New Graduate Program Proposal
Memorial University of Newfoundland

Master of Science in Boreal Ecosystems and Agricultural Sciences (MSc BEAS)

Proposed by:

Dr. Robert Gallant, Head of Division
Division of Science, Grenfell Campus
Email: rgallant@grenfell.mun.ca

Dr. Adrian Unc, Associate Professor, Grenfell Campus
Boreal Ecosystem Research Initiative, Grenfell Campus
Email: aunc@grenfell.mun.ca

Date: May 07, 2015

Anticipated start of new program: Fall 2015

Table of Contents

1. Executive summary

The Division of Science at Grenfell Campus is proposing to offer an inter-disciplinary graduate degree program titled Master of Science in Boreal Ecosystems and Agricultural Sciences (MSc BEAS).

With a long-standing reputation in the field of environmental studies and environmental sciences, Grenfell Campus has offered a variety of programs and degrees in the environmental field since 1995. Today, Grenfell Campus offers four bachelor-level environmental degree programs and a Master of Arts in Environmental Policy. The development of an additional Master program in the environmental field is recognition of both the maturity and capacity of Grenfell Campus' academic strength.

The development of this new graduate program at Grenfell Campus has been spearheaded in part by the Grenfell Campus Strategic Plan, which includes the need for expanding the scope for research based graduate education and thus increasing student enrolment at the graduate level. A fundamental part of the campus strategic plan has centered around the development of environmental programs and research at Grenfell as a basis to help increase enrolment, stimulate the regional economy, and develop a niche research area that would set Grenfell Campus apart from other small campuses. Existing partnerships with provincial and federal agencies provided context for the development of applicable and relevant research programs to meet key research objectives of local, provincial and national agencies, and the needs expressed by the environmental industry. Primary research areas include boreal ecosystem and agricultural science, which is inclusive of more broadly-based environmental science.

Since the initiation of program planning for the Master of Science in Boreal Ecosystems and Agricultural Sciences, Grenfell Campus has completed major steps toward the development of research and graduate programing: 1) construction of a $4M Boreal Ecosystem Research Facility, opened on March 28, 2014, 2) hiring of 5 research professors for the Boreal Ecosystem Research Initiative, 3) the purchase and installation of over $5M in major research equipment, and 4) the hiring of 2 laboratory coordinators to support the equipment and research requirements in the laboratories. The investment in facilities, equipment and human resources has prepared Grenfell Campus to conduct world-class research in boreal ecosystems and agricultural science.

Consultations within Memorial University to date, and with external agencies and industry have resulted in support for the initiative at the local, provincial and national level. The ability of the laboratories to not only support graduate research, but to also potentially provide industrial support for the testing and analysis of environmental materials and processes in the future, will result in the reduction of analysis costs and time to corporate partners. The full capacity of Memorial University, including its campus in St. John's, Grenfell Campus, and the Labrador Institute, will ensure that the research strength of the proposed program in Boreal Ecosystems and Agricultural Science will benefit a broad spectrum of local, provincial and national interests.

The MSc BEAS program will be offered in a "thesis only" format for the initial five-year period. This will allow time for the Campus to determine the success of the program in attracting suitable candidates, to determine their success in the academic or corporate sector and offer more flexibility for both students and the MSc BEAS program to evolve based on the clientele it attracts. A course-based program may be considered after the initial five-year period where demand from industry would permit candidates to work in areas of general interest and on specific related projects that can provide suitable background and experience to supplement program course requirements.

Enrolment for the MSc BEAS program would initially begin with an estimated five to eight (5-8) students with an estimated initial enrolment cap of fourteen to twenty (14-20) students annually. Any further expansion in enrolment will be governed by research grant success rates of the affiliated faculty members. Proposed tuition fees are consistent with Memorial University's School of Graduate Studies fee structure of $4,398/program ($2,199/year) for Canadian students, and $5,718/program ($2,859/year) for international students. See the Budget in Section 7 for details. With the proposed fees, resources required for successful implementation and maintenance of the programs are available within Memorial University, and Grenfell Campus more particularly.

2. Program description

2.1 Degree: Master of Science in Boreal Ecosystems and Agricultural Sciences

2.2 Short Name: MSc BEAS

2.3 Academic Unit: Division of Science, Grenfell Campus, Memorial University

2.4 Administrative Unit: Division of Science, Grenfell Campus, Memorial University

2.5 Study areas: Boreal Ecosystems and Agricultural Sciences, with emphasis in, but not limited to Economics and Social Science, Soil and Land Resource, Plant Science, and Water Resources

2.6 Intended learning outcomes: The Master of Science in Boreal Ecosystems and Agricultural Sciences (MSc BEAS) program will provide graduate students with advanced knowledge and skills in theoretical and technical advances in boreal ecosystem science and agriculture. The program scope will include the following learning outcomes: 1) ability to conduct basic and/or applied research relevant to boreal ecosystems and agriculture, 2) ability to conduct research programs funded through grants awarded to the advising faculty, allowing for both academic and industrial inputs into the study program according to the interests of the graduate students, and 3) students will acquire professional writing skills reflective of Master of Science graduates. The Master's program will focus on developing personal, methodological and scientific skills, within an interdisciplinary context, including the acquisition of quantitative and qualitative analysis skills relevant to their area of specialization.

2.7 Overview: The proposed MSc BEAS has been initiated to expand into areas that are not evident in the existing MSc in Environmental Science at the St. John's Campus. The MSc BEAS program is driven by need (provincial agricultural and forest research), integrating the newly developed Boreal Ecosystems Research facility laboratories and hired expertise within the Boreal Ecosystems Research Initiative at the Grenfell Campus. The MSc BEAS will complement the existing social science-oriented Environmental Policy Institute (EPI), which facilitates debate, research and capacity building on critical environmental policy challenges relevant to Newfoundland and Labrador.

In conjunction with the newly developed research capabilities this natural science-based graduate program will enhance the academic environment of Grenfell Campus, and provide opportunities for graduate students and experts in boreal ecosystems and agricultural science to develop new knowledge and applications to solve environmental problems. Grenfell Campus is therefore proposing to offer a new graduate program, Master of Science in Boreal Ecosystems and Agricultural Sciences (MSc BEAS) with study concentrations matched to the skills and expertise of existing and new faculty members.

3. Statement of justification

The development of graduate programs at Grenfell Campus has been spearheaded, in part by the Grenfell Campus Strategic Plan[1], which includes increasing student enrolment at the graduate level:

"Strengthen our identity as an excellent small university with distinctive academic and research programs.

Goal 2: Introduce new undergraduate and graduate programs and expand opportunities for other learning experiences.

Goal 3: Promote Grenfell Campus' research activities and programs and implement changes to ensure a productive research environment.*"*

Grenfell Campus Strategic Plan 2014

In the development of a campus strategic plan, significant consideration and discussion was centered around the development of environmental programs and research at Grenfell as a basis to help increase enrolment, stimulate the regional economy, and develop a niche research area that would set Grenfell Campus apart from other small campuses. The concept of creating an environmental cluster around our existing post-secondary institutions and resource base originated with academic and community leaders who saw an opportunity to grow the knowledge economy in the Western Region of the province. While much has changed since the original concept was first proposed, Grenfell Campus is now in a position to present a clear, focused and achievable approach to developing enhanced environmental programs and research, in particular at the graduate level.

Through the existing partnership with the Canadian Forest Service (Natural Resources Canada), and the addition of new partnerships with the provincial Forest and Agrifoods Agency (Department of Natural Resources), and Agriculture-Agrifoods Canada (Government of Canada), Grenfell Campus has reinforced its relationship with these agencies in the development of shared, applicable and relevant research programs. Additional opportunities for research and environmental services (i.e. municipal water testing / environmental assessments / mining research) applicable to regional, provincial or national environmental problems may emerge from existing research faculty, new research faculty hiring, industry partners, and graduate students.

In a study conducted for the Office of the President, Memorial University of Newfoundland, Goss and Harvey (2012) noted:

> *"as the [Grenfell] Campus moves to a culture of intensive research, means will have to be found to provide faculty with sufficient time to carry out research activity including the teaching and supervision of graduate students…. It would therefore be desirable to have a mechanism whereby the appointed faculty to this area plus other faculty who would like to have some input into the area could function together as a unit.* ***We support the development of a graduate-level academic/research unit, perhaps an "institute", based at the Grenfell Campus.*** *This unit could contain as full time members the newly appointed and any seconded faculty and have as associate or part time members any faculty or outside researchers who can make a contribution to its goals. The unit would then be responsible for appointments, assignment of duties and career development decisions as well as strategic planning for the area". (pp. 8-9)*

[1] Grenfell Strategic Plan 2014 is available at: http://www.swgc.ca/administration/Pages/strategic-plan.aspx

Based on the advice of Goss and Harvey (2012), Grenfell Campus initiated program planning for the Master of Science in Boreal Ecosystems and Agricultural Sciences (MSc BEAS), including: 1) construction of a $4M boreal ecosystem research facility, 2) hiring of 5 research professors, 3) the purchase and installation of over $5M in major research equipment, and 4) hiring of 2 laboratory coordinators to support the equipment and research requirements in the laboratories. The significant investment in facilities, equipment and human resources has prepared Grenfell Campus to effectively conduct world-class research in boreal ecosystem and agricultural sciences.

3.1 Benefits to Grenfell Campus and Memorial University

Grenfell Campus and Memorial University are growing, and along with the increase in the student base, programs that meet current and anticipated demand need to be rationalized, developed, and initiated. Grenfell Campus has graduated students in environmental science since 1998, and many of these graduates have moved into greater leadership and research-based positions. Many of these positions, and others which are on the market today, require a science-based Master degree.

The environmental research demands in this country, and globally, are expanding as the world faces greater environmental challenges and demands. Climate change, food security, and the production of resource based products all create immediate knowledge challenges. The proposed MSc BEAS will provide opportunities to develop the expertise to meet these challenges. The program will support both the need for increased student enrolment at Grenfell Campus and the demand for specialized programs in environmental science. With the hiring of five professors and two laboratory coordinators, Grenfell Campus is in a position to lead academic programming across Canada and North America in boreal ecosystems and agricultural research.

The proposed MSc BEAS graduate program will support Memorial University's strategic plan[2].

i. Serve students by:

- Accessing and potentially providing financial support to graduate students collaborating on projects led by faculty
- Giving access to a unique Master degree valuable for both the Canadian and the international labour market
- Providing innovative, cutting edge applied science experiences to graduate students that will assist them in transitioning to employment
- Facilitating graduate student research by suggesting research priorities and offering necessary and sufficient resources and research support
- Supporting the development of the future graduate programs at Grenfell Campus and within the Memorial University system

ii. Contribute to Memorial University's research agenda:

- Secure external funding for research formulation and dissemination
- Promote the research profile of Grenfell Campus by:
  - Creating and maintaining cross-disciplinary collaboration
  - Disseminating research findings
  - Collaborating with and sharing research findings with community and industry stakeholders in the province
  - Supporting new research and new researchers
  - Helping secure funding for graduate student researchers
- Fill a significant gap in environmental analysis needs for the province, particularly for soil, plant, water and air

[2] The 2014-17 Strategic Plan for Memorial University is available at www.mun.ca/ciap/Planning/plans_and_annual.php

- Build on Memorial University's existing strengths in diverse environmental fields in the social sciences, humanities and sciences and hone these strengths toward environmental analysis and development

iii. Contribute toward institutional responsibility:

- Support research and provide leadership on campus by linking with and supporting the President's Advisory Committee on Sustainability (PACS) at Grenfell Campus and the Advisory Committee on Sustainability (ACS) and the Earth and Human Systems Sustainability Initiative (EHSSI) in St. John's.

The proposed MSc BEAS graduate degree program will benefit Grenfell's students (goals 1 and 4 of the Grenfell Campus Strategic Plan[3]) by helping to connect graduate students to meaningful research experiences. The graduate program will strive to hire students to provide hands-on experience with research work that combines knowledge and develops skills in the sciences.

By contributing to and focusing on Grenfell's current environmental programs, the MSc BEAS graduate degree program will further strengthen Grenfell Campus' appeal as a "destination of choice" (goal 5) for environmental research and studies. The presence of an environmental science Master degree program at Grenfell Campus demonstrates it as a place where research is engaged with real-world problems, and this is greatly appealing to students.

Finally, as the MSc BEAS graduate degree program develops from the Boreal Ecosystem Research Initiative (BERI), it will increasingly create connections opportunities to other universities and researchers (goal 6), as required by specific projects, conferences, retreats and summer schools.

3.2 Benefits to the Province of Newfoundland and Labrador

The MSc BEAS graduate degree program is designed to provide a pool of talented and well-trained researchers. With the province of Newfoundland and Labrador's expanding development in mining, oil and gas, and renewable energy, as well as the increased need for food production and secondary wood fibre production, many graduates will potentially work with environmental and natural resource-based companies and organizations in the province. Many graduate students in the program will likely choose local and national companies in which to conduct their research, further increasing their chances of obtaining employment in the province after graduation. Companies such as NALCOR, Anaconda Mining, AMEC, Vale Minerals, and an increasing number of members of the Newfoundland and Labrador Environmental Industry Association (NEIA) are growing, and with their growth comes the demand to increase their environmental programs and services. The mission of Memorial University's Labrador Institute "to facilitate the capacities of the university on the needs and interests of Labradorians" provides both the mandate and impetus for research opportunities in Labrador. Collaborating with the Labrador Institute on its research program, and bringing Grenfell Campus expertise in cool climate, cold-crop and northern forest ecological research would assist in understanding and directing the sustainable development challenges of Labrador.

The MSc BEAS graduate degree program will address the needs of the province specifically by: 1) studying and advising on environmental issues impacting Newfoundland and Labrador; 2) collaborating with government, local communities and other institutions to respond to provincial needs for environmental research and sustainable expansion of land-based economic activities; 3) collaborating with the Labrador Institute and Aboriginal communities to support environmental research relevant to Aboriginal communities, and 4) supporting the attraction and retention of out-of-province and international student researchers at both the undergraduate and graduate levels.

[3] Grenfell Strategic Plan 2014 is available at: http://www.swgc.ca/administration/Pages/strategic-plan.aspx

3.3 Benefits to the Greater Academic Community, Including Potential Students

The Master of Science in Boreal Ecosystems and Agricultural Sciences program will meet the needs of students seeking a research-based graduate degree program in the environmental field in Newfoundland and Labrador. It is anticipated that student demand would come initially from graduates of undergraduate science programs at Memorial University, but as the program becomes known, it will attract students from North America and global markets. Matched with the existing Master of Arts in Environmental Policy (MAEP) at the Grenfell Campus, the MSc BEAS graduate degree program will provide students with the option of pursuing a social science or natural science graduate degree in the environmental field. In the process of developing the graduate program, letters of support[4] for research facilities and expertise in boreal ecosystem and agricultural science were received from the following individuals and agencies:

- Mr. Frank Ricketts, Chair, Newfoundland Environmental Industries Association
- Dr. Brian Hearn, Science Director, Canadian Forest Service, Corner Brook
- Dr. Christiane Delauriers, Director General, Agriculture-Agrifoods Canada
- Mr. James Evans, CEO, Forestry and Agrifoods Agency, Government of NL
- Dr. Richard Donald, Associate Dean, Faculty of Agriculture, Dalhousie University
- Mr. Eugene Legge, President, NL Federation of Agriculture

To quote relevant comments from these letters of support;

> *Newfoundland and Labrador Environmental Industry Association*
>
> *NEIA is a not-for-profit association of businesses that promotes the growth and development of the environmental sector In Newfoundland and Labrador. We represent firms operating in areas as diverse as waste management, sustainable resource development, green building and green transportation. The growth of this sector depends on qualified professionals. Several firms within the sector have identified "access to skilled human resources" as a barrier to growth. A recent report published by GLOBE Advisors and Earth & Environmental, "An Analysis of the Economic Development Opportunities Associated with the Green Economy in Newfoundland and Labrador", states that the environmental sector employs over 10,300 Newfoundlanders and Labradorians in over 1,100 private and public organizations. The report, even in its conservative estimates, predicts significant growth for the sector. The availability of qualified labour is a crucial factor in this growth. The current Grenfell [BERI] initiative helps address these workforce challenges within the environmental sector in a number of ways. The facilities will ensure the high quality of environmentally related education by complementing classroom teaching efforts and exposing students to the state of the art technology used within the sector. In addition, new facilities will assist Memorial in recruiting highly qualified faculty, laboratory technicians, graduate students, and postdoctoral fellows in environmental research. The presence of these skilled individuals not only contributes to an enhanced classroom experience, but also serves to establish Grenfell Campus and the Corner Brook region as a centre of excellence for environmental research. These measures, we hold, will further enhance the supply of qualified labour available to work in this growing sector.*

[4] The full version of the letters of support can be found in Appendix G.

Mr. Frank Ricketts, Chair
Newfoundland Environmental Industries Association

Faculty of Agriculture, Dalhousie University

…. universities in Atlantic Canada should be more deliberate about working together to support agriculture through closer research and academic planning and coordination of resources. Following in that vein, the Faculty of Agriculture at Dalhousie University is eager to lend support to your initiatives at Grenfell Campus toward the development of agriculture-focused research and graduate programs.
Dr. Richard Donald, Associate Dean
Faculty of Agriculture, Dalhousie University

Agriculture-Agrifood Canada

I am pleased to express Agriculture and Agrl-Food Canada's (AAFC) support for Memorial University's initiative in creating a graduate program with a focus on agricultural research at its Grenfell Campus. The new faculty and labs will also form the basis of future collaboration between our two organizations and contribute to industry and provincial government objectives of increasing the overall economic output of Newfoundland and Labrador's agricultural sector.
Dr. Christiane Delauriers, Director General
Agriculture-Agrifoods Canada

Canadian Forest Service, Natural Resources Canada

As you are no doubt aware, the office of Natural Resource Canada - Canadian Forest Service (CFS) is situated at Grenfell Campus in Corner Brook. Presently, all of the CFS Research Scientists in Corner Brook serve as Adjunct Professors at Grenfell and most are supervising or co-supervising graduate students at Grenfell's Environmental Policy Institute, or at the Faculty of Science on the St. John's Campus. Further, in May 2013, Natural Resources Canada, Canadian Forest Service and Memorial University signed a collaborative research agreement to establish a Boreal Ecosystem Research Initiative (BERI) to increase collaboration and to deliver a collaborative research program to support sustainable development particularly with respect to the forest sector. Thus, the addition of a second graduate degree program at Grenfell Campus would complement BERI and serve as an opportunity for further collaboration to enhance the forestry science capacity at Memorial University.

The forest industry plays a critical role in the natural resource sector of the province, in particular in the western region of Newfoundland and Labrador. Accordingly, the CFS is in support of this new graduate programming which we hope will enhance MUN-CFS collaborations.
Dr. Brian Hearn, Acting Director
Canadian Forest Service, Corner Brook

4. Market analysis

The Canadian Job Market
According to the Jobs Report: State of the Canadian Labour Market (2014), Canada's labour market has outperformed those of other Group of Seven (G-7) economies since 2006 with close to 1.6 million net new jobs created across the country. Despite the weak global economic environment, the Canadian economy has expanded at a faster pace than other G-7 economies and the labour market has been

resilient, with over 1 million net new jobs created since the recovery began in July 2009 (See Figure 4.1). This represents the strongest labour market performance among all G-7 economies. Moreover, high-wage, highly skilled, full-time and private-sector employment has been the main source of job creation over the recovery.

Job creation in Canada over the recovery has largely been in high-wage, full-time, private-sector employment

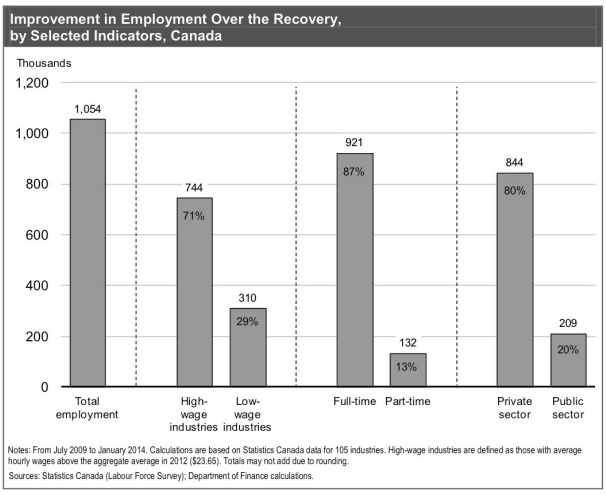

Figure 4.1 Job creation in Canada since 2009

Also evident is the fact that Newfoundland and Labrador has experienced higher than average job creation across Canada, with over 11 percent employment gains since 2009 (Figure 4.2).

Employment gains over the recovery have occurred in all provinces and territories

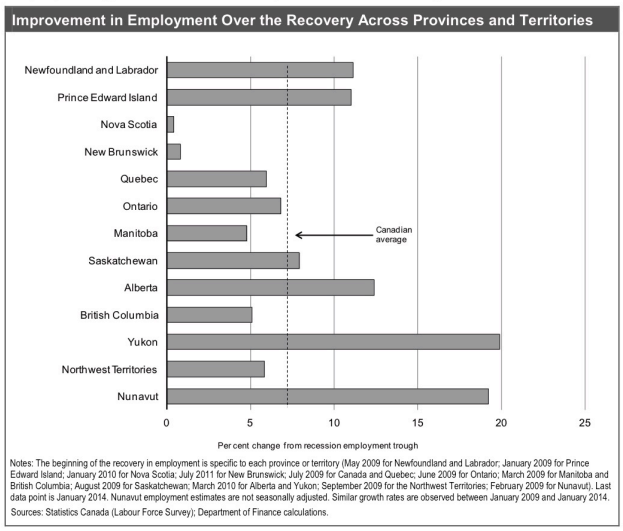

Figure 4.2 Provincial job creation in Canada since 2009

Canada also fares well compared to other countries with regard to post-secondary educational attainment. Overall, Canada enjoys a fairly mobile population that responds well to economic opportunities and regional differences in labour market conditions. Figure 4.3 demonstrates the increasing demand for education at all levels, and shows that there are over 1.75 millions graduate students in Canada (2011) and increasing yearly.

Participation in post-secondary education in Canada has grown significantly over the past two decades

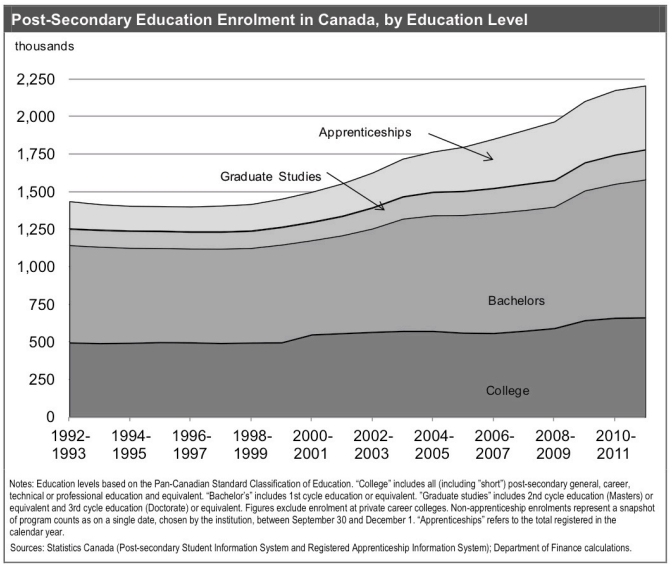

Figure 4.3 Post-secondary enrolment in Canada (1992-2011)

Fuelling innovative growth in the shift to a knowledge-based economy in the Canadian job market requires a highly skilled workforce. In this respect, workers with science, technology, engineering and mathematics (STEM) degrees play an important role as they are at the leading edge of technological progress. Canada's college system produces a substantial number of graduates in STEM fields. In particular, Canada graduates relatively more students than the OECD average and the United States in the Environmental Science, physical sciences, and mathematics and statistics. Figure 4.4 demonstrates that a university degree is becoming the skill requirement for successful employment in emerging labour markets, and graduate degree completion undoubtedly significantly increases the opportunity for employment.

Ongoing technological change, along with the rising competitive intensity of emerging-markets, will continue to raise the skill requirements of jobs

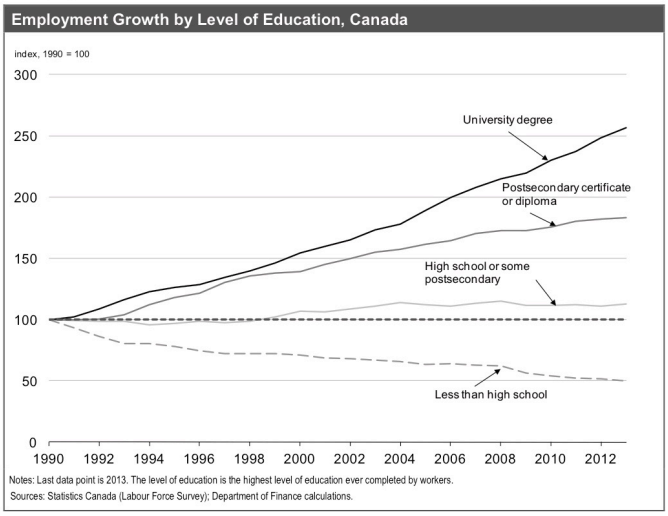

Figure 4.4 Skill requirements for emerging markets in Canada (1990-2012)

Occupations related to natural and applied sciences have had persistently high job vacancy rates over the recovery, suggesting unfilled labour demand in this occupation group.

Alberta, Saskatchewan, and Newfoundland and Labrador have seen the largest increase in job vacancy rates since 2009, largely reflecting high labour demand in certain occupations in these regions, particularly skilled trades and science-based occupations.

The Environmental Employment Market

ECO (Environmental Careers Organization) Canada develops programs that help individuals build meaningful environmental careers, provides employers with resources to find and keep the best employees, and informs educators and governments of employment trends to ensure the ongoing prosperity of the Canadian environmental sector.

Since 1992, ECO Canada has established itself as the national, industry-initiated and led organization for environmental human resources issues. ECO Canada's extensive labour market intelligence provides insight on the opportunities, challenges and solutions for building a world-leading environmental workforce. ECO Canada offers environmental career resources for professionals and employers.

Eco-Canada's publication "Labour Market Research - Profile of Canadian Environmental Employment, 2013" summarizes the labour market statistics for environmental professional in Canada. It's most recent report shows tremendous promise for job creation and emerging professions in environmental industries:

> *"As social awareness of the environment's importance continues to grow, so does the impact that environmental work has on the Canadian economy. This growth produces many important benefits, including the creation of new jobs, the reduction of economic costs, and the development of innovative business opportunities."*
>
> Labour Market Research - Profile of Canadian Environmental Employment, Eco Canada, 2013

According to their recent study (2013), over 730,000 environmental professionals are employed in Canada (Figure 4.5), and spend at least 50% of their work time performing environmental activities. This represents just over 4% of the total Canadian labour force. Since 2010, the number of environmental professionals has grown by about 7%. Based on a general comparison of trends over the years, there is a continual increase in the demand for environmental skills. This growth has consistently outpaced that of the overall Canadian workforce.

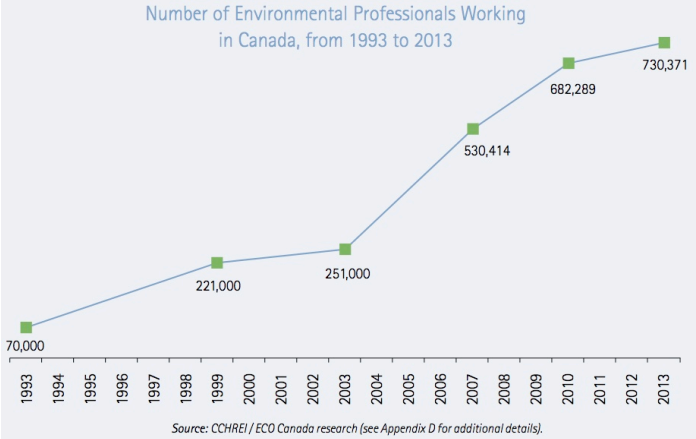

Figure 4.5 Environmental professionals working in Canada (1993-2013)- Source: Eco-Canada (2013)

The study highlights the fact that more than 10% of all employed workers in Canada use environmental skills, underscoring the diversity and importance of environmental competencies in a wide range of industries. The following industries have the highest proportion of environmental employees: Administrative and Support, Waste Management and Remediation Services (25.1%), Professional, Scientific, and Technical Services (22.4%), Wholesale Trade and Retail Trade (13.9%), Other Services (13.8%), and Manufacturing (13.7%). With 22.4 percent of environmental workers employed in the "professional, scientific and technical services" category, this amounts to over 163,000 professional (>50% of their work) workers employed in Canada in 2013.

However, the total number of environmental employees (Figure 4.6) in Canada is over 1.7 million as many employees do other non-environmental work as a part of their job. The table also clearly shows the lack of environmental scientists specializing in agriculture and forestry.

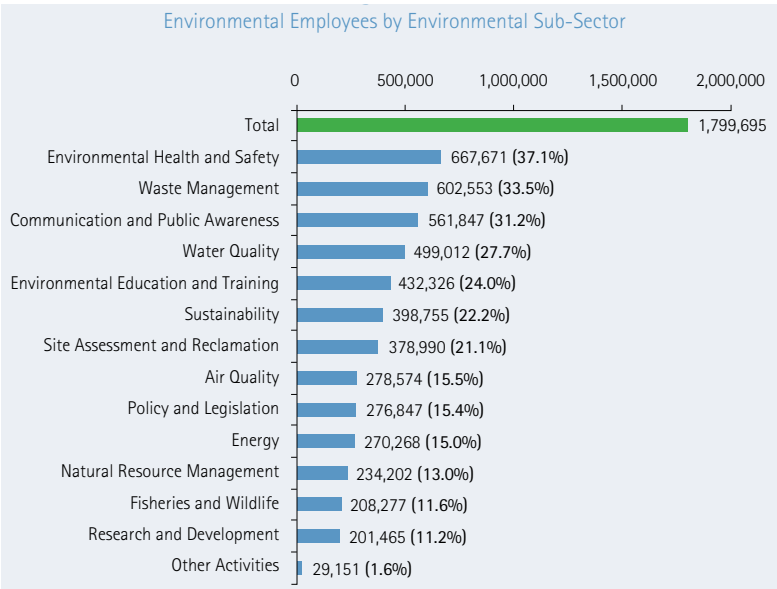

Figure 4.6 Environmental employees by sub-sector in Canada (2013) - Source: Eco-Canada (2013)

Demand for environmental employees

Eco-Canada also estimates that the demand for workers with environmental skills will increase over the near future. Their study found that most employers (74.5%) intend to hire new environmental employees over the next two years, both for newly created roles and replacement positions following staff departures and retirements. In addition to growth among current environmental employers, the number of environmental employees may also expand as regulatory requirements continue to evolve and a greater number of Canadian establishments adopt environmental practices.

New job openings will include technical roles, such as Forestry and Mining Workers, and Environmental Technicians, as well as specialist roles that require advanced education, such as Environmental Engineers, Marine Biologists, and Geoscientists. If recent trends hold, employers will need to hire recent graduates and transitioning workers from other industries to fill these positions. A notable proportion (13.1%) of job opportunities will be for past employees who have changed positions within the same establishment or changed employers.

Retirements will create many job openings in the near future. Nearly one-fifth (19.0%) of the environmental workforce is expected to retire over the next 10 years, creating openings for primarily intermediate- and senior-level roles. Employers will need to rely on existing junior and intermediate-level employees to fill some of these senior roles. Transitioning workers from other sectors and industries may also help meet this increased demand for experienced practitioners.

Employers have had some difficulty filling a wide variety of different environmental occupations, including both technical occupations and specialist roles that require advanced education. Some employers found it especially difficult to fill positions for Environmental Engineers, Environmental Technicians or Technologists, Forestry or Mining Workers, and Remediation Specialists.

Summary of employment opportunities

Based on the Government of Canada's job analysis and Eco-Canada's career opportunities, it is evident that the environmental industries are growing in Canada, and globally. This resulted in increased

graduate studies opportunities for students around the world. As an emerging provider of environmental graduate degree programs, Grenfell Campus has the opportunity to compete nationally and internationally for graduate students, faculty and staff. The proposal for the MSc in Boreal Ecosystems and Agricultural Sciences (MSc BEAS) at Grenfell Campus will set forth tremendous opportunities for Canadian and international students in this growing field of study.

Analysis of competing graduate programs

As a component of the proposal for the MSc in Boreal Ecosystems and Agricultural Sciences at Grenfell Campus, a scan was undertaken (Table 4.1) to determine the competitive "marketplace" for graduate programs relevant in the broad field of the environment and environmental sustainability in particular, including disciplines in ecosystem, agricultural environmental science. The scan is focused on graduate programs that are geographically close to Grenfell Campus – Memorial University, or that may compete in the graduate studies national marketplace for students in the agricultural, forest science, environmental and life science fields. It is primarily comprised of interdisciplinary and applied programs focused on the environment that could feasibly produce graduates capable of working at the interface of environmental science, environmental studies and the social sciences, and the humanities. Programs with a pure, non-applied science focus, and arts programs lacking a clear link to the MSc in Boreal Ecosystems and Agricultural Sciences strategic research priorities, have been excluded.

Table 4.1 Selected Scan of Relevant Graduate Programs

Title	Type	Threat	Institution(s)	Discipline(s)	Location	URL
MSc. in Agriculture	Masters Degree	High Strong AG program	Dalhousie University	Agriculture	Truro, NS, Canada	Program Homepage
Master of Environmental Studies (MES)	Masters Degree	High Strong ES program	Dalhousie University	Environmental Studies and Sciences	Halifax, NS, Canada	Program Homepage
Master's in Forestry and Environmental Management (MScF, MF, MScFE, MFE, MEM)	Masters Degree	Low No thesis option	University of New Brunswick	Other	Fredericton, NB, Canada	Program Homepage
M.Env. in Environmental Assessment	Masters Degree	Low No thesis option	Concordia University	Environmental Studies and Sciences	Montreal, QC, Canada	Program Homepage
MA, MSc, MBA, MEd, MEng, MFC, MI, MScF, MScPI in Environmental Studies (collaborative program with student's "home" department)	Masters Degree	Medium Highly flexible programs	University of Toronto	Environmental Studies and Science	Toronto, ON, Canada	Program Homepage
Master of Science in Sustainability Management (MScSM) (management or science stream)	Masters Degree	Low No thesis option Policy-based	University of Toronto	Sustainability Studies and Science	Toronto, ON, Canada	Program Homepage
MA or MSc in Environmental Sustainability (Collaborative)	Masters Degree	Low Policy-based	University of Ottawa	Sustainability Studies and Science	Ottawa, ON, Canada	Program Homepage
Master of Environmental Studies (MES)	Masters Degree	Medium-High Environmental Chemistry	Queen's University	Environmental Studies and Sciences	Kingston, ON, Canada	Program Homepage
Masters in Environment and Sustainability (MES)	Masters Degree	Low No thesis option	University of Western Ontario	Environmental Studies and Sciences	London, ON, Canada	Program Homepage

Title	Type	Threat	Institution(s)	Discipline(s)	Location	URL
M.Sc. in Food, Agriculture & Resource Economics	Masters Degree	Medium Primarily Social Science Policy-based	University of Guelph	Agriculture	Guelph, ON, Canada	Program Homepage
Master of Environment and Sustainability (MES)	Masters Degree	High Full-range AG-ES Master programs	University of Saskatchewan	Environmental Studies and Sciences	Saskatoon, SK, Canada	Program Homepage
MA or MSc in Agricultural Studies	Masters Degree	Medium-High Flexible MSc in AG	University of Lethbridge	Agriculture	Lethbridge, AB, Canada	Program Homepage
MSc or MEng or MAg or MBA/MSc in Agricultural, Food & Nutritional Science	Masters Degree	High Full-range AG-ES Master programs	University of Alberta	Agriculture	Edmonton, AB, Canada	Program Homepage
Master of Forestry (MF), MSc or Master of Applied Science (MASc), Soil Science, Master of Sustainable Forest Management (MSFM)	Masters Degree	High Full-range Soil-Forest-AG-ES Master programs	University of British Columbia	Other	Vancouver, BC, Canada	Program Homepage
M.S. in Ecology and Environmental Sciences	Masters Degree	Medium Basic MS program	University of Maine	Environmental Studies and Sciences	Orono, ME, USA	Program Homepage
M.S. in Sustainable Agriculture	Masters Degree	High Full-range AG Master programs	Iowa State University	Agriculture	Ames, IA, USA	Program Homepage
M.S. in Agroecology	Masters Degree	High Full-range AG Master programs	University of Wisconsin-Madison	Agriculture	Madison, WI, USA	Program Homepage
M.S. in Agriculture, Food and Environment	Masters Degree	High Full-range AG–ES Master programs	Tufts University	Agriculture	Medford, MA, USA	Program Homepage

Sources

(AASHE) The Association for the Advancement of Sustainability in Higher Education. 2012. "AASHE Academic Programs Database" http://www.aashe.org/resources/academic-programs/.

(A/J) Alternatives Journal. 2012. "The 2012 A/J Canadian Environmental Education Guide: Higher Learning for a Smaller Footprint." *Alternatives Journal* 38: 21-29. Available online at http://www.alternativesjournal.ca/community/education/schools (June 16, 2013)

Cohen, Maurie and Amy Forrester, eds. 2011. "Academic Programs in Sustainability." *Sustainability: Science, Practice, & Policy* http://sspp.proquest.com/sspp_institutions/display/universityprograms (June 5, 2013).

(ECO Canada) The Environmental Careers Organization Canada. 2013. "Post-Secondary Environmental Program Directory" http://eco.ca/programdirectory/ (June 24, 2013).

Various academic institution websites

Conclusions:

Based on the scan of relevant Master of Science programs in Boreal Ecosystems and Agricultural Sciences, the obvious competitors for graduate students are the major agricultural and environmental science universities in Canada and North-Eastern US.

In Canada these include Dalhousie University (Faculty of Agriculture and Faculty of Science), the University of Saskatchewan, University of Alberta and the University of British Columbia, with secondary competition from Ontario's Queens University and University of Guelph. Each of these universities has significant capacity in a range of overlapping research areas in boreal ecosystem and agricultural science (soil science, plant and crop science, hydrology, water analysis and toxicology, resource economics). Grenfell Campus is fortunate to be geographically distanced from the strong competing markets, and still offer a program of the highest quality with competitive tuition and living costs.

In the US North-Eastern region, Tuft's University, Iowa State University and the University of Wisconsin-Madison appear to be the primary competitors.

This scan provides a rough analysis of potential academic competitors in the Master of Science (MSc) graduate education marketplace in boreal and agricultural science. The scope of the proposed program at Grenfell Campus – Memorial University is sufficiently diverse to attract graduate students from a wide background in natural and social science. With the opportunity to study in a small university environment with world class faculty and resources (laboratory and technical equipment, support staff, library resources), Grenfell Campus is in the unique position to create a research identity second to none in North America.

5. Projected enrolment

Although difficult to predict over a five-year period, projected enrolment is estimated to increase over the period, due in part to the increased exposure of the programs, and the strength of the faculty members in attracting graduate students in their specialty. The MSc BEAS program steady-state enrolment is estimated to cap at between twenty-seven (27) and forty (40) students in all aspects of the program (part-time, full-time, and returning students), and the balance of Canadian versus international students is expected to achieve a 2/3 – 1/3 ratio respectively after five years. Over a longer term, judging by the history of Grenfell's Master of Arts in Environmental Policy (MAEP), international enrolment may exceed

Canadian enrolment. International student enrolment may also rise above expected numbers due to the increased demand for environmental scientists in the global labour market. To achieve this level of enrolment, MSc BEAS annual student intake would initially begin with five to eight (5-8) students and cap at fourteen to twenty (14-20) by the end of Year 5. Table 5.1 below demonstrates the anticipated annual intake and continuing enrolments based on the lower end of enrolment projections.

Table 5.1 MSc BEAS Projected 5-year enrolment* (including continuing students)

MSc BEAS Enrolment

Type/year	Year 1 (2015)	Year 2 (2016)	Year 3 (2017)	Year 4 (2018)	Year 5 (2019)
New FT enrolment (CDN)	4	5	6	7	7
New PT enrolment (CDN)	0	1	1	2	2
New FT enrolment (INT)	1	2	2	2	3
New PT enrolment (INT)	0	1	2	2	2
Annual New Enrolment	**5**	**9**	**11**	**13**	**14**
Returning FT enrolment (CDN)	0	4	5	6	7
Returning PT enrolment (CDN)	0	0	1	1	2
Returning FT enrolment (INT)	0	1	2	2	2
Returning PT enrolment (INT)	0	0	1	2	2
Annual Returning Enrolment	**0**	**5**	**9**	**11**	**13**
Canadian enrolment	4	10	13	16	18
International enrolment	1	4	7	8	9
Total Annual Enrolment	**5**	**14**	**20**	**24**	**27**

*Projected enrolment as of Fall semester of each year.

6. Resource implications

6.1 Faculty complement and workload

Faculty expertise

The proposed MSc BEAS graduate program will be open for teaching and research opportunities to all interested faculty on any of the campuses of Memorial University. Given that the program is established at the Grenfell Campus and managed by the Grenfell's Division of Science, it is expected that local faculty participation may predominate. Grenfell Campus currently has 15 faculty members and 17 staff specializing in environmental programs associated with the Division of Science. Another 17 faculty members deliver degree programs in the Division of Social Science, including Environmental Studies and Sustainable Resource Management. The list of expertise for the program, including CV's, can be found in Appendix F. Given the pool of expertise available to Grenfell campus for the delivery of the MSc BEAS program, this expertise will allow extensive flexibility in the program focus and course offerings. Other faculty within MUN or else may affiliate and participate in the program.

For example, Grenfell Campus has recently hired five (5) professors for the Boreal Ecosystems Research Initiative. Individuals hired for these positions have strong research backgrounds in areas of soil science, water resources, plant science, agronomy and economics. New faculty and staff will work with existing campus expertise to develop and oversee the implementation of the graduate program in boreal ecosystems and agricultural science, and will participate in the teaching and the supervision of graduate

students in their respective fields. The focus areas of faculty expertise immediately available for study and research include:

Agronomy	Biology	Earth Science
Environmental Chemistry	Hydrology & Water resources	Natural Resource Economics
Physics	Plant / Crop Science	Soil Science

The MSc BEAS will mainly focus on four Boreal Ecosystems and Agricultural research and education areas:

- Economics and Social Science
- Plant Science
- Soil and Land Resource
- Water Resources

New faculty hired 2013-2014

Dr. Mumtaz Cheema is an Associate Professor at Grenfell Campus with a research focus on **a)** integrated nutrient management practices that conserve or enhance soil fertility through efficient nutrient cycling and management strategies to maximize nutrient use efficiency and maintain optimum economic sustainable crop productivity with minimize damage to the environment, **b)** abiotic stresses (saline, drought, chilling and heat/temp stress), and management strategies to induce stress tolerance and enhancement of antioxidant defense system induced by hormonal priming/exogenous application of salts/chemicals, **c)** biological nitrification inhibition (BNI) capability in cereals, **d)** agronomic bio-fortification, and e) impact of climate change (elevated CO_2 and temp) on crop growth and productivity. He has advised 9 PhD and 25 MSc students in the disciplines of Agronomy/Plant Sciences and Soil Sciences.

Dr. Lakshman Galagedara is a hydrologist who studies land and water resources development & management leading to sustainable agriculture and water & food security. He is a member of the Environmental Science faculty and the Boreal Ecosystem Research Initiative (BERI). Dr. Lakshman incorporates different approaches to sustainable land and water resources development and management and he has engaged in interdisciplinary collaboration. His research areas include; near surface hydrology, effect of climate change on land & water resources, interdisciplinary approaches in sustainable water resources management, non-destructive methods in land and water resources, numerical modeling of water and contaminant transport through unsaturated and saturated media, water pollution and wastewater management. His recent publications focus on irrigation water management, hydrogeophysics and vadose zone hydrology, soil and water conservation, water pollution, wastewater treatment and sustainable sanitation.

Dr. Catherine Keske is an agricultural and forest economist who studies contemporary resource and policy issues. She is an Associate Professor and member of both the Environmental Studies faculty and the Boreal Ecosystem Research Initiative (BERI) at Grenfell Campus. Dr. Keske incorporates a number of different economic methods into her research program and she frequently engages in interdisciplinary collaboration. Her recent publications focus on sustainability, soil conservation, nutrient management, forest recreation and tourism, biomass/bioenergy production, community sense of place, and ecosystem service valuation. Several of Dr. Keske's current projects address food security and food sovereignty, boreal forest ecosystem services, crop production, land use policies, and sustainability metrics.

Dr. Raymond Thomas is an Associate Professor at Grenfell Campus, and his research specializes in Plant Biochemistry and Physiology (lipid biochemistry). Dr. Thomas has advanced knowledge of mass spectrometry, plant science, secondary plant metabolites (lipids and antioxidants), agriculture, lipid biochemistry, column, thin-layer, gas and liquid chromatography. He brings three years of project management experience building CFI funded academic research facilities, more than ten years of

agriculture and lipid biochemistry related research experience. Dr. Thomas has six years teaching experience at the undergraduate level, has presented at over thirty seminars or conferences and has published over thirty peer reviewed journal articles and abstracts.

Dr. Adrian Unc is an Associate Professor of Soil Sciences at Grenfell Campus, Memorial University of Newfoundland, a Visiting Research Fellow with the School of Geography at the University of Leeds, and an Affiliated Associate Professor with the Department of Plant and Environmental Sciences at the New Mexico State University. He is a member of the Environmental Science faculty and the Boreal Ecosystem Research Initiative (BERI) and trained in agronomy, soil sciences and environmental microbiology. He integrates soil and water sciences with standard microbiology and molecular tools to ensure environmental quality, human health and food sustainability. His research focuses on agricultural sustainability, microbial and chemical quality at soil and water interfaces, the microbiology of the soil plant continuum, and water and wastewater management. More recently he has been an investigator with the US National Association for Algal Biofuel and Biomass and is a member of the editorial board of Algal Research. He is also an Associate Editor for the Soil Use and Management, a journal of the British Society of Soil Science. He has advised or co-advised 19 graduate students, numerous undergraduate students, and participated as principal investigator or co-investigator in over 26 research projects and contracts (US, UK and Canada; >$70 M). He has also served as a technical advisor on student committees at the Bu Ali Sina University (Iran), Universidad Autonoma de Nuevo Leon (Mexico), Bar-Illan University (Israel), and the King Michael 1st of Romania Univ. of Agric. Sciences.

Laboratory and technical personnel

Operating an environmental research laboratory for the purposes of soil, water quality and plant chemical analysis will require the assistance of fully trained, accredited and qualified personnel. Two (2) highly qualified laboratory coordinators / technicians were recently hired, and they will assist in the set-up and maintenance of the equipment, conducting tests, developing methods and analyses, as well as training graduate students in the use of the advanced research equipment.

Additional / potential research faculty

Western Newfoundland is becoming a hub for environmental research, and there are many people within the region to conduct research facilitated by Boreal Ecosystems Research Facility. Beyond faculty at Grenfell College, there are also environmental researchers focusing on boreal ecosystems and boreal agriculture issues within Natural Resources Canada (NRCan), Agriculture-Agrifood Canada (AAFC), provincial Departments of Natural Resources (DNR) and Environment and Conservation (DEC), Parks Canada (PC), and local non-governmental organizations. Many of these researchers are already working in environmental scientific research and many more are interested in developing this capacity within Grenfell and in the greater community. Furthermore, as the MSc BEAS graduate program develops at Grenfell Campus, there will also be a local pool of graduate students specifically trained in these fields of study. In addition, the university will network with researchers currently working on relevant topics across the province and in other provinces. The MSc BEAS program will draw on faculty from St. John's campus, the Labrador Institute, the partner agencies (CFS / NL Forestry & Agrifoods / Agriculture-Agrifood Canada) and other universities (Dalhousie's Faculty of Agriculture) and institutes to support its programs through sabbatical replacements, post-doctoral appointments, and/or by serving as adjuncts or affiliate faculty on specific projects. Work is ongoing to continue expanding the list of collaborators who will participate and assist with the MSc BEAS program. A preliminary list of currently identified experts can be found in Appendix F.

Support services for faculty and graduate students

The Master of Science in Boreal Ecosystems and Agricultural Sciences program will require the services of administrative support, including a Coordinator, a Graduate Officer. An administrative assistant will offer support to students and researchers. These services have been included in the budgetary requirements for the program (see Table 7.2a and 7.2b).

6.2 Space, facilities, and student support

Grenfell Campus currently operates several laboratories within the Division of Science: Earth Sciences Laboratory, Environmental Analytical Chemistry Laboratory, Environmental Biology Laboratory, a College Herbarium, and the new 500 m^2 (5382 ft^2) Boreal Ecosystems Research Facility. These laboratories offer capabilities for teaching and research spanning chemistry, physics, biochemistry, biology, standard and molecular microbiology, and environmental & earth science. Soil, water, air, plant and other biological samples can be analyzed. Software capabilities for bioinformatics, statistical and spatial analyses are also present within these laboratories. The laboratories are currently operated by a number of highly trained technicians and laboratory coordinators. The Boreal Ecosystems Research Facility contains 3 separate laboratory spaces in which to conduct research for the MSc BEAS graduate program. The facility houses a full complement of research space, equipment, and administrative workspaces to accommodate the proposed graduate programs.

i. Physical Plant – Grenfell Campus extension of the Forest Centre building: Construction of the boreal ecosystem research facility was completed in Fall 2013, attached to the current Forest Centre on the Grenfell Campus. This new facility has been designed to meet the needs of the research faculty, associate researchers and graduate students, including research space, workstations, high-speed internet access, and data transfer and storage.

ii. Equipment: A suite of research grade equipment with the capacity to analyze soils, water, air and plants valued at over $5M has been installed in the boreal ecosystem research facility. As the development of the research agenda expands over time, it is anticipated that additional equipment may be added to the lab with the support of external research funding grants. All such equipment becomes part of the general pool of equipment available to all faculty and adjunct researchers at Grenfell Campus.

iii. Classroom Space: Classroom space on the Grenfell Campus is sufficient to accommodate class sizes up to 60 students. Due to the nature of the graduate program being proposed, it is anticipated that classrooms suitable for up to 20 graduate students will be required, and that there is sufficient access to classrooms and meeting spaces for the proposed program.

iv. Graduate Study Space: Grenfell Campus has been expanding its building capacity and support for graduate research. Currently approximately 27 graduate students are enrolled in the MAEP program, and as students become enrolled in the MSc BEAS program, campus administration has confirmed that graduate study space will be expanded as needed.

6.3 Financial support

Graduate Student Funding

Eligible students will receive baseline fellowship funding through the School of Graduate Studies of approximately $6,800 per year (student must meet minimum academic requirements). MSc BEAS students will also be eligible to receive support from the Research Office, Grenfell Campus for up to $3,150, and Graduate Assistantship support up to $3,503 annually. Graduate students will also be supported directly by principal investigators (PI's) through research grants, as they become available,

for a total potential funding of no less than $13,453 annually. Scholarships and bursaries may also be available to graduate students as they progress through their program. The graduate student support funding is included in the program budget. Faculty members will also have access to competitive research grants through Tri-Council and commercialization activities and research contracts that will benefit graduate student funding opportunities.

7. Budget

Significant capital investments in the building and equipment have been made for the proposed graduate program. Based on the anticipated costs of operating the MSc BEAS graduate program, proposed tuition fees will be consistent with Memorial University's School of Graduate Studies fee structure of $4,398/program ($2,199/year) for Canadian students, and $5,718/program ($2,859/year) for international students. While not included in the budget additional revenue may nevertheless be secured for the operation of the laboratories from faculty research grants, partner and industry opportunities for research projects, environmental sampling, testing and analysis. These potential areas of revenue have not been included in the budget projections. The projected enrolment and revenue from graduate tuition for the program is noted below (Table 7.1). The proposed revenue is based on the lowest number of projected student enrolment.

Table 7.1 Graduate student enrolment and projected revenue

Student Enrolment & Fees

MSc BEAS Enrolment

Type/year	Year 1 (2015)	Year 2 (2016)	Year 3 (2017)	Year 4 (2018)	Year 5 (2019)
New FT enrolment (CDN)	4	5	6	7	7
New PT enrolment (CDN)	0	1	1	2	2
New FT enrolment (INT)	1	2	2	2	3
New PT enrolment (INT)	0	1	2	2	2
Annual New Enrolment	**5**	**9**	**11**	**13**	**14**
Returning FT enrolment (CDN)	0	4	5	6	7
Returning PT enrolment (CDN)	0	0	1	1	2
Returning FT enrolment (INT)	0	1	2	2	2
Returning PT enrolment (INT)	0	0	1	2	2
Annual Returning Enrolment	**0**	**5**	**9**	**11**	**13**
Canadian enrolment	4	10	13	16	18
International enrolment	1	4	7	8	9
Total Annual Enrolment	**5**	**14**	**20**	**24**	**27**
Canadian Tuition - $2199/year	$ 8,796.00	$ 21,990.00	$ 28,587.00	$ 35,184.00	$ 39,582.00
International Tuition - $2859/year	$ 2,859.00	$ 11,436.00	$ 20,013.00	$ 22,872.00	$ 25,731.00
MSc. Total Revenue (5 years)	**$ 11,655.00**	**$ 33,426.00**	**$ 48,600.00**	**$ 58,056.00**	**$ 65,313.00**

* Program tuition fees are collected over 6 program semesters (2 years)

Based on the projected enrolment and costs associated with the MSc BEAS program (see Table 7.2a), it is anticipated that the program will be self supporting based on the proposed annual budget allocation by the Grenfell Campus Office of Research. With potential increases in enrolment or revenue from research

grants or commercial applications of the laboratory services, this revenue balance may increase favourably.

Table 7.2a Program proposed budget (Years 1-5).

Proposed Budget (Years 1-5)					
Type/year	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Revenue (Projected)					
MSc Program tuition fees (based on enrolment projections)	$11,655.00	$33,426.00	$48,600.00	$58,056.00	$65,313.00
AES funding (Research Office)	$145,165.00	$157,368.30	$170,280.67	$183,939.53	$198,384.23
Internal revenue (estimate - research grants)	$150,000.00	$157,500.00	$165,375.00	$173,643.75	$182,325.94
Total Revenue	**$306,820.00**	**$348,294.30**	**$384,255.67**	**$415,639.28**	**$446,023.17**
Expenditures (Projected)					
Instructional costs					
LUMUN/TALMUN appointments (2-6 courses annually@$4800)	$9,600.00	$14,400.00	$19,200.00	$24,000.00	$28,800.00
Graduate Assistantships ($6800 / FT student)	$34,000.00	$81,600.00	$102,000.00	$115,600.00	$129,200.00
Administrative costs					
Stipends - Chair or Coordinator / Graduate Officer (2x $900)	$1,800.00	$1,800.00	$1,800.00	$1,800.00	$1,800.00
Operating costs					
Materials and supplies (labs)	$150,000.00	$153,000.00	$156,060.00	$159,181.20	$162,364.82
Reference materials	$5,000.00	$5,000.00	$5,000.00	$5,000.00	$5,000.00
Computers and software	$10,000.00	$10,000.00	$10,000.00	$10,000.00	$10,000.00
Travel (field sampling and collection)	$5,000.00	$5,000.00	$5,000.00	$5,000.00	$5,000.00
Other operating costs (overhead)	$90,000.00	$90,000.00	$90,000.00	$90,000.00	$90,000.00
Total expenditures	**$305,400.00**	**$360,800.00**	**$389,060.00**	**$410,581.20**	**$432,164.82**
Net income/expenditures	$1,420.00	$(12,505.70)	$(4,804.33)	$5,058.08	$13,858.35

Given that this is a thesis based program an associated research budget has bee also attached below. This budget describes the research support costs for all associated research activities carried in the Boreal Ecosystems Research Facility. Note that is expected that all research projects will likely support graduate students and that most Grenfell based graduate students will likely be associated with Grenfell based research projects.

Table 7.2b Budget for research support with the Boreal Ecosystems Research facility (Years 1-5).

Proposed Budget (Years 1-5)					
Type/year	**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Administrative costs / research support					
Lab coordinators	$148,800.00	$151,776.00	$154,811.52	$157,907.75	$161,065.91
Administrative support	$16,035.00	$16,355.70	$16,682.81	$17,016.47	$17,356.80
	$164,835.00	**$168,131.70**	**$171,494.33**	**$174,924.22**	**$178,422.71**
Revenue					
AES Funding (Research Office)	$164,835.00	$168,131.70	$171,494.33	$174,924.22	$178,422.71
Net	$-	$-	$-	$-	$-

*AES= Department of Advanced Education and Skills

Appendix A. Library holdings evaluation

Introduction

An assessment of the Ferriss Hodgett Library collection was conducted to determine its ability to support the proposed Master of Science in Boreal Ecosystems and Agricultural Sciences (MSc BEAS). While the program will benefit from the existing print and electronic collections at both the Ferriss Hodgett Library and the Queen Elizabeth II Library, additional funds will be required to further develop and provide ongoing support for these programs on the Grenfell Campus. These funds will come from the existing library materials budget. As well, funds will be required to refurbish existing library space to meet the unique needs of this student group.

Monographs

Erin Alcock, Science Research Liaison Librarian at the QEII, was consulted on the course list associated with this program and has confirmed that the library system has strong print and electronic book collections in crop production and nutrition, climate change and global food security, sustainable agriculture, soil functions, plant biochemistry and physiology, organic farming, functional food and lipid metabolism. She did note more limited resources for soil as reactor and metagenomics for environmental science.

Kathryn Rose, History and Economics Liaison Librarian at QEII, was also consulted on the course list and has confirmed that the library has strong print and electronic book collections in the areas of production economics and commodity marketing, ecological economics, natural resource economics, environmental economics, and applied economic methods.

CNS is a special research collection of books, government documents, periodicals, newspapers, theses, microforms, and historic maps reserved for the study of all aspects of Newfoundland and Labrador. The Centre holds the largest collection of published Newfoundlandia in the province. It is a non-circulating collection but due to our distance, the Grenfell Library has an agreement with CNS that allows material to be sent here for use by our researchers in our library. As a branch of Memorial University libraries, the Grenfell Library is able to provide faculty and students with prompt access via Intercampus Loan, to the extensive research collections especially of the Queen Elizabeth II Library, including the Centre for Newfoundland Studies.

The Library also provides a collection on demand service. If a book is requested for loan, but it is a recent publication and relatively inexpensive, the library will purchase the title instead of borrowing the book. The process is more effective as it can be cost saving to the Library, but more importantly, gets the material to the student or faculty faster. The Library also provides a rush order service for faculty. Material that is needed immediately for a course or a research project can be obtained for that individual by the library within a few days.

Journal Literature

The library system has an extensive collection of online journals in all subjects areas included in the proposed programs. Access to the journal literature is available via the following databases: AgEcon Search, Agricola, Agricultural & Environmental Biotechnology Abstracts, Agris, Biological Abstracts, EconLit, Scopus, and Web of Science. Full database descriptions can be found at: www.library.mun.ca/eindex/index.php

Select potential faculty were consulted concerning database access to the journal literature and all required databases are included in current library subscriptions.

Facilities

Over the past few years the Library has created diverse study spaces, designed primarily to suit the needs of the undergraduate students. Currently, there is one small room in the library specifically for graduate students. This room has already exceeded its capacity, so should additional graduate programming be added to the Campus, more library space directed to the needs of this student population group will need to be developed prior to program commencement.

Library Hours

One of our primary services is providing access to our facility and ensuring we have qualified staff on the ground to answer user queries at all times. Since 2008 we have reworked the library staff schedules to ensure that a trained library assistant is working with the students during evening and weekend shifts. We have also extended library hours since 2008. The library is now open Monday to Thursday from 8:00am to midnight throughout the regular semester. Friday hours have been extended to 6pm, Saturday hours are now 10am to 8pm (previously 11am to 5pm) and Sunday hours are now 12pm to 10pm (previously 2pm to 10pm).

Louise McGillis

Associate University Librarian, Grenfell Campus, MUN

Ferriss Hodgett Library

November 12, 2014

Appendix B. Calendar regulations

1.0 Regulations Governing the Degree of Master of Science in Boreal Ecosystems and Agricultural Sciences (MSc in BEAS)

Associate Professor and Division Head (Grenfell Campus)

R. Gallant

1.1 Qualifications for Admission

To be considered for admission, applicants shall hold a Bachelor's (Honours) degree normally in Science, Agriculture, Forestry, Engineering, Geography, or Environmental Science with at least second class standing, or equivalent, from an institution recognized by the Senate or shall have qualifications and/or experience in environmental science acceptable to the Dean of Graduate Studies and the Grenfell Campus graduate committee. The Grenfell Campus graduate committee makes recommendations on admission to the Dean of Graduate Studies for this program.

The Degree is offered by the Division of Science, Grenfell Campus to full-time and part-time students in Boreal Ecosystems and Agriculture research areas focused on, but not exclusively to, 1) Economics and Social Science, 2) Plant Sciences, 3) Soil and Land Resource, and 4) Water Resources.

Admission is limited and competitive, and will follow the general qualifications for admission to Masters Programs at Memorial University of Newfoundland as set out under **General Regulations, Qualifications for Admission**. All applicants found academically acceptable to the MSc BEAS program are required to have a faculty supervisor before final acceptance can be offered.

As well, applicants are required to demonstrate English proficiency by submission of a minimum score in TOEFL, IELTS, or another acceptable language test, in accordance with General Regulation 4.1.7.

1.2 Program of Study and Research

1. The program of study for the MSc BEAS degree shall consist of the successful completion of a program of courses and a thesis embodying original research.
2. Every candidate shall successfully complete at least 12 credit hours as per program requirements (see 1.3 below). Undergraduate courses at the 4th year level may be required at the recommendation of the supervisory committee; these courses do not count against the required graduate credit requirements but are necessary for graduation.
3. Every candidate shall submit a thesis (see General Regulation Theses and Reports) on an approved subject in which systematic research has been conducted under the direction of the Supervisor recommended by the academic unit concerned and approved by the Divisional Head.
4. In addition to courses and thesis research, it is a requirement that all graduate students of this program must participate in Grenfell campus-wide graduate student seminars. Note: this is graded by supervisor(s) for participation as satisfactory/unsatisfactory; a satisfactory evaluation is required for graduation.

1.3 Program Requirements

Students admitted to the program must complete a research thesis under the supervision of a faculty member or members, and a minimum of four (4) courses (12 credit hours) as determined by the thesis supervisor. Three courses are selected from 4 core courses. A fourth course can be selected for a list of optional courses.

All students must complete three core (3) courses:

BEAS 6000 – Issues in Boreal Ecosystems and Agricultural Sciences (3 credit hours). This course will initially be offered during the fall semester.

BEAS 6001 – Graduate Research Seminar (3 credit hours). This course will be offered in fall and/or spring; details in Appendix C

Students must also complete one of the two options of the following course:

BEAS 6002 or BEAS 6003 – Advanced Quantitative Research Methods for the a) Natural Sciences (BEAS 6002) or b) Social Sciences (BEAS 6003) (3 credit hours)

Further three (3) credit hours will be accumulated in elective courses related to the student's research area.

1.4 Focus Areas and Sample Elective Courses

Economics & Social Science	**Plant Science**	**Soil and Land Resource**	**Water Resources**
BEAS 6010: Agroforestry Economics	BEAS 6020: Management of Crop Nutrition BEAS 6021 Organic Farming for Sustainable Agriculture BEAS 6022: Plant Biochemistry BEAS 6023: Plant Physiology	BEAS 6030: Chemical Speciation Modeling for Environmental Matrices BEAS 6031: Soil Functions: Soil as a Bioreactor BEAS 6032: Environmental Soil Physics BEAS 6033: Soil and water conservation	BEAS 6040: Advanced Groundwater Management BEAS 6041: Applied Hydrology BEAS 6042: Soil and Groundwater Remediation

1.5 Evaluation

1. In order to continue in the School of Graduate Studies and in order to qualify for a Master's Degree, a candidate shall obtain an A or B grade in each program course. (See Evaluation. Evaluation of Graduate Students).
2. When it has been determined, on the basis of consultation with the candidate, the instructors in graduate courses, and the thesis Supervisor, that a candidate's work has fallen below a satisfactory level, the Supervisor or the Head of the appropriate academic unit may recommend to the Divisional Head that such a candidate be required to withdraw from the program. (See Evaluation. Evaluation of Graduate Students).

1.6 Study Options

Students are able to study in a full-time or part-time capacity.

Appendix C. Sample Course Calendar Descriptions

The program course and research work is structured to represent the interdisciplinary nature of Boreal Ecosystems and Agriculture Sciences covering 1) Economics and Social Science, 2) Plant and Crop Sciences 3) Soil and Land Resource, and 4) Water Resources. The "sample" courses listed in this proposal are aligned with these research and education foci.

Course Descriptions

Required Core Courses

BEAS 6000: Issues in Boreal Ecosystems and Agricultural Sciences: 3 credits (Fall semester)

This is the first course for the interdisciplinary MSc BEAS graduate program, and it lays the groundwork for subsequent coursework in this program. This course is primarily designed to introduce the breadth or scope, approaches, and interdisciplinary nature of the fields of boreal ecosystems and agricultural sciences. Further, this course will serve to introduce students in the program to the breadth of their colleagues in the program as well as some of the faculty members participating in this program on the campus, as well as other research professionals in the region (e.g. industry, federal and provincial department staff).
The objectives of this course are: to develop an understanding of the main concepts and methodologies used in several key sub-disciplines of boreal ecosystems and agricultural sciences; further develop critical thinking skills by applying them to specific questions relevant to the fields of study; learn how to work within interdisciplinary teams and construct approaches to address interdisciplinary problems; and gain experience in critical writing within the context of boreal ecosystems and agricultural sciences.

Syllabus example:

Overview of Applied Economic Methods
Quantifying the Value of Ecosystem Services
Hydrological Processes and Functions; Watershed Issues in Boreal Ecosystems and Agriculture
Vadose Zone Hydrology
Plants as Resources
Assessing Plant Physiological and Biochemical Processes
Imaging in Plant Sciences
Functional Foods
Cold Climate Crops
Understanding Crop Phenology and Crop Modeling
Agriculture, Forestry and Agroforestry
Soil Fertility, Food Security, Environmental Quality, and Environmental Risks
Land Use and Management in Boreal Ecosystems
Land Degradation and Remediation
Microbiology for Crops and Environment
Bioinformatics and its Practical Applications

BEAS 6001: Graduate Seminar: 3 credits (Fall and Winter semesters)

The course will provide support to students in the development of their critical scientific skills and the development of their research proposal. This will include critical evaluation of scientific literature,

hypothesis development, development of research protocols and methodology, data collection, handling and interpretation strategy, and dissemination strategies. The seminar will be team-taught. Students are required to make a minimum of one presentation on their research proposal, before the end of the second semester.

Syllabus example:

Accessing scientific literature; Internet searches, databases, scientific journal websites
"Grey" literature
Reading and summarizing scientific papers
Disciplinarity and interdisciplinarity
Scientific theories, hypothesis building, and testable predictions
Models of scholarly research and writing
Exploratory vs. manipulative research
Development of research proposal
Presentation and discussion of research proposal
Assessing research proposals; understanding grant applications

Elective core courses – (either BEAS 6002 or BEAS 6003 required)

BEAS 6002 Advanced Quantitative Research Methods for the Natural Sciences: 3 credits (Fall or Fall and Winter semesters)

This course will introduce students to the basic concepts of experimental design and data analysis in Environmental Sciences. Specific topics will mainly focus on the analysis of designed experiments, including multivariate statistical analyses, linear and non-linear regressions and statistical distributions fitting. Exploratory statistics for spatially distributed datasets, time series analyses and microarray analyses will be included to match the various research questions of individual students. The course is in an applied form employing statistical software packages such as R, Statistix, Genstat for Teaching and Learning, SAS, or Minitab. Students are expected to have basic statistical understanding obtained through an undergraduate statistical course. The course is to be taught in rotations by various faculty members. Reading list will include the freely available software manuals and selected research papers. Students are expected to have access to own laptops or desktops. The course will be delivered in two modules. A first module, initially planned for the fall semester, will focus on theoretical elements of the quantitative research methods. A second module will be delivered during the following spring semester and will focus on applied aspects of quantitative analysis. Note that the latter will offer more flexibility according to the students' research program. Credit hours will be equally distributed.

Syllabus example:

1st Module sections:

Discrete and continuous variables
Measures of spread and central tendency
Probabilities and distributions; normal and non-normal distributions
False positives and false negatives
Analysis of variance; parametric and non-parametric; impact of data collection protocols
Outliers and censored data analysis
Simple and multiple linear regressions
Binary distributions
Visual presentations of statistical results

2nd Module sections:

Statistical sampling and/or analysis design
Relevant and valid data: data quality objectives
The sample and the error; total error and its sources
Quality control and quality assurance
Detection limits
Project planning
Data handling and reporting

BEAS 6003: Advanced Quantitative Research Methods for the Social Sciences: 3 credits

This course will provide students with the basic concepts of experimental design and hypothesis testing in social science research. The course will focus on research design, selection of appropriate quantitative method, data collection, and statistical analysis. Students will gain hands-on experience by using data analysis software. Specific topics will include data exploration and plotting, sample selection, basic statistical tests, linear and non-linear regression, statistical model selection, non-parametric tests, survey design, and mixed methods research.

Elective courses examples (minimum one course required)

BEAS 6010: Agriculture and Forestry Economics: 3 credits

Agroforestry involves the integrated production of multiple outputs (such as crops, trees, and livestock), over space and time. Small-scale agroforestry practices are not uncommon in developing nations, where land is scarce and there is a high demand for varied agricultural outputs. In developed economies, agroforestry is often conducted to maximize ecosystem service benefits. This course provides students with critical thinking and analytical skills necessary to evaluate both types of agricultural systems.

This is a graduate-level economics course in agriculture and forestry economics with an initial agroforestry focus. Students will be exposed to the theoretical, mathematical, and policy aspects of both production economics and ecological economics. Students will be expected to apply quantitative models from classical production economics to agroforestry ecosystems. There will be an emphasis on practical quantitative methods.

BEAS 6020: Management of Crop Nutrition: 3 credits

This course focuses on the management and physiological aspects of macro and micronutrients in crops. Topics may include: Introduction and scope of crop nutrition; principles of mineral nutrition in crops, Nutrients and their classification, Biological membranes, Mechanisms of nutrients absorption, Nutrient translocation, Micronutrients, absorption, translocation and metabolism, Novel sustainable nutrient management approaches for optimum crop productivity with minimum impact on environment.

BEAS 6021: Organic Farming for Sustainable Agriculture: 3 credits

This course will cover the topics which may include overview of organic agriculture, opportunities and challenges, Principles of organic farming, soil fertility and crop agronomy in organic agriculture, crop protection in organic agriculture, organic plant breeding and seed production; ecological and ethical aspects, organic standards and certification, environmental impacts of organic farming, food quality, Nutrient cycling, Rotation design for organic system with examples, special topics will be included like biodynamic agriculture today, Regulatory and management issues, contradictions of principles in organic farming.

BEAS 6022: Plant Biochemistry: 3 credits

This course will introduce students to concepts in plant biochemistry and cover areas such as plant metabolism, plant-specific biochemical pathways, processes, and their regulation. Storage carbohydrates, cell wall biosynthesis, lipid metabolism, nitrogen fixation and assimilation, and photosynthesis; biochemical ecology of secondary plant metabolites such as lipids, isoprenoids, phenolics and alkaloids will also be covered.

BEAS 6023: Plant Physiology: 3 credits

This will introduce students to concepts in plant cell biology, physiology and biochemistry. Specifically areas such as plant nutrient metabolism, photosynthesis, respiration, water relations, plant response to environmental stress, plant-pathogen interaction, plant hormones, signal transduction, and plant biotechnology will be covered.

BEAS 6030: Chemical Speciation Modeling for Environmental Matrices: 3 credits

This is a course will expose students to applied chemical speciation models. Environmental processes are explored through hands-on modeling of chemical phenomena in aqueous environments, including soil water. Particular attention is given to reactions involved in environmental pollution and management of wastes. Hands-on modeling of chemical environmental processes with the PHREEQCI model is carried out on data provided by the instructor or on students' own datasets.

Sections that may be included: Flow and Transport of chemical species; Minerals and water – chemical speciation modeling; Carbonates and carbon dioxide in water and soils (dissolved carbonate equilibria); Surface interactions; Redox processes; Weathering processes; Complexation to humic acids; Pollution by organic chemicals.

BEAS 6031: Soil Functions: Soil as a Bioreactor: 3 credits

Microbes carry out most soil functions. The regime of water, gaseous and heat flows will control microbial activity. Management activities that affect these regimes will affect microbial activities and thus nutrient and contaminant kinetics in soil. The course aims to offer an integrated approach to numerical modeling of the chemical, physical and biological processes relevant for nutrient availability and contaminant risk and transport through soils. The course is aimed at a wide range of students interested in soil sciences, water quality, bioengineering systems, and agricultural sciences.

BEAS 6032: Environmental Soil Physics: 3 credits

This course will cover topics which may include flow of water in saturated and unsaturated soils, movement of solutes, movement and exchange of gases in the soil, soil temperature and heat flow, soil compaction, entry and redistribution of water in soil, groundwater drainage and pollution, uptake of soil moisture by plants, water and energy balance in the field, and water-use efficiency. Spatial variability and applications of soil physics to soil and groundwater remediation also will be discussed.

BEAS 6033: Soil and Water Conservation: 3 credits

In this course, land degradation issues and management practices of land and water resources disturbed by human activities are reviewed. In depth understanding of soil erosion process, causes of erosion and prediction of erosion will be provided. It intends to provide a holistic understanding of soil and water conservation in the perspective of watershed management. Emphasis is placed on technical, agronomic and biological approaches to soil and water conservation, conservation methods and the design of terraces, waterways and water control structures. Special emphasis will be given to Boreal and Agricultural Eco-systems, case studies will be varied from temperate to tropical climate systems.

BEAS 6040: Advanced Groundwater Management: 3 credits

This course intends to provide students the background and opportunity in understanding and solving real field problems related to groundwater rather than derivation of theory. The main idea is to expose

students to understand groundwater as a resource in agriculture, forestry and environment of which development and management is essential for the sustainability of the ecosystem. Topics will include groundwater flow, aquifers, resource evaluation, field methods, and sustainable management. Case studies will provide students in depth understanding of issues with respect to groundwater development and management and developing sustainable solutions.

BEAS 6041: Applied Hydrology: 3 credits

This course will provide students an understanding of the interpretation techniques used in the computation of water flows from hydrological processes in agriculture, forestry and environmental perspectives. The course covers all physical processes in the hydrological cycles and their influence on the eco-systems. Effect of snow, fog and land use changes on hydrological processes and water yield will be discussed. In depth understanding of hydrological processes, measurements and interpretation in spatial and temporal scales that are affected by land use changes under managed and natural ecosystems will be highlighted.

BERI 6042: Soil and Groundwater Remediation: 3 credits

This course will cover topics which may include an overview of principles of flow and contaminant transport in porous media and site characterization, soil and groundwater remediation technologies such as pump-and –treat method, air sparging, electrokinetic remediation, bioremediation, phytoremediation, reactive wells and barrier technology. Remediation technology development – past experience and future directions will be discussed. Topics such as constructed wetlands and vegetative filters for effluent treatment, and assessing the impact of remediation will be covered.

BEAS 6050, Special topics in Boreal Ecosystems and Agricultural Sciences. (Various Instructors)

A special topics course number will be available to enhance course and topics delivery flexibility by any supervising faculty within the MSc BEAS

COURSE LISTING

Core Courses
BEAS 6000: Issues in Boreal Ecosystems and Agricultural Sciences
BEAS 6001: Graduate Seminar
BEAS 6002: Advanced Quantitative Research Methods for the Natural Sciences
BEAS 6003: Advanced Quantitative Research Methods for the Social Sciences

Electives
BEAS 6010: Agriculture and Forestry Economics
BEAS 6020: Management of Crop Nutrition
BEAS 6021: Organic Farming for Sustainable Agriculture
BEAS 6022: Plant Biochemistry
BEAS 6023: Plant Physiology
BEAS 6030: Chemical Speciation Modeling for Environmental Matrices
BEAS 6031: Soil Functions: Soil as a Bioreactor
BEAS 6032: Environmental Soil Physics
BEAS 6033: Soil and Water Conservation
BEAS 6040: Advanced Groundwater Management
BEAS 6041: Applied Hydrology
BERI 6042: Soil and Groundwater Remediation
BEAS 6050-6150: Special topics in Boreal Ecosystems and Agricultural Sciences

Appendix D. Consultations

During the development of the Boreal Ecosystems Research Initiative, an in-depth consultation process proceeded regarding the initiative, as well as the need for graduate programming at Grenfell Campus. Consultations were held widely within Grenfell Campus and across the Province. The initial phase of consultations, completed in 2011, surveyed representatives from both the federal and provincial levels of government, non-governmental institutions and universities across Canada regarding the suitability of a Boreal Ecosystem Research Institute and its complementary graduate program at Grenfell Campus. A list of these consultation meetings is included below. This phase of consultations demonstrated a very positive response for the establishment of BERI and graduate programs at Grenfell Campus, in particular the development of boreal ecosystem and agricultural research initiatives.

The second phase of consultations took place from Sept 2012-May 2013, and focused on the Grenfell Campus, as well as federal and provincial levels of government, non-governmental agencies, Dalhousie University, and the environmental industry association in Newfoundland and Labrador. A list of these meetings is included below. This phase was designed to identify interested external individuals, faculty, staff and graduate programs relevant to the MSc BEAS program of study. Strong support for the development of a research institute and graduate programs was heard across all divisions within and outside of the university.

Phase three of consultations regarding the proposed MSc BEAS program occurred during the Fall 2014 – Winter 2015 semester. The MSc BEAS proposal was circulated within Grenfell Campus and Memorial University's Faculty of Science and Labrador Institute, as well as federal and provincial levels of government, non-governmental institutions and select Canadian universities. The purpose of the consultations was to seek advice and recommendations from the internal and external stakeholders regarding the focus and design of the proposed graduate program.

Consultations with Federal Government, Provincial Government, NGO and Academic Institutions

Participants

Conducted by:
Michael J. Goss and Bryan Harvey – September 2011
Greg Wood – Sept 2012 – May 2013
Greg Wood – May 2014 – December 2014

Name	Department / Division / Agency
Crystal Anderson-Baggs	Provincial Agrifoods Division
Bill Dawson	Provincial Forestry Division
Mark Tierney	ACOA
Katie Temple	Environmental Policy Institute, Grenfell
Susanne Dawe	Prov. Human Resources Labour and Employment
Jocelyn Noseworthy	Prov. Human Resources Labour and Employment

Chris Freake	Employment preparation
Gordon Hancock	Humber Economic Development Board
Dmitry Sveshnikov	Environmental Science/ Biology, Grenfell
Mark Lamswood	Red Ochre Economic Development Board
Susan Pottle	Environmental Policy Institute, Grenfell
Louis MacDonald	College of the North Atlantic, Stephenville
Danny Brock	Provincial Agrifoods Division
Carolyn Wheeler	Western Environment Centre
Colin Walsh	Provincial Agrifoods Division
Craig Blanchard	Provincial Agrifoods Division
Dave Jennings	Provincial Agrifoods Division - Production
Sabrina Ellsworth	Provincial Environment and Conservation, IBES
Rick Carey	Provincial Agrifoods Division - Soils and Lands
Jianghua Wu	Sustainable Resource Management, Grenfell
Wade Bowers	Environmental Science and EPI, Grenfell
Chan Wiseman	Young Farmers and College of the North Atlantic
Leah Madore	Provincial Agrifoods Division - Pest Management
Blaine Hussey	Provincial Agrifoods Division – Cranberries, etc.
Stewart Reid	Provincial Innovation Trade and Rural Development
Mano Krishnapillai	Environmental Science, Grenfell Campus
Ivan Emke	Former VP Research- Research Office, Grenfell
Brent Howell	Dean, Tourism and Natural Resources, College of the North Atlantic
Keith Deering	ADM, Provincial Agrifoods Division
Ed O'Rielly	Director of Strategic Resource Development, Forestry and Agrifoods Division
Dean Strickland	Manager, Research Office, Grenfell
Gerry Sullivan	Agriculture Awareness and Agri-Tourism Coordinator, NL Federation of Agriculture
Christa Wright	Agriculture in the Classroom Coordinator, NL Federation of Agriculture

Mary Bluechardt	Vice President, Grenfell Campus, MUN
Christine Campbell	Head, Science Division, Grenfell
Gabriela Sabau	Chair, Environmental Studies, Grenfell
Bryan Harvey	Consultant - Univ. of Saskatchewan
Michael Goss	Consultant - University of Guelph
Gary Kachanoski	President, Memorial University
Charles Pender	Director, Grenfell Secretariat
Angela Carter	Faculty, Environmental Policy Institute, Grenfell
Robert Scott	Faculty, Sustainable Resource Management, Grenfell
Chen Lui	Faculty, Environmental Science, Grenfell
Tamara Murphy	Financial Officer, Provincial Agrifoods Division
Darryl Houlihan	Policy Analyst, Provincial Agrifoods Division
Karen Kennedy	Alternative Feeds Specialist, Agrifoods Division
Krista Bradley	Manager, Agricultural Services, Agrifoods Division
Paul Lomond	Owner, Lomond Farms, Steady Brook, NL
Melvin Rideout	Owner, Rideout's Farm and Dairy, Cormack, NL
Kevin Clarke	Marine Institute, MUN
Heather Manual	Marine Institute, MUN
Fereidoon Shahidi	Dept. of Biochemistry, MUN
Tom Chapman	Dept. of Biology, MUN
Paul Marino	Department Chair, Dept. of Biology, MUN
Norm Catto	Dept. of Geography, MUN
Hugh Whitney	Chief Veterinarian, Dept. of Natural Resources
Richard Carey	Agrifoods Division - Soils Lab
Peggy Dixon	AAFC - Agriculture - Agrifoods Canada, St. John's, NL
Gary Bishop	AAFC - Agriculture - Agrifoods Canada, St. John's, NL
Allan Kwabiah	AAFC - Agriculture - Agrifoods Canada, St. John's, NL

Samir Debnath	AAFC - Agriculture - Agrifoods Canada, St. John's, NL
Gerry Wicks	Lester's Farm, Mount Pearl, NL
Rebecca Schiff	Labrador Institute, Happy Valley-Goose Bay, Labrador
Ron Sparkes	Labrador Institute, Happy Valley-Goose Bay, Labrador
Frank Pye	Grand River Farm, Mud Lake Road, Labrador
Joyce Pye	Grand River Farm, Mud Lake Road, Labrador
Scott Neilsen	Labrador Institute, Northwest River, Labrador
Jennifer Butler Wight	Labrador Institute, Happy Valley-Goose Bay, Labrador
Robert Miller	Soil and Crops Lab, Colorado State University
Julian Dust	Faculty, Environmental Science, Grenfell
Sudhir Abhyankar	Faculty, Environmental Science, Grenfell
Don Roger Parkinson	Faculty, Environmental Science, Grenfell
Len Moores	CEO, Forestry and Agrifoods Division, DNR (Retired)
Hon. Tom Marshall	Minister of Finance, Gov't of NL
Holly Pike	Former Principal, Grenfell Campus, MUN
Mike Dolter	Chief Administrative Officer, City of Corner Brook
Danny Williams	Former Premier, Gov't NL (Retired)
Glenn Payne	Research Coordinator - GRF, College of North Atlantic
Bill Iams	Former Vice-Principal, Grenfell Campus, MUN
John Davis	Regional Director, Innovation, Business and Rural Development
Mario Levesque	Faculty, Environmental Policy Institute, Grenfell
Pierre Rouleau	Faculty, Environmental Science, Grenfell
David Peddle	Associate Vice President (Academic), Grenfell
Rhea Hutchings	Supervisor of Sustainable Development, City of Corner Brook
Paul Mills	Vice President, ACOA
Sheila Earle	Regional Planning Specialist, Innovation, Business and Rural Development
Robert Otto	Director, IBES, Department of Environment and Conservation

Sheldon Peddle	Executive Director, ACAP, Corner Brook
Jeff Whalen	ADM, Dept. of Natural Resources
Wayne Kelly	Director of Ecosystem Sustainability and Research, Forestry and Agrifoods Division
Cyril Organ	VP Academic & Learner Services, College of the North Atlantic
Darren Pike	Deputy Minister, Department of Education
Bruce Belbin	ADM, Advanced Education and Skills
Dennis Waterman	Associate Vice President (Administration and Finance), Grenfell
Javis Hulan	Manager, Facilities Management, Grenfell
Hon. Ross Wiseman	Minister, Department of Environment and Conservation
Keith Hiscock	Facilities Management, MUN
Karen Skinner	Director, Enterprise Development, ACOA
Chad Butt	Account Manager, ACOA
Paul Barnable	Director of Community Services, City of Corner Brook
Marion McCahon	Regional Partnership Planner, Office of Public Engagement, Gov. NL
Sandy Todd	Research Manager, Atlantic Cool Climate Crop Research Centre, Agriculture Canada
Peter Duinker	School for Resource and Environmental Studies (SRES), Dalhousie University
Sean St. George	Executive Director, Red Ochre Economic Development Board
Valerie Simms-Anderson	Executive Director, Humber Economic Development Board
Eugene Legge	President, NL Federation of Agriculture
Debra Coughlin	Economic Development Officer, Long Range Economic Development Board
Andrea Meyers	Economic Development Officer, Nordic Economic Development Corporation
Marie Ryan	Provincial Environment and Conservation - Policy and Strategic Planning
Wayne Turpin	Soiltec - NL Environmental Remediation Business
Ken Martin	ACOA - Director General - Regional Operations
Bill Grandy	ACOA - Director - Community Development
Bruce Pike	Canadian Forest Service - Deputy Director

Tom Rosser	Canadian Forest Service - Assistant Deputy Minister
Susan Ziegler	MUN - Dept. of Earth Science, MUN
Darrin Sooley	Fisheries and Oceans - Area Habitat Coordinator
Keith Clarke	Fisheries and Oceans - Science Branch, St. John's
Carl Noseworthy	Provincial Forestry Division - Center for Forest Science & Innovation
Chris Power	Department of Municipal Affairs - Regional Engineer
Derrick Maddocks	Director - Pollution Prevention , Water Management, Dept of Env and Cons
Ian Bell	Environmental Scientist - Dept. of Env and Cons
Leonard House	Aquaculture Development Officer - Dept. of Fisheries and Aquaculture
Daryl Whalen	Director, Provincial Aquaculture Veterinarian, Dept of Fisheries and Aquaculture
Lourens Robberts	Director of Provincial Public Health Laboratory, Department of Health and Community Services
Don Downer	Independent Chair, Western Regional Waste Management Authority
Ed Evans	Manager, Central Newfoundland Waste Management Authority
Ted Lomond	Executive Director, Newfoundland and Labrador Environmental Industry Association
Glenn Sharpe	Abydoz Environmental Inc
Rob Whelan	Maxxam Analytics
Paul Staeben	Regional Manager - Pinchin LeBlanc Environmental

MSc Degree Proposal Consultation

Group / Organization	Contact Person	Position	Anticipated Completion Date	Feedback Received
Division of Science, Grenfell Campus	Dr. Robert Gallant	Division Head	15-Oct-14	Y
Division of Social Science, Grenfell Campus	Dr. Sandra Wright	Division Head	15-Oct-14	Y
Division of Fine Arts, Grenfell Campus	Dr. Todd Hennessy	Division Head	15-Oct-14	Y
Division of Arts, Grenfell Campus	Dr. Ken Jackobsen	Division Head	15-Oct-14	Y
Ferris Hodgett Library, Grenfell Campis	Ms. Louise McGillis	Associate University Librarian	15-Dec-14	Y
Faculty of Science, St. John's Campus	Dr. Len Zedel	Associate Dean	15-Dec-14	N
School of Graduate Studies, MUN	Dr. Faye Murrin	Dean pro Tempore	15-Dec-14	N
Canadian Forest Service	Dr. Brian Hearn	Science Director	30-Nov-14	Y
Dept. of Natural Resources (NL Gov)	Mr. James Evans	CEO/Deputy Minister	30-Nov-14	Y
Agriculture - Agrifoods Canada	Dr. Sandy Todd	Associate Director	30-Nov-14	Y
Dept of Environment and Conservation (NL Gov)	Mr. Jamie Chippett	Deputy Minister	30-Nov-14	Y
Labrador Institute	Ms. Martha MacDonald	Acting Director	30-Nov-14	Y
NL Environmental Industry Association	Mr. Frank Ricketts	Chair	30-Nov-14	Y
NL Federation of Agriculture	Mr. Paul Connors	Executive Director	30-Nov-14	Y
Dalhousie University, Faculty of Agriculture	Dr. David Gray	Dean	30-Nov-14	Y
University of Toronto, Graduate Studies	Elizabeth Smyth	Vice-Dean, Programs	15-Dec-14	N
University of Guelph, Ontario Agriculture College	Dr. Robert Gordon	Dean	15-Dec-14	N

Appendix F. Potential Faculty and Academic CVs

Faculty and Associates who may potentially contribute to the Master of Science in Boreal Ecosystems and Agricultural Sciences program are listed below. Available CV's are provided immediately following the list. This is an initial non-definitive list relevant at the time of the proposal preparation.

Dr.	Joinal	Abedin	Labrador Institute, Memorial University
Dr.	Andre	Arsenault	Canadian Forest Service, NRCan, Corner Brook
Dr.	Gary	Bishop	Agriculture-Agrifoods Canada (AAFC)
Dr.	Wade	Bowers	Environmental Science, Grenfell Campus
Dr.	Mumtaz	Cheema	BERI, Grenfell Campus
Dr.	Samir	Debnath	Agriculture-Agrifoods Canada (AAFC)
Dr.	Peggy	Dixon	Agriculture-Agrifoods Canada (AAFC)
Dr.	Kate	Edwards	Canadian Forest Service, NRCan, Corner Brook
Dr.	Paul	Foley	Environmental Policy Institute, Grenfell Campus
Dr.	Merline	Fonkwe	Labrador Institute, Memorial University
Dr.	Erin	Fraser	Environmental Science, Grenfell Campus
Dr.	Lakshman	Galagedara	BERI, Grenfell Campus
Dr.	Maura	Hanrahan	Environmental Policy Institute, Grenfell Campus
Dr.	Brian	Hearn	Canadian Forest Service, NRCan, Corner Brook
Dr.	Gary	Kachanoski	President, Memorial University
Dr.	Vanessa	Kavanagh	Agrifoods Div., Dept of Natural Resources Gov't of NL
Dr.	Catherine	Keske	BERI, Grenfell Campus
Dr.	Andreas	Klinke	Environmental Policy Institute, Grenfell Campus
Dr.	Mano	Khrishnapillai	Environmental Science, Grenfell Campus
Dr.	Allan	Kwabiah	Agriculture-Agrifoods Canada (AAFC)
Dr.	Chen	Lui	Environmental Science, Grenfell Campus
Dr.	Joan	Luther	Canadian Forest Service, NRCan, Corner Brook
Dr.	David	McKenzie	Agriculture-Agrifoods Canada (AAFC)
Dr.	Don-Roger	Parkinson	Environmental Science, Grenfell Campus
Dr.	Reg	Parsons	Canadian Forest Service, NRCan, Corner Brook
Dr.	Bruce	Pike	Canadian Forest Service, NRCan, Corner Brook
Dr.	Harunur	Rashid	Environmental Science, Grenfell Campus
Dr.	Gabriela	Sabau	Environmental Science, Grenfell Campus
Dr.	Robert	Scott	Sustainable Resource management, Grenfell Campus
Dr.	Julie	Sircom	Environmental Science, Grenfell Campus
Dr.	Dmitry	Sveshnikov	Environmental Science, Grenfell Campus
Dr.	Adrian	Unc	BERI, Grenfell Campus
Dr.	Michael	van Zyll de Jong	Environmental Policy Institute, Grenfell Campus
Dr.	Kelly	Vodden	Environmental Policy Institute, Grenfell Campus
Dr.	Barry	Wheeler	Canadian Forest Service, NRCan, Corner Brook
Dr.	Jinhua	Wu	Environmental Science, Grenfell Campus
Dr.	Xinbiao	Zhu	Canadian Forest Service, NRCan, Corner Brook

Potential Faculty - Academic CVs included:

Dr.	Joinal	Abedin	Labrador Institute, Memorial University
Dr.	Christine	Campbell	Environmental Science, Grenfell Campus
Dr.	Mumtaz	Cheema	BERI, Grenfell Campus
Dr.	Merline	Fonkwe	Labrador Institute, Memorial University
Dr.	Lakshman	Galagedara	BERI, Grenfell Campus
Dr.	Gary	Kachanoski	President, Memorial University
Dr.	Catherine	Keske	BERI, Grenfell Campus
Dr.	Mano	Krishnapillai	Environmental Science, Grenfell Campus
Dr.	Raymond	Thomas	BERI, Grenfell Campus
Dr.	Adrian	Unc	BERI, Grenfell Campus