves as both the Director's office and the personal office of S. Tyler.
- LMR 160 serves as a hydrology teaching laboratory, meeting room and HSP student computer resource center.
- LMR 257 serves as a DRI/USGS occasional office space and communal copy room for Geological Science faculty in LMR.
- Storage space is provided for HSP equipment in LMR 263 and LMR 285

- Graduate student office space is available in LMR, KRC, Fleishmann Ag. and DRI and is arranged by individual faculty.

The HSP also has some equipment provided with funds from the Graduate School and various faculty start-up funds over the past decade. This equipment includes waders, data loggers, pressure transducers, stream flow gauge, a generator (not functioning) and a 4" submersible pump (also not functioning). Equipment has not been a significant limiting factor for HSP students or faculty however, as most faculty maintain their own equipment and freely allow students to use equipment, laboratory facilities and software.

5.0 ACCOMPLISHMENTS AND CHANGES OVER THE PAST 5 YEARS

The following represents a brief summary of major improvements, structural changes and issues that have occurred within the Hydrologic Sciences Graduate Program since 2000.

- Major curriculum review and course additions to the MS and Doctoral degrees in Hydrology (2002) to adjust to market trends. Required courses and new courses have been added to focus these degrees in watershed hydrology and surface water quality. This has led to a more focused degree track for students, while still leaving sufficient room for diversity of surface water research. New courses in this area include Advanced Surface Water Hydrology (GEOL 781), Field Methods in Hydrology (GEOL 702Z and NRES 701D), Fluvial Geomorphology, Advanced Surface Water Quality Modeling (NRES 740)

- Review and revision of entrance requirements in mathematics. These revisions now require incoming students to have mathematics through differential equations and probability/statistics. Beginning in 2003, the Math/Stats Department, in cooperation with HSP, developed a new course, MATH 767, Mathematics for Geoscientists to substitute for this deficiency. The course is offered each fall, and this year will be taught by Dr. Anna Panorska of the HSP faculty.

- Rescheduling of course rotations (begun in 2000 and on-going) now allow MS students to more easily complete their course work and thesis requirements in 2 years. Typical time to graduation for MS students now stands at 2.5 years.

- Initiation of a formal doctoral Qualifying Examination process including an oral examination.

- Enhanced recruiting efforts have led to a significant improvement in student applications, with now a large percentage of student applicants coming from top rated undergraduate institutions. As an example, the top 15 Fall 2005 applicants averaged 730 and 570 on the GRE Quantitative and Verbal tests respectively. This same cohort of students had an average GPA of 3.66.

- Expansion of graduate student population from ~63 to 78 by 2005.

- Expansion of the HSP Graduate Faculty from approximately 53 in 2000 to 66 in 2005. The number of voting cooperating faculty has also increased over this period from approximately 30 to 38.

- Overhaul and redesign of the Program's web site to allow electronic application and to provide a better image to prospective students.

- Development and support of student work activities in developing countries. Specifically, the formation of "Student Association for International Water Issues" (SAIWI) and its efforts in Ghana, Haiti, Kenya, Panama and Chile. This organization began as a grassroots effort by HSP faculty and students, and now has grown into a self-sustaining effort including water well drill training and yearly work trips to developing countries. SAIWI membership is primarily HSP students, but also includes students from across the campus.

- In 2000, the HSP Program Office was moved onto the main campus, from its previous location in the KRC building to the east of campus. This has led to an increase in visibility of the program.

- Development of two major strategic plans (2002 and 2003) and the development of a broad faculty consensus of the concept of formation of a Hydrology Department at UNR.

- University and department support for one replacement position (Dr. Laurel Saito, NRES), several related aquatic ecologist positions (Biology and NRES) and a new position for HSP Program Director (search begun in February 2005).

- Designation of LMR 160 as a HSP student computing and resource center. Only limited remodeling has occurred to date.

- Departure of several key HSP faculty beginning in 2004. These include: R. French (DRI, hydraulics), M. Meerscheart (Mathematics and stochastic hydrology), D. Benson (subsurface contaminant transport), D. Shaw (water resource economics), A. Hassan (DRI, stochastic hydrology), B. Hu (DRI, stochastic hydrology).
- Restructuring of the interdisciplinary environmental graduate programs under the Academy for the Environment (2005).

5.1 RATIONAL FOR DEPARTMENT STATUS OF HYDROLOGIC SCIENCES

As described in the HSP's Strategic Plans of 2002 and 2003, formation of a Department of Hydrology and Water Resources would lead to fundamental and positive changes in the educational opportunities of both graduates and undergraduates at UNR. Listed below

is a bulleted summary of the major advantages and disadvantages of a department formation.

5.1.1 ADVANTAGES

- IMPROVED NATIONAL RECOGNITION FOR UNR: The only other department North America is at the University of Arizona and it is the top ranked in the nation. Department status will increase visibility, recruiting success and generate growth. The formation of the Department of Hydrology and Water Resources at Arizona produced a very large and successful graduate and, a small but successful undergraduate program.

- STATE RECOGNITION: As the driest state in the nation, UNR's focus on water and hydrology are obvious. A UNR Department of Hydrologic Sciences would support, not compete, with UNLV's Graduate Program in Water Resources Management. A synergy between north/south would develop; with UNR focusing it's training in the science/engineering of water, and UNLV focusing on policy aspects.

- HYDROLOGY AS A DISCIPLINE: Hydrology has been recognized as a discipline in the last two decades, with many universities expanding their programs. A department would share a common theme, but embrace a wide range of traditional disciplines (civil engineering, geology, ecology, environmental chemistry, mathematics, economics, etc.). Specific new areas of focus would include: Drought Management in Water Resources, Ecohydrology and Water Resource Economics.

- CURRICULUM STABILITY: To provide the best education possible, it is critical that the faculty maintain a stable and up to date curriculum responsible for the students. Formation of a department would allow the faculty to effectively manage the curriculum.

- RESPONSE TO DISCIPLINE AND MARKET FORCES: Department status would result in an effective and self-directed set of new hires that are capable of leading, not following in an ad-hoc manner, the trends in Hydrologic Sciences. Without department status, new or replacement faculty positions will not be responsive to market forces.

- DEVELOPMENT OF A STRONG AND COHERENT UNDERGRADUATE PROGRAM: Three undergraduate focus areas in hydrology currently exist (Civil Eng., Geological Sciences and NRES) yet have small and under advertised student populations.. Consolidation of at least two of these (GSD and NRES) under a single focused department into undergraduate majors of: 1) Hydrogeology and 2) Watershed Science would insure that these students get a solid

undergraduate education. It is anticipated that within 5 years of forming a department, undergraduate enrollment would grow from a total of ~20 students in 2004 to 50 students. Given current market trends, 50 students represent a stable and realistically sustainable size.

- DEVELOPMENT OF NON-MAJOR UNDERGRADUATE WATER COURSES: Undergraduate enrollment is anticipated to significantly grow at UNR in the next 5 years. To accommodate non-majors and to educate the population of the state, development of two 100-level (overview courses) in water and water resource education to meet the demands of our population will be needed. These courses will be designed for a) science majors and b) non-science majors to introduce them to the water cycle, water pollution and water resource management. The UNR administration has recognized the need for additional science courses for the core curriculum and has also recognized that existing non-major science courses will not be able to handle the student population in the near future.

- REDUCTION OF COURSE DUPLICATION: The UNR campus has a significant number of Hydrology course offering duplications. Offerings from NRES, Civil Engineering and Geologic Sciences should be coordinated. Department status for Hydrologic Sciences would allow much more efficient optimization and sharing of course offerings.

- FACULTY SYNERGY: Currently, faculty are spread around the UCCSN system, with limited opportunity for collaboration. Building a central core within a department will guarantee synergy in academics and research funding, i.e. "you collaborate with the people you see in the halls and share coffee with."

- IMPROVED STUDENT SYNERGY: Currently, the students are tight knit due to faculty energies in promoting social functions, etc. However, students are housed all over campus with, at times, limited computation facilities. Centralizing many of the students will allow for more interaction on a scholastic level as well as the current social level. This will produce better research and opportunities for undergraduate mentoring that is currently absent.

- FACULTY RECRUITING AND RETENTION: With one home, prioritization of new faculty hires will be streamlined and in-fighting will reduced, i.e. department vs. department, rather than faculty vs. faculty.

- NO NET COST OF DEPARTMENT FORMATION: Formation of new department of Hydrologic Sciences would have little real cost. Departmental support staff is already in place in the Graduate Program (full time secretary, part time student worker, Teaching Assistantships, etc.) and no new resources would be needed at the outset with the exception of B&G moving expenses for faculty.

The department should however ask for at least 1 new UNR hire and 0.5-1.0 new FTE to be used for DRI teaching.

- IMPACT ON EXISTING DEPARTMENT CURRICULUM: Preliminary analysis of the formation of the new Hydrology Department from existing faculty indicates that there would be very limited impact on the teaching of courses required for these departments.

5.1.2. CONCERNS AND DISADVANTAGES

- MAINTAIN EXISTING ADVISING STRENGTH: Currently, the program draws from 68 graduate faculty for its strength. A successful department must develop a system in encourage those faculty from outside the department to continue to participate.

- STUDENT CREDIT HOUR/FTE VIABILITY: Can a department support itself with a small undergraduate population and large (~75) graduate program? Growth in the undergraduate population and at 1-2 service courses will be needed. The current graduate and undergraduate student population in water and hydrology are estimated to support 9 FTE using UCCSN recommended student/faculty ratios. With the inclusion of two, non-major 100 level courses, FTE generation can be increased by at least 1-1.5 FTE. The addition of DRI faculty (currently funded at ~1.35 FTE), while only partial appointments, would also significant raise the number of faculty available for students and research, at a fraction of the cost of an equivalent number of faculty.

- FACULTY COMMITMENT: In 2003, 10 UNR faculty were easily identified as willing to move to a new Hydrology Department. Faculty have not been polled recently and with faculty departures and the passage of time since 2003, this commitment has been reduced.