REVIEW OF THE M.S. IN HYDROGEOLOGY
Classification of Instructional Programs (CIP) Code: 40.0605
Geological and Earth Sciences, Hydrology and Water Resources Science

OVERVIEW

The M.S. in Hydrogeology program at Illinois State University is housed within the Department of Geography, Geology, and the Environment in the College of Arts and Sciences. The department offers undergraduate programs in Geography, Geology, and Environmental Systems Science and Sustainability, and graduate study in Hydrogeology. The M.S. in Hydrogeology is a thesis-based program that emphasizes quantitative skills, field and laboratory methods, and interdisciplinary problem-solving. Students engage in applied research and professional preparation in collaboration with faculty and external partners, including local, state, and federal agencies. With small cohorts and close faculty mentorship, students are encouraged to tailor their academic path to individual interests within the hydrogeological sciences. Graduates are well prepared for careers in consulting, government agencies, and environmental services, as well as for continued study at the doctoral level.

Enrollment and Degrees Conferred by Plan of Study, Fall Census Day, 2017-2024
M.S. in Hydrogeology, Illinois State University
First Majors Only

	2017	2018	2019	2020	2021	2022	2023	2024
Enrollments	18	18	20	16	14	9	13	14
Degrees	9	8	3	11	4	9	4	9

Table notes:
Graduating Fiscal Year consists of summer, fall, and spring terms, in that order. For example, Graduating Fiscal Year 2024 consists of the following terms: summer 2023, fall 2023, and spring 2024.

EXECUTIVE SUMMARY
PROGRAM REVIEW SELF-STUDY REPORT

Self-study process

Self-study is a constant process for faculty of the Hydrogeology MS Program. During the 2023-2024 academic year the Geology and Hydrogeology faculty met to discuss the program review process. In addition to program assessment data, students exit interviews documented student feedback and recommendations. Alumni were engaged through individual emails inviting them to complete a survey through Qualtrics. Data reports were generated via PRPA and other internal resources by Interim Chair Dr. Eric Peterson. Dr. Tenley Banik compiled data for the Overview of the Academic Unit. Dr. Lisa Tranel compiled data for the first draft of the remaining sections. The first draft was shared with the rest of the program faculty and Chair.

Program Curriculum

The Hydrogeology MS curriculum provides specialized training for those students who wish to pursue employment following completion of the program while simultaneously ensuring the breadth of academic background for those who will pursue a doctoral degree. We accomplish this dual goal by offering a rigorous curriculum that includes 32 hours of coursework. The core requires 15 credit hours focused on students' choice of groundwater or surface water focus. The remaining 17 hours are a combination of elective and thesis hours. Of the required 17 credit hours of electives, students can choose to complete the three-course sequence required for the GIS Certificate. During the period of program review, the CIP code was changed from 40.0699 (Geology and Related Sciences, Other) to 40.0605 (Geological and Earth Sciences, Hydrology and Water Resources Science). The new classification better

reflects the mission of the program and provides better alignment to the content and curricula of the master's in Hydrogeology, M.S. The curriculum was also modified to broaden the scope of study and to provide students more course options. While not a change to the M.S. Program, the Department approved accelerated (4+1) sequences for the Geology and Environmental Systems Science (ESSS) program., Taken as a whole, the changes provide graduate and undergraduate students in the department additional pathways within the geological and environmental sciences, increasing post-ISU opportunities.

Program or Academic Unit Faculty

The Department Chair and six tenure-line faculty serve the Geology Program as fall of 2024; the Chair and two faculty are hydrogeologists. The Hydrogeology headcount was consistently three faculty until 2022, when one member took leave to serve on the National Science Foundation Program Director and will be resigning from ISU effective December 2024. In 2023, Dr. Eric Peterson served as Interim Department Chair and was hired as Chair beginning in 2024. All faculty members have PhDs from leading research institutions. Faculty members are recognized university-wide, state-wide, nationally, and internationally as subject-matter experts and for their teaching, scholarship, and service to their specialization. We anticipate a series of hirings during the upcoming program review cycle.

Program Goals and Quality Indices

Our program provides courses to encompass the geologic and hydrologic aspects of water, Earth's most precious resource. The goal of the MS in Hydrogeology is to deliver a balanced set of core courses which, when combined with other elective courses, enable students to become knowledgeable in applied environmental and water sciences. Graduates enter the job market capable and ready to perform professional responsibilities from a solid academic base needed for career growth. The continued placement of our students in geoscience employment or continuing education in PhD programs is testament to the high-quality education provided by our program.

Student Learning Outcomes, Assessment Plan, and Specialized Accreditation

Students who complete the MS in Hydrogeology will:

1. Display an understanding and proficiency in physical hydrogeology (GEO 460 Groundwater Geology).
2. Display an understanding and proficiency in chemical hydrogeology (GEO 439 Aqueous Geochemistry).
3. Display an understanding of the underlying theories and mathematical solutions used in numerical models to solve hydrogeologic problems (GEO 435 Introduction to Groundwater Modeling).
4. Perform field and laboratory techniques for collection of hydrogeologic data.
5. Interpret and analyze hydrogeologic data.
6. Discuss and critique current research and techniques in water resources (Electives focused on topics in water science).
7. Communicate research and techniques in water resources appropriately as part of their interactions within academic, public, or private sector careers.

The annual assessment involves individual courses, the capstone course, and feedback from our graduating students. Initial assessment takes place in each of the core courses noted with their corresponding outcomes listed above. The primary comprehensive assessment tool is embedded in GEO 456, the capstone course for the program. The final project for the course requires students to write a conceptual model report that draws from all the other core courses. The last assessment tool is an exit interview that is conducted to all Hydrogeology graduates once they have completed either their thesis or the comprehensive exam. Students are sent interview questions and return their responses electronically. This also allows us to track their first career steps. The Hydrogeology MS program has no specialized accreditation agency.

Responses to recommendations resulting from the previous program review

Following the last program review in 2016, the Academic Planning Committee, found the MS in Hydrogeology to be in Good Standing. The Academic Planning Committee made 6 recommendations to address within the next review cycle:

1) *Recruit students from other programs and from the undergraduate geology program through a 4+1 program*: We recruited students from 44 different institutions during the review period and our proposals for accelerated (4+1) sequences in both geology and ESSS programs were approved in 2023.
2) *Increase the number of students who self-identify with racial or ethnic groups traditionally underrepresented at ISU*: We removed the GRE requirement to admission and recruited 20-50% of our students from international institutions.
3) *Identify different or additional content areas that could be offered and explore offering a "four plus one" program:* In addition to the accelerate (4+1) sequences, we expanded the curriculum with new modeling and remote sensing when Dr. Wondwosen Seyoum joined the faculty in 2016. Additional electives are available to graduate students through courses offered by the Department's environmental geographers.
4) *Investigate whether strategies are needed to improve career development opportunities and effectiveness of academic advisement*: Beginning in 2016, the Geology colloquium series expanded to bring in more guest speakers to give research and career presentations to our student in Geology and Hydrogeology. Continuous efforts to improve advisement are considered following exit surveys each year. Our alumni survey did not include Likert scale questions to directly compare change in this area since the last review.
5) *Coordinate equipment purchases with other physical science units at ISU, seek external funds, and explore partnerships with business, industry and alumni*: The FESEM was acquired through collaborative NSF grant between Physics, Geology, Biology, and Chemistry faculty members. Hydrogeology members partnered with community agencies to contribute to projects in Bloomington and Chicago. Collaborative and multidisciplinary external and internal grants supported faculty and student projects during this review period.
6) *Explore development of endowed fellowships or scholarships to help offset recent losses in general funds for graduate assistantships*: We have not yet established a fellowship or scholarship; however, our alumni have continued to generously donate to the Birds Give Back Campaign. We will continue to work toward this goal in the upcoming review cycle.

Changes in the academic discipline, field, societal need, and program demand

Employment opportunities for geoscientists knowledgeable about water systems will continue to exist and grow with continued pressures to protect and sustain water resources. The need for experience in computational analyses and experience working in multidisciplinary teams will continue to grow. Our faculty recognize these changes and are working toward building experience into course and thesis projects through their research collaborations. With 22% of the geoscience employment positions filled by non-geoscientists, demand for students with advanced degrees in this field will continue.

Major findings of this program review self-study

The MS in Hydrogeology at Illinois State is unique in the state, the region, and the US. We sometimes view Hydrogeology is as a "small" graduate program, but small does not equal weak. We remained third in enrollment in Geology MS programs in the state and second in terms of degrees conferred. Scholarly productivity nearly doubled since the last review, with 41 peer-reviewed manuscripts, 3 geologic maps, and 135 presentations generated by students during this period of review. Our program offers effective individual attention for students, strong academics, and quality scholarship at Illinois State.

Initiatives and plans for the next program review cycle

We will focus on three priority areas: 1) increase diversity of our student body, 2) increase the interdisciplinary opportunities for students in the areas of water issues, and 3) integrate the environmental students and faculty in the Department into the graduate program.

PROGRAM REVIEW OUTCOME AND RECOMMENDATIONS FROM THE ACADEMIC PLANNING COMMITTEE

Review Outcome. The Academic Planning Committee finds the M.S. in Hydrogeology to be in Good Standing.

The Academic Planning Committee commends the M.S. in Hydrogeology program on its comprehensive and reflective self-study. The report substantiates claims with insightful evidence gathered from a range of stakeholders, including students, alumni, and faculty. The program's ongoing faculty discussions, annual assessment efforts, and responsiveness to evolving disciplinary trends underscore a data-informed culture of continuous improvement.

Over the period of review, enrollment in the M.S. in Hydrogeology program remained stable and aligned with the program's target range, typically fluctuating between 9 and 20 students per year. Despite nationwide declines in geoscience graduate enrollments, the program maintained consistent interest, drawing applicants both domestically and internationally. This enrollment stability reflects strong program reputation, faculty mentorship, and the curriculum's relevance to contemporary hydrogeology challenges.

To support student success, the program has cultivated multiple high-impact practices. Students benefit from individualized mentoring, early advisory meetings, and a research-driven curriculum culminating in a comprehensive capstone field course. Regular research group meetings, grant-writing workshops, and professional development sessions further enhance skill sets and career readiness. The program also emphasizes participation in conferences, securing external grants for student research, and leveraging alumni networks to share job opportunities and career guidance. This holistic support structure contributes to strong retention, timely degree completion, and an excellent record of post-graduation employment or admission to doctoral programs.

The committee recognizes the program's success in placing graduates into relevant professional roles and doctoral programs. A strong research and mentorship environment, along with support for travel and external funding, fosters both theoretical and applied competencies. The program's commitment to equity, diversity, and inclusion (EDI), including efforts to remove barriers to admission, connect with organizations like the American Geophysical Union Bridge Program, and integrate inclusive content into the curriculum, further strengthens the learning environment.

Overall, the M.S. in Hydrogeology program is well-positioned to respond to changing job markets, external funding challenges, and faculty transitions. Its adaptability, engagement with alumni and external partners, and robust framework of assessment and responsiveness ensure ongoing relevance. The combination of stable enrollment, strong student success activities, and strategic EDI efforts enhances the program's long-term competitiveness and impact.

Recommendations

The Academic Planning Committee appreciates the efforts of the M.S. in Hydrogeology faculty and staff. In addition to commending the program's current strengths and accomplishments, the committee provides the following recommendations to be addressed within the next review cycle. Detailed actions and outcomes should be included in the subsequent self-study report. The next program review for the M.S. in Hydrogeology is tentatively scheduled for October 1, 2032.

Formalize enrollment management and recruitment efforts. While current enrollment is stable, a more structured approach can sustain and potentially enhance the applicant pool. Consider diverse pipelines, including domestic, international, and 4+1 pathways, and evaluate financial packages and targeted marketing. Such formalized strategies will help ensure a consistent pool of qualified candidates.

Develop planning for resource sustainability amid faculty and facility transitions. With impending shifts in faculty expertise and laboratory infrastructure, proactive planning is essential. Succession strategies, strategic hiring aligned with the program's evolving directions, and to identify effective strategies to ensure resources are available to maintain up to date- research infrastructure will preserve the distinctive strengths of hydrogeology research and education.

Continue implementing and refining the student learning outcomes assessment plan. The committee encourages faculty to continue their implementation of the student learning outcomes assessment plan for the program during the next program review cycle, to continue to utilize information gathered through plan implementation to make program revisions as necessary, and to document how that has been done. The committee encourages faculty to periodically evaluate the effectiveness of the plan in assessing student learning to identify any modifications to the plan faculty may deem necessary.

Continue curricular innovation. Explore opportunities for more substantive curriculum changes that reflect evolving social work practices and student needs. Monitor and assess the impact of experiential learning activities.

Enhance external funding strategies. To mitigate fluctuations in grant funding, consider professional development in grant writing, collaborative proposals with external partners, and diversifying research areas. Stabilizing external funding streams will support assistantships, research opportunities, and overall program vitality.

Continue collaborations with Milner Library. Build upon a strong existing relationship to evaluate and maintain resource availability. Consider expanding digital resources, integrating information fluency outcomes and assessment into the curriculum, and integrating library tools into assessment plans. Such efforts ensure that both faculty and students have ongoing access to the information and skills needed for effective scholarship.

Stakeholder engagement. Maintaining an ongoing dialogue with appropriate stakeholders throughout the college, university, and external audiences. Consider leveraging the program's high job placement rates to further improve relationship with alumni and employers. Utilize tools such as SteppingBlocks to improve knowledge of alumni outcomes and maintain post-graduation connections.