

Academic Program Review

**Department of Earth Sciences
Memorial University**

Report of the Review Committee

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1. The Review Procedure

Prior to arriving on site the members of the Academic Review Committee (henceforth referred to as the *Committee*) were presented with a Self-Study Report prepared by the Department of Earth Sciences (henceforth referred to as the *Department*) which, together with appended information, was intended to provide a comprehensive picture of the Department as a basis for the subsequent review process.

The Academic Review Committee met with members of the senior administration of the University on the evening of September 24. Present were the Vice President (Academic), Dr. Evan Simpson, the Vice President (Research), Dr. Christopher Loomis, the Dean of Graduate Studies, Dr. Chet Jablonski, and the Dean of Science, Dr. Robert Lucas. Some general perspectives as well as specific issues were discussed which were of benefit to the Committee.

The principal activities of the Committee within the Department were scheduled for September 25 and 26. An itinerary for these activities had previously been prepared by Ms. Joan Bessey of the Centre for Institutional Analysis and Planning following consultations with the Chair of the Committee and with Dr. J. Wright, Head of the Department. This itinerary can be found at the end of this Report as an Appendix. The meetings with faculty and staff were well attended and demonstrated a high level of interest which was eloquently expressed. Meetings with students were not well attended but were nevertheless of value to the Committee. Special opportunity was provided for any member of the faculty, and new faculty members in particular, to meet individually with the Committee. Four individuals responded to these invitations. Special meetings were scheduled to probe the opinions of interest groups external to the Department. The first of these involved selected representatives from the Departments of Geography, Biology, Physics and Physical Oceanography, Mathematics and Statistics, and from the Faculty of Engineering and Applied Science. The second meeting included representatives from the following agencies and companies : the provincial Department of Mines and Energy, the Canada-Newfoundland Offshore Petroleum Board, Altius Minerals, and Deer Lake Oil and Gas.

The process was generally well organized and smoothly executed, thanks to the attentiveness and guidance of Ms. Bessey.



2. Summary of Key Issues

The Committee has identified the following as being the most pressing and important issues confronting the Department. Further elaboration on these points will be presented throughout the Report.

- 2.1** There is a clear need to establish or reactivate administrative and committee structures within the Department for dealing with program issues in particular, and for providing effective avenues of communication in general.
 - 2.2** The nature of the decision-making process above the level of the Department Head is seen as obscure and contributes to confusion and uncertainty within the Department.
 - 2.3** There is an urgent need for a formal strategic planning process within the Department in order to establish a consensus on priorities, particularly with respect to research, over the next five years and beyond.
 - 2.4** There is an uneven distribution of research activity over the faculty as well as a developing imbalance towards unpublished contract and service research versus fundamental research.
 - 2.5** Processes for monitoring and directing of MSc thesis projects are inadequate.
 - 2.6** There is a lack of recognition and inclusion of academic and technical staff in the decision-making process, as well as a lack of management structure within the complement of technical staff.
 - 2.7** Although external stakeholders speak highly of Earth Science graduates there is clear evidence of alarm at the lack of financial support for basic infrastructure in undergraduate programs which is seen as being in fundamental conflict with the proclaimed first priority of the University.
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3. Undergraduate Programs

Some details of the undergraduate programs were provided in the Self-Study Report and other information was obtained from the student handbook and the University calendar. The Committee also met with several enthusiastic undergraduate students, as well as four employers of graduates from the private and public sectors. Some of these employers were also alumni of the MUN Earth Science programs. The list of graduates and their current employment provided to the Committee is to be applauded and this kind of information would be useful for the review of other units. It is very encouraging to see that most of the graduates have been recruited by major oil and gas or mineral exploration companies, the Provincial Department of Mines and Energy, or have gone on to graduate studies at MUN and other universities.

The enrolment in Earth Sciences programs is about 30 per year for the last 5 years. The maximum possible enrolment is dictated mainly by laboratory sizes. An upper limit of about 50 is probably appropriate without the need to triplicate labs. Hence there is still room for some growth. This growth can be realised with active recruitment and the prospects of highly publicised job opportunities in both the oil and gas, and mineral exploration sectors in the province.

3.1 Response from Students

The sampling of student opinions indicates a generally positive and complimentary attitude towards the Department. The undergraduates appear quite satisfied with the quality of the Earth Science programs. They like the hands-on field and laboratory experiences, the low student-faculty ratio, and the close interaction between the professors and students. They find the professors are accessible, and they have a relaxed and open relationship with them. The undergraduates are particularly pleased with the advice they are getting from the Department through Mr. Ray Pätzold and through the Guidebook which is provided to them. Mr. Pätzold's counselling on course selection and general encouragement and support is a major reason why most students are on track and graduating on time. Mr. Pätzold should also be applauded for the proactive recruitment of students into the Earth Science program. The Committee were told that any students who had received an A in any Earth Science courses in their first years were written a letter by Mr. Pätzold encouraging them to consider Earth Science. He also strongly encourages students to take the Honours program. The Honours program route is partly motivated by requirements for graduate studies and professional registration. This explains the high ratio of Honours to General BSc students as mentioned in the Self-Study Report.

3.2 Response from Employers

The employers interviewed were also satisfied with the graduates of the Earth Science program. They indicated that MUN graduates are particularly strong in the exploration area. They are generally well-rounded with good training in sedimentary basins and structural geology, and the seismic training is as good as anywhere in Canada. There was strong interest from the external stakeholder group in the well-being of the Earth Science Department and it appears their members would be willing to play a more active role in advising the Department. The Committee concurs that this would be very useful to the Department.

Recommendation 3(i): *We recommend that a formal Industry/Government Advisory Group be set up to provide advice and feedback to the Department on curriculum matters as well as other matters that may impact on the industry or the profession.*

3.3 Gender Balance and Length of Programs

The gender balance is good at about 1:1 over the last few years. This is consistent with other programs in Canada. The length of the Honours program is also comparable with those of other universities, i.e. about 5 years. Most delays appear to be caused not by the Department but by late identification of career paths by the students. Those that make up their minds at an early stage normally graduate within 4 to 5 years. However, the Self-Study Report and the undergraduate students we met did indicate that some Earth Science offerings at the 4000 level are not available on a consistent basis which leads to some delays in completion of their degree requirements.

Recommendation 3(ii): *We recommend that the Department institute some longer-term (2-3 year) planning of course offerings, especially at the 4000 level, to minimize delays in completion due to the non-availability of courses.*

3.4 General Service Courses

The four general service courses offered by the Department are three 1000 level courses, *Earth Systems*, *Evolution of Earth Systems*, *Concepts and Methods in Earth Sciences*, and one 2000 level course, *The Solar System*. Except for the Solar System course these courses are generally well subscribed. The lower enrollment in the Solar System course is most likely due to the mathematical background (Mathematics 1000) required of the students.

Recommendation 3(iii): *We recommend that the Department redesign the Solar System course and investigate the possibility of adding new service courses that do not need prerequisites in calculus. This is often done in other universities and has been found to be a good vehicle to promote the study of Earth Science which in turn will lead to a bigger pool of students for recruitment to Earth Science programs.*

3.5 Service Teaching

The Department provides service teaching in the Faculty of Engineering, other departments within the Faculty of Science, and the Faculty of Arts. Biology teaches a service course for Earth Science (Biology for Students of Earth Sciences 2120) and 2 courses are cross-listed with Earth Science (Palaeontology and Advanced Palaeontology) but these are very rarely taken by biology students. The Department of Geography has a steady stream of students doing Geography and Earth Sciences, and there are many Earth Science students doing minors in geography. Scheduling of courses is generally a problem for these students. There are also several faculty members from Geography who are jointly involved with the Department in the MSc program in Environmental Science.

In general, the service provided by the Department is good. However, other departments and Faculties would benefit from more advanced notice of the scheduling and assigned instructors for courses offered by the Department. Faculty members in the

Department have also indicated that they often do not know what they will be teaching from one term to the next.

Recommendation 3(iv): *We recommend a longer-term teaching schedule be prepared for all faculty members so that they know what they will be teaching ahead of time. This will also help other departments and Faculties in scheduling courses within their units.*

3.6 Cooperative Program

The Self-Study Report indicated that the Department is interested in pursuing the possibility of a co-operative program in Earth Science. We do not support this idea. Allocation of the significant human and financial resources that would be required seems unwise given current fiscal constraints. Students are already receiving good training and experience during the summer and in field schools.

3.7 Joint Honours and Interdisciplinary Programs

Currently there are 1 joint-major and 5 joint-Honours programs with Physics, Chemistry, Biology, and Geography. From the information provided in the Self-Study Report it is clear that all joint programs are very poorly subscribed and some more flexible approach is required as an alternative. It is noted in passing that current regulations permit joint programs of this kind to be tailored on demand to meet the specific needs of the occasional students who may be interested. A statement of this kind could appear in the Department section of the Calendar instead of the detailed listing of the current joint programs. An opportunity exists to establish an interdisciplinary program with the Department of Geography whose faculty members are already collaborating via the MSc program in Environmental Science, and there is historical evidence of students taking courses from Geography on a regular basis.

Recommendation 3(v): *We recommend that all joint Honours programs currently listed in the Calendar be discontinued. In their place, we recommend an interdisciplinary program with the Department of Geography.*

3.8 Streaming

We strongly feel that any graduate with an Honours or General degree in Earth Science should have courses in petrology, structural geology, and stratigraphy of some kind beyond the 2000 level. In the opinion of the Committee, too little is specified in general for both Honours and General Degree programs. It is noteworthy that the representatives from the industrial and government sectors also stressed the value of a broad undergraduate Earth-science background. The Department's plan to introduce changes that will increase the number of specified Earth Science credit hours from 17 to 41 for the Honours program is encouraged for consistency with other programs in Canada. However, the Department should keep the above points in mind when introducing the changes. This will also aid the Department in streamlining their offerings and in providing more structure to their program, which may help reduce the time required to graduate.

Recommendation 3(vi): *We recommend that formal streams within the Earth Science programs be eliminated and that the Department offer two degrees: a broadly-based*

BSc in Geology, and a BSc in Geophysics. In the BSc in Geology there could be some informal 'streams' through the choice of course options at the senior level, but the core should be common to all. In the BSc in Geophysics, high-level mathematics courses such as MATH 3202 and MATH 3260 should be required.

3.9 Field Schools and Laboratory Work

We strongly support the approach taken by the Department regarding bringing practical experience to the students through field schools and laboratory work. There was strong support from faculty, technical staff, and students for the continued involvement of faculty members in field schools and teaching laboratories, to maximize the learning experience. The undergraduates, in particular, consider the presence of a faculty member during laboratory and field work to be essential and are strongly opposed to having only Teaching Assistants or Laboratory Instructors running the laboratories and field schools, especially for senior level courses.

Recommendation 3(vii): *We recommend that field and laboratory work continue to be conducted by faculty members and be given the appropriate teaching credits.*

3.10 Equipment and Resources

Equipment for undergraduate teaching in the Department is generally adequate at present given the generally small class sizes. However, much basic equipment such as microscopes and computers for undergraduate use is in serious need of replacement, and/or repairs. The external stakeholders we interviewed were alarmed and upset that the University is not providing the basic infrastructure to the Department to carry out its undergraduate teaching functions. This, they pointed out, is not consistent with the principles and goals stated in the Strategic Framework document for Memorial University as approved by the Board of Regents.

Recommendation 3(viii): *We recommend that the University provide a capital budget to the Department adequate to ensure that basic equipment and other resources for academic use are maintained, or replaced as required, so that the quality of educational experience at MUN is not jeopardized.*

3.11 Delivery of Courses

Alternative delivery methods via Distance Education or Continuing Professional Development (CPD) courses should perhaps be pursued only on an opportunistic basis at present. We feel that given the current Departmental set up and administrative structure, regular offerings by such alternative means would put significant stress on the human and financial resources of the Department while contributing little to its core mission. CPD courses would depend heavily on market demand and on the availability of instructors. In considering the opportunistic approach the Department should look into imaginative ways of offering CPD courses.

Recommendation 3(ix): *We recommend that the Department not consider alternative delivery of courses in any formal way.*

3.12 Honours versus General Degrees

Currently registration as a Professional Geoscientist in Newfoundland and Labrador is automatic with an Honours degree. However, registration as a professional geoscientist is still possible as long as the minimum knowledge for registration set out by the Canadian Council of Professional Geoscientists is met. Knowledge or content based registration is used in many other jurisdictions. If students are advised of the appropriate course selections that will meet the requirements for registration without an Honours degree, this will liberate resources for research or other teaching duties and lighten the burden of supervising Honours students during the summer term for many faculty members.

Recommendation 3(x): *We recommend that the planned changes to the number of specified credits as mentioned in the Self-Study Report and discussed in Section 3.6 take into consideration the alternate route to professional registration through content based registration rather than an Honours degree.*

4 Graduate Programs

The Committee met with 6 graduate students from the Department, from a range of disciplines. All were MSc students. They expressed a generally high level of satisfaction with their research programs, quality of supervision, research facilities, and opportunities to attend conferences etc., but commented on the need for improvement in administrative aspects of the graduate program as well as better defined expectations of graduate students. The Department has done a masterful job in tracking the placement and career paths of graduate alumni and the success of these students is testament to the overall quality of the graduate program.

The Committee also met with external stakeholders from government, oil and gas, and minerals sectors. These individuals expressed positive views about the quality of graduate students from the Department, reflected by their willingness to provide cash and in-kind support for graduate student thesis research.

4.1 Number of Graduate Students

The Department currently has 44 MSc and 11 PhD students registered in its graduate programs. In loosely-defined research areas within the Department, there are 17 students in the “hard-rock/minerals” discipline group, 12 in the “soft-rock/petroleum” group, 15 in “geophysics” and 7 in the emerging “environmental/engineering” group. There are also 4 MSc students within joint programs in the Department, primarily the Environmental Science Program. The split between PhD and MSc students within these cohorts was not provided.

Enrolment in the graduate program has followed a cyclical pattern in the past decade, falling from a total of about 60 (24 PhD’s, 36 MSc’s) in the early 1990’s to a low of about 30 in total in 1998. This trend is similar to graduate enrolment trends at most other Earth Science Departments across Canada and the United States. The recovery to the present enrolment number (of ~55) has been exclusively at the MSc level, with the number of PhD students remaining steady at around 10. The increase in enrolment at the MSc level is attributed, to some extent, to the fact that this degree has become the

de facto entry-level qualification into the oil and gas and minerals industries in recent years.

The goal of the Department is to increase graduate enrolment to at least 75 (average of 3 students per faculty member) by the end of 2006. This ambitious goal is supported by the Committee, but it will require additional resources as well the establishment of a balanced graduate admissions/funding protocol and monitoring program by the Department. Increasing graduate enrolment will be challenging since the pool of potential graduate students across Canada has been decreasing in recent years and competition from other institutions in Canada will be strong. However, the lack of significant differential fees for foreign students at Memorial University provides a meaningful competitive advantage in attracting students from outside of Canada, when compared to the fee structures at many other Canadian universities. The Committee noted that the present number of PhD students is low for the faculty complement and the Department is strongly encouraged to increase the ratio of PhD to MSc students during the expansion of its graduate program.

Recommendation 4(i): *We recommend that the Department pursue proactively its goal of increasing graduate student enrolment to 75 by the end of 2006, but with the concomitant goal of increasing the ratio of PhD to MSc students over this period.*

4.2 Time to Completion

Average residence times in graduate programs were reported to be 4.5 years for MSc students and 6 years for PhD students, but these times include the examination and thesis revision periods that were estimated by the Department to be between 8 months and 1 year in duration. Thus the Department claims time-to-completion of about 3.5 years for the MSc degree and 5 years for the PhD degree programs. The latter number is similar to that in many other Canadian programs, but the former is viewed by the Committee as longer than average. Professional employment prior to thesis completion and defence was given as one possible reason for the long time to completion for MSc students. It would be very useful for the Department to be able to separate time-to-completion from time-on-campus as a 'full-time' students in order to better understand (and defend) completion times. It was felt by the Committee that completion times could be reduced by the Department initiating a comprehensive monitoring program for graduate students, particularly those in the MSc program.

Recommendation 4(ii): *We recommend that the Department implement a comprehensive monitoring program for graduate students. In the case of the MSc program, mechanisms should be established for constructive feedback following submission of the thesis proposal and to track student progress on a yearly basis.*

4.3 Required Course Work

MSc students at Memorial are required to take a minimum of 6 graduate-level course credits (2 x 1-semester courses), normally to be completed within 12 months of initial registration in the program. PhD students are required to complete a minimum of 12 graduate-level course credits. MSc students interviewed by the Committee indicated that the availability of graduate courses was sometimes a problem for graduate students, and more so for geology courses than for geophysics courses. Twenty-six graduate courses are currently listed in the University Calendar.

In the Committee's opinion, the Department should require more courses for MSc students, with the goal of enhancing both the breadth and depth of knowledge obtained by graduate students; the recommended number is 4 x 1 semester courses (12 credit hours). The Committee recognizes that the ability of the Department to deliver graduate-level courses may be bound to some extent by the Collective Agreement at the University with respect to prescribed teaching loads. However, the Committee suggests that the Department could achieve the goal through a number of mechanisms, including:

- Streamlining the undergraduate teaching program (see Recommendation 3(vi)).
- Developing more team-taught courses that could be either discipline-specific or overview in nature, thus minimizing the load on any one particular faculty member. The three overview courses currently identified in the Calendar could be augmented through this approach and offered on a more frequent basis.
- Maximising efficiencies in disciplines that involve instrumental analysis or advanced computer software through graduate courses in which there is a significant instrumental or software training laboratory component. Involvement of departmental technical support staff in these courses would not only be effective for the graduate students, but it would also engage technical staff directly in the formal teaching function of the Department. Faculty reported that such a course in Instrumental Analysis had been taught in the past but is no longer offered.
- Introducing a Reading or Independent Study course to upgrade students' skills in modern methods of accessing information and in mining the literature. Information Resources staff (formerly known as Librarians) could be accessed in this type of course.
- Including courses from other Departments or Faculties as acceptable graduate credit in a student's program. Currently, several graduate students reportedly sit in on one or more graduate-level courses in the Faculty of Engineering and Applied Science. These courses could be reviewed and included as credit courses in the Earth Sciences Department.

The Committee was surprised to discover that graduate students are not required to give a seminar or make presentation to the Department at any stage during their graduate program. Such requirements are common in other Canadian graduate programs with which members of the Committee are familiar. We believe that the Department should introduce a formal seminar program for graduate students, either within the structure of a graduate course, or as a graduation requirement.

Recommendation 4(iii): *We recommend that the number of required credit hours for the MSc program be increased to 12.*

Recommendation 4(iv): *We recommend that all graduate students be required to give at least one public presentation within the Department during their graduate program.*

4.4 Administration of Programs and Student Funding

It was unclear from the Department's Self-Study Report and from the Site Visit exactly what functional internal administrative and monitoring procedures currently exist for the

MSc program. For example, MSc students are required to submit a thesis proposal but evaluation of, and feedback on, the proposal appear to be lacking. Annual reports from students are submitted, but expectations are unknown and the quality and detail of reports are highly variable. The Committee considers that a more tightly structured MSc program would help to alleviate concerns about time to completion and costs per student, as well as the perception that some faculty members prefer well-qualified research assistants in place of MSc students.

The mechanism for accepting graduate students into the program is poorly understood and the awarding of Graduate Student Fellowships within the Department apparently is based strictly on GPA. There is considerable concern within the Department about the lack of transparency in the awarding of funds to graduate students, particularly in light of significant levels of targeted funding coming to the Department through several new external initiatives.

Based on information provided during the APR Site Visit, a Graduate Coordinator has recently been appointed in the Department, and the duties of the Undergraduate Advisor have been expanded to now also include academic advising of graduate students. The Committee views these developments as a positive step which should be augmented in accordance with the following recommendations.

Recommendation 4(v): *We recommend that a Graduate Program Committee be struck, chaired by the Graduate Coordinator, with representation from a wide spectrum of disciplines within the Department.*

Recommendation 4(vi): *We recommend that the Graduate Program Committee be responsible for overseeing and approving all recommendations to the Faculty of Graduate Studies for the admission of graduate students to the graduate programs in the Department.*

Recommendation 4(vii): *We recommend that the Graduate Program Committee establish fair and equitable criteria for the awarding of graduate funding, teaching assistantships and other scholarship support to students.*

Recommendation 4(viii): *We recommend that the Graduate Program Committee be given the authority to award graduate funding, teaching assistantships and other scholarship support to students in the graduate program.*

4.5 Course-based Programs

In the Self-Study Report, the Department raised the issue of building the graduate program through a course and/or project-based program for targeted fields. The structure of such a program would be self-sustaining through an appropriate fee schedule and viewed as revenue-generating for upgrading teaching equipment. However, no market studies were reported in the Self-Study Report to predict the success of this type of program.

Recommendation 4(ix): *We recommend that the Department undertake a market study to determine the feasibility of a fee-based graduate program prior to committing resources to develop such a program.*

5. Research and Scholarship

5.1 External Funding and Faculty Complement

The Department has been exceptionally successful, both in the context of Memorial University and in the context of Canadian Earth Sciences, in the pursuit of research support from outside sources. The funding and positions associated with the PanAtlantic Petroleum Systems Consortium (PPSC) will immeasurably strengthen the Department in the general area of petroleum geology, and the Inco Innovation Centre (IIC) will significantly enhance the already strong analytical capability of the Department. There is, however, a clear possibility that these developments, particularly in the PPSC, will significantly change the research foci of the Department if they are used by the University as an argument for not replacing upcoming retirement positions. At this stage it is unclear to members of the Department and to the Committee whether the University regards these new positions as additional to current and future staffing, or as replacements for future retirees. Which of these options is chosen, and to what extent, could influence the choice of occupants for these positions.

Recommendation 5(i): *We recommend that the University provide clear guidelines on whether the new Chairs in the PPSC are additions to the current staffing of the unit or replacements for future retirees, before the selection process for the Chairs begins.*

5.2 The Range of Research Activities

The Department has a well-established reputation as a leading Earth Science research institution in Canada. Several members of the Department publish frequently in the international scientific literature and are well known in the Earth Science community, both within and outside Canada. The proportion of the faculty that participate in this way is, however, lower than is typical for a Canadian Earth Science department. This is reflected in the extent to which research within the Department is supported by Discovery Grants from the Natural Sciences and Engineering Research Council (NSERC). The number of faculty members with NSERC Discovery Grants above the median granting levels for the Earth Science granting committees is small, and several faculty members hold no NSERC Discovery Grants.

Some research in Earth Sciences, particularly when conducted in association with industrial partners, is not directly suitable for publication in international scientific journals. The Committee recognizes that several members of the Department are active in research of this type, and that such research provides excellent opportunities for the development of highly qualified graduate students. Nonetheless, the Committee is concerned that an appropriate balance between fundamental research and research in the service of industry is not being maintained. There is a danger that this situation may deteriorate further with the advent of personnel associated with the new funding coming from the PPSC.

Recommendation 5(ii): *We recommend that the Department encourage wider participation of faculty members in publication of their research activities in international journals.*

Concern was expressed in the Self-Study Report that the greater availability of research funding for dedicated research emanating from new outside funding sources might

result in marginalization of individual researchers and their graduate students if they are not directly involved in the dedicated research. The Committee strongly endorses the principle expressed in the report that all research in the Department should be valued.

Recommendation 5(iii): *We recommend that the Department establish mechanisms to ensure that the limited central funds for the support of graduate students are used to optimize the research activities of as many departmental researchers as possible, regardless of the availability of external funds to support research.*

5.3 Future Directions

There is some discussion in the Self-Study Report concerning future directions that should be pursued by the Department. In particular, there are suggestions that the Department should develop greater strengths in areas related to natural resources and environmental geoscience. The PPSC appointments address at least one subset of the first of these developments, but the commitment to environmental geoscience in particular appears rather tentative. The development of a stronger environmental geoscience group within the Department would be timely, and consistent with strategic thrusts within the University, but it would require a stronger commitment from the Department than has so far been demonstrated. There is no indication that the Department has reached consensus, or even agreement, on which areas should in fact be given priority in any new positions. Without such agreement, no compelling case can be made to the administration for the hiring of faculty to replace those who retire or resign. Pursuant to Recommendation 5(i), the committee recognizes that such discussions within the Department may not yet have taken place because of uncertainty in the long-term status of the externally funded appointments to be made through the PPSC and IIC.

Recommendation 5(iv): *We recommend that the Department arrange a series of meetings or retreats, as soon as possible, to establish a coherent long-term plan for the Department. This plan should include identification of the areas in which the Department intends to develop new strengths, which areas can potentially be strengthened through the pursuit of further external funding, and which could be filled through the replacement of retiring faculty without unduly compromising the existing strengths of the Department.*

6. Faculty and Staff Issues

Some issues affecting faculty have already been addressed in sections 3.5, 3.9, 5.1, and 5.3. Here we focus on the Key Issues identified as 2.1, 2.2, and 2.6.

6.1 Communication and Collegiality

A recurring theme throughout discussions with both faculty and staff was that of a general lack of communication within the Department. While this can be attributed in part to the physical size of the building in which the Department resides it must also be recognized as a problem that needs to be addressed in the interests of establishing a collegial atmosphere and a healthy level of morale within the Department. An effective solution to this problem cannot be mandated but can only be promoted over time by actions designed to encourage inclusiveness and by removing, where possible, the impediments that currently exist. Actions as simple as instituting a daily Departmental

coffee break and organizing the occasional social function should not be discounted as insignificant.

The existence of an active committee structure to provide advice and recommendations to the Head is of particular importance in this connection. A common structure appropriate for this Department would involve an all-inclusive Faculty Committee or Faculty/Staff Committee with targeted and annually reconstituted subcommittees that report to it. These (sub)committees could be authorized to act autonomously in certain restricted areas, and the Graduate Program Committee already proposed from a different perspective under Recommendation 4(v) is an example. Here it is emphasized that such a committee is essential in providing a valued participatory role for Department members in administration and in the decision-making process. Notwithstanding the applauded performance of the Undergraduate Officer (Mr. Pätzold), it is equally important for faculty and relevant staff members to be included in decisions affecting undergraduate studies via a parallel Undergraduate Program Committee. This minimal structure could be expanded as deemed appropriate; for example, to include a Social Committee.

Available information indicates that the equivalent of a Faculty Committee exists in the Department but meets only on an occasional basis, and is poorly attended. It was suggested by some Department members that this is representative of a general apathy which follows from the perception that there is no effective means of influencing the course of events. We understand from late information that a committee structure similar to that suggested above has recently been revived. This could be a significant development. The future prospects of the Department will be determined in an important measure by the success of this exercise.

Recommendation 6(i): *We recommend that the Department Head reactivate an effective advisory committee structure within the Department and promote the involvement of all Department members in the decision-making processes.*

6.2 Internal Administrative Structure and Staffing

The internal reporting structure for staff appears to be in a transitory state, or at worst in a state of disarray. Feelings of confusion, isolation, and discontent were expressed by several members. It is doubtful that existing staff resources are being effectively utilized under these circumstances. It is likely that this is the result, at least in part, of inadequate staffing in some areas, and a satisfactory solution may only emerge when the staffing issues have been resolved. Under the assumption that a strong role for faculty members in the undergraduate laboratories is maintained, there is a need for one additional staff person in the Departmental General Office and additional support in the area of equipment maintenance and repair. Notwithstanding this addition to the staff, it is important that a stable internal managerial structure be established and regular meetings with the Head be scheduled to address any problems that are identified.

Recommendation 6(ii): *We recommend that the complement of staff in the Departmental General Office be increased by one and that one additional support person be assigned to the area of equipment maintenance and repair.*

6.3 Workloads

The Self-Study Report contained no information that would enable the Committee to assess the average overall workloads of faculty members in any meaningful way.

7 University and Community Service

Information in this area is available only through scanning of the faculty resumé's supplied. Not surprisingly the distribution of these activities over the faculty is quite uneven. Six individuals listed significant levels of involvement with Faculty and University level committees. In the broader perspective, and with some overlap, six individuals listed activities of significance at the local community and national levels. At least three faculty members are noted for impressive levels of service in both areas. On average the Department's record compares favorably with others in the University.

8 University Support

8.1 Resources

Given the sequence of upcoming retirements and short term external funding for new positions under the PPSC and IIC initiatives the faculty complement is clearly in a state of flux. The question of whether faculty numbers will be adequate for the delivery of programs in the future cannot be answered until a response to Recommendation 5(i) is forthcoming.

As noted in Section 5.1 the Department has achieved a remarkable level of success in attracting external research funding. This is no doubt due in part to the active participation and logistical support of the University in recognizing the potential benefits. At the same time it is appropriate to raise a warning flag because the lack of support for basic resources at the undergraduate level (see Section 3.10) will eventually have a comparable negative affect on the research effort through a decline in the quality of the undergraduate programs. To repeat a metaphor contributed by one of the external employers, "the Department's research has taken on the attributes of a high performance racing machine while the condition of the race track is being neglected".

Recommendation 8(i): *We recommend that the infrastructure requirements of relevant undergraduate programs be included in any future negotiations for external research funding from industry and that avenues should be explored for targeting some fraction of the funding accordingly.*

8.2 External Managerial Structure

While the reporting structure above the Department level is clearly defined, there is evidence that, perhaps in the interests of expediency, it is being short circuited by direct communication between the senior administration and the Head. Further to the comments of Section 6(i), this has contributed to feelings of exclusion among the Department faculty and staff because important developments can occur without advance notice or consultation. The persistence of this situation will most likely lead to more problems than it solves.

Recommendation 8(ii) : *We recommend that any irregularities in reporting through the administrative structure above the Department level be resolved without delay.*

In the foregoing context brief discussions were engaged with some Department members regarding the idea of changing the Unit's status from a Department to a School. The Committee is of the opinion that such a change should not be contemplated only on the basis of what may be a temporary administrative anomaly.

9 Summary of Recommendations

Recommendation 3(i): *We recommend that a formal Industry/Government Advisory Group be set up to provide advice and feedback to the Department on curriculum matters as well as other matters that may impact on the industry or the profession.*

Recommendation 3(ii): *We recommend that the Department institute some longer-term (2-3 year) planning of course offerings, especially at the 4000 level, to minimize delays in completion due to the non-availability of courses.*

Recommendation 3(iii): *We recommend that the Department redesign the Solar System course and investigate the possibility of adding new service courses that do not need prerequisites in calculus. This is often done in other universities and has been found to be a good vehicle to promote the study of Earth Science which in turn will lead to a bigger pool of students for recruitment to Earth Science programs.*

Recommendation 3(iv): *Similar to Recommendation 3(ii), we recommend a longer term teaching schedule be prepared for all faculty members so that they know what they will be teaching ahead of time. This will also help other departments and Faculties in scheduling courses within their units.*

Recommendation 3(v): *We recommend that all joint Honours programs currently listed in the Calendar be discontinued. In their place, we recommend an interdisciplinary program with the Department of Geography.*

Recommendation 3(vi): *We recommend that formal streams within the Earth Science programs be eliminated and that the Department offer two degrees: a broad based BSc in Geology, and a BSc in Geophysics. There can be some informal 'streams' through the choice of course options at the senior level, but the core should be common to all. In the BSc in Geophysics, high-level mathematics courses such as MATH 3202 and MATH 3260 should be required*

Recommendation 3(vii): *We recommend that field and laboratory work especially at the senior levels should be continued to be conducted by faculty members and be given the appropriate teaching credits.*

Recommendation 3(viii): *We recommend that in order for the University to be true to its mission, must provide the necessary capital budget to the Department to ensure that basic equipment and other resources for academic use are adequately maintained, or replaced as required so that the quality of educational experience at MUN is not jeopardized.*

Recommendation 3(ix): *We recommend that the Department not consider alternative delivery of courses in any formal way. However, the Department is encouraged to investigate imaginative ways of offering CPD courses perhaps together with other units or organizations.*

Recommendation 3(x): *We recommend that the planned changes to the number of specified credits as mentioned in the Self-Study Report and discussed in Section 3.6 take into consideration the alternate route to professional registration through content based registration rather than an Honours degree.*

Recommendation 4(i): *We recommend that the Department pursue proactively its goal of increasing graduate student enrolment to 75 by the end of 2006, but with the concomitant goal of increasing the ratio of PhD to MSc students over this period.*

Recommendation 4(ii): *We recommend that the Department implement a comprehensive monitoring program for graduate students. In the case of the M.Sc. program, mechanisms should be established for constructive feedback following submission of the thesis proposal and to track student progress on a yearly basis*

Recommendation 4(iii): *We recommend that the number of required credit hours for the MSc program be increased to 12.*

Recommendation 4(iv): *We recommend that all graduate students be required to give at least one public presentation within the Department during their graduate program.*

Recommendation 4(v): *We recommend that a Graduate Program Committee be struck, chaired by the Graduate Coordinator, with representation from a wide spectrum of disciplines within the Department.*

Recommendation 4(vi): *We recommend that the Graduate Program Committee be responsible for overseeing and approving all recommendations to the Faculty of Graduate Studies for the admission of graduate students to the graduate programs in the Department.*

Recommendation 4(vii): *We recommend that the Graduate Program Committee establish fair and equitable criteria for the awarding of graduate funding, teaching assistantships and other scholarship support to students.*

Recommendation 4(viii): *We recommend that the Graduate Program Committee be given the authority to award graduate funding, teaching assistantships and other scholarship support to students in the graduate program.*

Recommendation 4(ix): *We recommend that the Department undertake a market study to determine the feasibility of a fee-based graduate program prior to committing resources to develop such a program.*

Recommendation 5(i): *We recommend that the University provide clear guidelines on whether the new Chairs in the PPSC are additions to the current staffing of the unit or replacements for future retirees, before the selection process for the Chairs begins.*

Recommendation 5(ii): *We recommend that the Department encourage wider participation of faculty members in publication of their research activities in international journals.*

Recommendation 5(iii): *We recommend that the Department establish mechanisms to ensure that the limited central funds for the support of graduate students are used to optimize the research activities of as many departmental researchers as possible, regardless of the availability of external funds to support research.*

Recommendation 5(iv): *We recommend that the Department arrange a series of meetings or retreats, as soon as possible, to establish a coherent long-term plan for the Department. This plan should include identification of the areas in which the Department intends to develop new strengths, which areas can potentially be strengthened through the pursuit of further external funding, and which could be filled through the replacement of retiring faculty without unduly compromising the existing strengths of the Department.*

Recommendation 6(i): *We recommend that the Department Head reactivate an effective advisory committee structure within the Department and promote the involvement of all Department members in the decision-making processes.*

Recommendation 6(ii): *We recommend that the complement of staff in the Departmental General Office be increased by one and that one additional support person be assigned to the area of equipment maintenance and repair.*

Recommendation 8(i): *We recommend that the infrastructure requirements of relevant undergraduate programs be included in any future negotiations for external research funding from industry and that avenues should be explored for targeting some fraction of the funding accordingly.*

Recommendation 8(ii) : *We recommend that any irregularities in reporting through the administrative structure above the Department level be resolved without delay.*