Buffalo State College
Individual *Faculty* Information Sheet

Time Frame for Review: July 1, 2003 – June 30, 2004

Request for information to be used in preparing departmental annual report and as request for discretionary salary increase. *(Discretionary process is dependent on contract.)*

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Department:	Earth Science and Science Education
Date:	June 2, 2004

Section I - Summarize your professional activities and accomplishments for the past year.

A. Teaching Effectiveness (include summary of student, peer, and other evaluations; changes in courses that strengthen the classroom experience and student learning)

This past year I have taught courses in Introductory Geology (GES 101), Historical Geology (GES 102), Environmental Geochemistry (GES 350), Hydrogeology (GES 452) and Applied Environmental Methods (GES 460). I also taught a summer section of Introductory Geology in 2003 and will be teaching a summer section of Historical Geology in 2004.

Due to the size of the classes and the widely varying backgrounds of the students in my introductory level courses, I have begun utilizing many different teaching tactics in order to make the course materials as accessible as possible. In these classes, which have ranged in size from around 45 to over 100 students, I have created multi-media presentations which address each of the topics to be covered, give pointers to useful on-line materials available from reliable sources, and utilize as much hands-on experience as is practicable. For example, I pass around hand samples of rocks and minerals and have students fill in informational tables. I have been building an extensive library of digital presentation materials to be used in the classroom, and Bonnie Muller and I have been putting together materials for in-class presentations, including a magnetic field display model (since many of the students have had great difficulty understanding how the Earth's magnetic field works and what paleomagnetic alignment is) and a small model of a seismograph. I am continuing to incorporate demonstration materials and in-class hands-on exercises in all of my classes.

I firmly believe that students must actively participate in the learning process and this means doing homework exercises. In addition to the typical types of paper homework, I have incorporated into my classes several freely available Internet-based virtual laboratory exercises that were developed using funding from the National Science Foundation (see http://vcourseware4.calstatela.edu/ for an example) and mini-field trips, which require students to look at materials on display around campus or which are part of the structures on campus. I have also developed a system by which I can give weekly homework assignments to even my largest classes and still get the materials back to them in a timely fashion.

For my upper-level courses, I have been actively acquiring materials for hands-on laboratory experiences. In the Hydrogeology course, which I plan on extensively revising over the next couple of years, I have developed four in-class laboratory exercises which allow students to use the material from lectures to access certain hydrogeologic characteristics. This is especially important as the students here typically have a weak background in mathematics and cannot visualize behaviors based purely on exposure to an equation. I will also be incorporating several excersizes that take advantage of the well outside the Science Building, giving the students some practical hands-on experience.

Another upper-level course which is still under development is the Applied Environmental course. Because there is no single textbook appropriate for this course, I have been creating a course handbook with material that I have written. In this course students will be exposed to a variety of environmental sampling methods and each year a new "local" environmental issue will be examined. Last year we concentrated on the "Sinking Suburb" problem in Amherst, where relatively new and quite expensive houses are developing severe foundation problems due to the behaviors of the underlying soils. This year we assesses the Farmersville Landfill issue, in which a waste management company has applied to the New York State Department of Environmental Conservation to open a landfill in Cattaraugus County, which could accept 1,500 tons of garbage a day during a 15- to 20-year period. Theoretically this landfill would replace the recently closed Fresh Kills landfill in New York City. In the class we are investigating various aspects of this issue and each student has been assigned specific topics to research and present in class. In the future I hope to have each year's class produce a small informational booklet on the topic they researched.

In the Fall 2003 semester I received good ratings in two of my courses (GES101 : 3.41, and GES 350 : 3.10), and only a high fair rating (2.67) in my Hydrogeology course which I attribute in some part to the high difficulty of the material. That particular course is still evolving and I will hopefully find a happy medium between the level of mathematics required to optimally understand the material and a level that my students are comfortable with. I continue to have students recommend my courses to others and a few decide to switch their majors to Earth Sciences. I have not yet received the results from the Spring 2004 semester.

Thus far all of my introductory geology courses are very well attended and I have gotten a very good response from students. Some of the comments from students in the Fall 2003 Introductory Geology (GES 101) course were:

"I liked that the instructor was very passionate about the subject. She was extremely knowlegable, [sic] experienced, professional yet easy to talk to… I recommended this class to many people because of the subject matter and expertise of the instructor"

"This class has been the best class that I have taken so far. Dr. Bergslien was very clear about the material she taught. She was extremely funny and kept things interesting."

"Dr. Bergslien Rocks !"

For the past year I have also been developing an exciting new course – Forensic Geology

(GES 360) (please see attachment). This course is substantially different from typical courses in this department, as it is meant to introduce any upper-level student to the application of science to the law. Due to shows such as "Cold Case", "CSI" and "The X-Files," not to mention the numerous cable reality shows, there has been a documented increase in student interest in the sciences. By tapping into this interest, and offering a course that ties geological concepts to forensic science, we can potentially attract students who traditionally are unwilling to participate in college science courses. Each class deals with one specific geological topic, starting with a description of classic criminal cases and a lecture on the type of material to be investigated. This is followed by detailed simulated forensic investigation exercises that are reviewed and evaluated at the end of the session. GES 360 is designed for upper-level students from any major and will introduce students to the principles of Earth Science and their application to forensic investigation. The topics covered will include evidence handling and procedure, rocks, sand, soils, fossils, ore deposits, archeology, spores and pollen, construction materials, forensic engineering and forensic geochemistry. In this new course there will be hands-on use by students of analytical equipment and a capstone crime scene project where the students will evaluate a staged crime scene, collect forensic evidence and analyze that evidence using the appropriate analytical equipment.

Problem-based learning is a recognized teaching technique, in which small groups of students work together to analyze complex problems, that has been successfully used to teach geology to undergraduates. While this technique is very time and labor intensive, it motivates learning, develops communication skills and intrigues students in a way that traditional lectures can not. In addition, use of non-traditional teaching techniques in the geosciences appears to attract involvement by women and minority groups. Forensic science has also been successfully used to teach the principles of science and the scientific method to non-science majors.

Other items of interest –

 I had two of my students prepare grant applications for the 2004 Undergraduate Summer Research Fellowships. We selected the best of these and submitted it. Ultimately our proposal was unsuccessful, but it was a good experience for both students.

 I am on the graduate committee of Joanna Tuk, a Master's student in Multidisciplinary Studies program who is performing an analysis of the Point Peter Brook Watershed, identifying Variable Source Area (VSA) controls on the exports of nitrogen (N) and dissolved organic carbon (DOC) during storm events. I have also provided Independent Study courses for two graduate students.

 I have four students working with me this summer preforming research projects.

B. Scholarship, Research, and Creative Activity (cite works published, professional presentations, performances and exhibitions, grants awarded; describe professional development activities)

Thus far I have had one paper, entitled "**Characterization of the surface properties of epoxy-type models used for multiphase flow studies in fractured media and creation of a**

new model" accepted for publication by the journal Water Resources Research (see attached). It should appear sometime in the latter part of the year. Water Resources Research is a well respected journal that is Ranked #2 of 53 titles in the Water Resources category, #3 of 12 titles in the Limnology category, and #22 of 132 titles in the Environmental Sciences category of the 2002 Journal Citation Reports. This article compares the surface characteristics of commonly used models with geologic material in order to address the issue of how well the models actually replicate geologic material. Geological materials, indeed most materials, can be identified as being ranging between hydrophilic ("water-loving") or as hydrophobic ("water-fearing"). A common example of a hydrophilic material is glass. Water will spread out onto the surface of clean glass into a thin film. On the other hand, Teflon is a good example of a hydrophobic material, so is RainX, a compound you can use on your windshield to repel water. Water on a hydrophobic material pull in on itself and tends to form little balls. Oils, and most organic solvents, will have the opposite behavior, with hydrophobic surfaces being attractive to oil (oleophilic) and vice versa. By understanding and correctly modeling the surface characteristics of geologic materials it is possible to determine how mixtures of fluids, also referred to as multiphase fluids, behave while flowing through those media. This is an important area of study for such diverse fields as petroleum engineering and remediation of contaminated groundwater.

I also have an article tentatively entitled "**Measurement of aperture distribution in fractured dolomite via direct and indirect methods**" that is under review. This article discussions the geometry of fractures in local dolomite bedrock. This information is also used to model groundwater and multiphase flow inside fractured rock.

I have completed two major grant applications. The first, to the National Science Foundation's Course, Curriculum, and Laboratory Improvement Adaptation and Implementation Program, is entitled "**Development of a Novel, Problem-Based Forensic Geology Laboratory for Students Utilizing XRD Analysis"** and asks for $99,990 from the NSF, with the promise of $74,937.50 in matching funds from Buffalo State College (see attached). The funding is to be used for a major piece of equipment (an X-ray Diffractometer) to enhance the Forensic Geology course that I am developing, and for course supplies and development. To colleges in the department are listed as senior personal for this project. Dr. Gary Solar, who would use the XRD in his Mineralogy and Petrology, would receive training on the equipment and to aid in assessment, Dr. Joseph Zawicki, a Science Educator, would be brought in for several days during the first and second year to assist in development and application of an evaluation program. This project also has support from the Art Conservation, Chemistry, and Physics Departments and the Great Lakes Center (please see the last four pages of the grant application for letters of support).

I have received word from the program director that he is recommending this proposal for funding and we now are waiting to see what happens with respect to the distribution of funds (i.e. how many projects actually receive funding before the money runs out.

The second grant proposal was to the National Science Foundation's Major Research Instrumentation Program and in a proposal entitled "**Acquisition of an X-Ray (XRF) Fluorescence Spectrometer for the Foundation of a Multidisciplinary Research and Educational Laboratory"** requests $445,072.00. (see attached) The goal of this NSF MRI proposal is to acquire funding to establish a multi-disciplinary x-ray fluorescence (XRF) laboratory to be housed in the Earth Science and Science Education Department at Buffalo State College. Funding is sought for a state-of-the-art XRF spectrometer plus necessary sample preparation equipment including a muffle furnace, a shatterbox, a manual press and a fusion system. This laboratory would represent the only state-of-the-art enclosed XRF facility in western New York open for multi-disciplinary research and education projects. X-ray fluorescence (XRF) spectrometry is a non-destructive analytical technique for qualitative and quantitative determinations of the elemental composition of a wide range of samples including materials such as rock, soil, sand and water. The availability of an XRF spectrometer at Buffalo State College would greatly enhance our ability to engage in valuable geologic research, allow us to participate in multi-disciplinary projects, greatly expand the ability of our undergraduate and graduate students to engage in research, and would allow us to develop joint research projects with the Departments of Geology at the University at Buffalo and SUNY Oswego. I have brought together three Co-investigators on this proposal, Dr. Gary Solar, also in the Earth Sciences and Science Education department, Dr. Aniko Bezur in the Art Conservation Department, and Dr. Rossman Giese, Jr. in the Geology Department at the University at Buffalo. In addition, I have several other faculty, such as Dr. Shreeram P. Inamdar in the Geography Department, and Drs. Michael Sheridan and Marcus Bursik in the Volcano Studies Group at the University at Buffalo interested in utilizing the proposed facility if we receive funding.

I just received word this week that this proposal has been declined. However, with the information from the reviewers we are now in a position to create a much stronger proposal for the next funding cycle.

I am still in the process of acquiring equipment and supplies for use in both research and for hands-on experience in the classroom. My main area of research involves investigating the behavior of clays that have been contaminated by organic liquids, such as chlorinated solvents, which have been commonly used at industrial sites for decades as solvents and degreasers. I am

currently engaged in a multi-stage assessment of the interaction of organic compounds with clay minerals using a surface thermodynamic approach in order to create a stable framework by which the behavior of a variety of different organic compound-clay mineral mixtures can be successfully predicted. More simply stated, the goal of this project is to correlate some key chemical properties of the clay to their resultant behavior when exposed to specific types of contaminants and use this information to make predictions of behavior for other mixtures.

This research program involves measuring the surface thermodynamic properties of several standard clay minerals, including some local (Erie and Niagara Counties) clay barrier materials, which in effect means performing a detailed chemical analysis of the degree of hydrophilicity (degree of attraction to water) or hydrophobicity (repulsion from water) of the clay and other several of its other chemical behaviors. Once these properties are understood, the clays will be exposed to a series of organic contaminants and their surface properties re-examined. Non-toxic analog fluids will often be used in these experiments as proxies for organic solvents to ensure student safety. The effect of the interactions between the clay and organic contaminant will also be determined using permeameter tests, which quantitatively measure the ability of fluids to flow freely through a sample. A simple glass falling-head, rigid wall permeameter cell where the clay sample is confined between layers of sand is currently under development in my laboratory (figure 1). Glass cells are used for these tests so that changes in

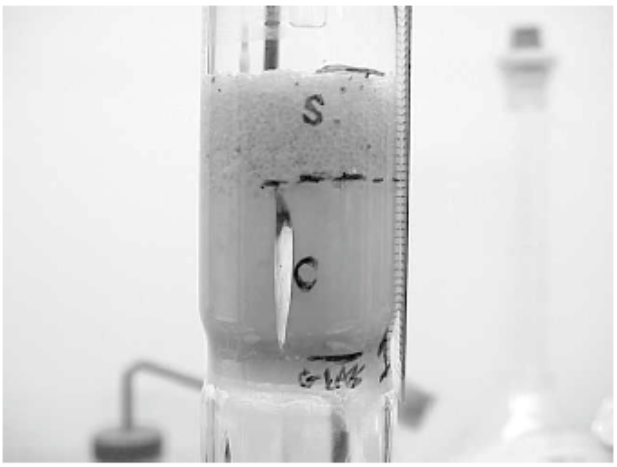

Figure 1: Test Sample in Glass Permeameter Cell
Montmorillonite Clay Exposed to Tricholoroethylene Saturated Water for 5 weeks

the clay or clay soil can be visually monitored and the rate of shrinkage, one of the potential side effects of exposure to organic solvents, can be directly measured. Initially, test samples will be prepared using slurries of commercially available clays and slurries of local clay-rich soils. In the

future, a method for introducing trimmed, intact clay-rich locally collected soil samples into the glass permeameter cells will also be developed. The permeameter cells will have to be monitored over the course of several months and this project will be an ongoing endeavor.

This experimental program contains aspects that can be successfully and safely performed by student researchers. Their work would actively support my overall research program and allow them to take part in cutting edge environmental work. The initial results from this program will also be used to apply for larger research grants from the NSF or DOE. To that end I have been working on a grant proposal with Dr. Giese at the University at Buffalo to begin a multi-year study of the interaction between clays and organic contaminants. We are currently searching for an engineer to add to the project and hope to submit the grant in the next couple of months. Students involved in this project will potentially become co-authors on research papers and can present their findings at the appropriate national conferences. The equipment and supplies used for this research can also be used to demonstrate some fundamental behaviors of organic contaminants and basic research techniques.

Another project, that also involves the students in my upper-level Applied Environmental Methods course, involves tracking urban pollution distribution in the City of Buffalo. Historically, Buffalo was home to a variety of industries, including steel mills and chemical production facilities, and communities in Buffalo typically grew up around specific industries. For example, the "Seneca Babcock" neighborhood was originally a housing development for employees of National Aniline, a chemical plant, and nearby "The Valley" was a neighborhood of workers for the now departed Republic Steel plant, on the south side of the Buffalo River. People in these areas tend to think of industrial pollution as a "local problem" and a normal side effect of living with their workplace.

In reality these neighborhoods, or social communities are only a few blocks apart. Not only is research required to understand historic and contemporary hazards, there needs to be research into understanding how contaminants migrate beyond local social boundaries and intermingle in urban neighborhoods. Some of these issues are already being addressed by the Community Based Environmental Chemical Analysis program led by Dr. Joseph A. Gardella, Jr. at the University at Buffalo (more information on this program can be found at http://www.acsu.buffalo.edu/~gardella/caai.htm). He utilizes Atomic Adsorption (AA), Inductively Coupled Plasma (ICP) Atomic Emission, and various Gas Chromatography (GC) methods to study the distribution of certain contaminants in Buffalo. To aid in this effort I and my students are currently working on compiling data on the Delaware Park area of Buffalo.

Delaware Park (originally just called "The Park") was designed by Frederick Law Olmsted in 1870 and represents a 367 acre area of Buffalo that was preserved from development, with the only major disruptions being the 1901 Pan American Exposition held in the park and in 1960 when an expressway was extended across the park, separating it into two sections. Study of this relatively "clean" area gives us a baseline by which to compare the pollutant load the industrialized areas of the city and an opportunity to study the degree to which urban pollution affects theoretically "untouched" areas.

Undergraduate students from the Applied Environmental Methods course will spend part of the semester collecting samples from the park, including soil, water, air, and soil gas. These samples will then be analyzed using several field analytical methods and in the laboratory via GC. Selected samples will also be sent off campus to Dr. Gardella for additional analysis.

A future urban geology project involves the Buffalo River and its tributaries. As with the City, historically several industries made their home along the banks of the Buffalo River, resulting in the area being declared an "area of concern" by the Environmental Protection Agency. Dr. Shreeram Inamdar from the Buffalo State College Department of Geography and Planning is the Principle Investigator in several projects to assess contaminants in urban creeks, specifically in Scajaquada Creek, which runs though Delaware Park, and Cazenovia Creek, a tributary to the Buffalo River. The objective of this research is to determine contaminant concentrations in the creek's water and sediment and identify their sources. He and I are working on collaborations to expand his watershed analysis project to include soil-gas data, geologic material source data and groundwater data.

Other items of interest –

- I was invited to apply to attend a Center for Workshops in the Chemical Sciences National Science Foundation sponsored workshop entitled "Chemistry of Art" to be held June 6 - 11, 2004 in Millersville, PA. A NSF grant would cover the cost of registration and housing. This workshop, which explores methods for chemical analysis of artistic media, such as pigments, papers and dyes, in order to promote conservation and for the detection of forgeries, will provide additional material for my Forensic Geology course.
- One idea that I had which I hope will blossom into a fruitful area of future teaching and research for our department is the development of a forensic geology program. Initially, this would start small with a single introductory class in forensic geology. But ideally, this program could be a minor that would supplement programs for students in both the geology program and forensic science program. And while forensic geology is indeed a

very small niche in the job market, there are very few colleges/universities that offer it as an option. It seems to me that at Buffalo State College we are in the perfect position to move into this market. This would be an additional area where the geology and chemistry departments can achieve synergy. In order to get more information about what is offered in the area of forensic geology I have been in contact with a few of the more prominent people in the field. One of the people that I contacted was Ray Murray, the author of the only forensic geology textbook available. He told me that a new edition of his book will be coming out soon (in March probably). I have used the information I have gathered as background for developing a course here at Buffalo State College, which will be taught for the first time in Fall 2004. In general I have found people in the field to be very excited at the prospect of another college entering the area. Everyone I have contacted has been more than willing to help us get something going. I plan to devote a portion of my time over the next year into trying to further this idea.

C. Service to the College, Community, Profession (describe extent of involvement and outcomes; cite contribution to the department's advisement efforts; describe any activities beyond normal classroom efforts that supports students)

College Service:

- Since I arrived I have been an active member of the Analysis and Planning / Undergraduate Committee in the Earth Science and Science Education Department. This committee was responsible for compiling the draft department evaluation and assembled a large portion of the information for the department program review. The committee also compiled a draft report on proposed changes in our curriculum.
- In addition, I am on the ad hoc Bylaws Revision Committee, and I am the chair of the ad hoc Evaluation Form Revision Committee.
- I have volunteered to 'resurrect' the ESSE department's internship program. I have been developing an industry contacts list and have been drafting a standardized workbook that students will use to structure and evaluate their internship experience. This effort is still in very preliminary stages of development.
- On September 16th, 2003, I hosted a member of the Student Conservation Association who came to speak about paid internship opportunities. I plan to have another of these meetings next year.
- I was a member of the 2004 President's Medal for Outstanding Graduate Student, and Chancellor's Award for Student Excellence Committee.
- I was a member of the Who's Who and Mildred Campbell Awards Committee.

Work with Students:

- I have four students conducting independent research with me this summer and into the fall.
- I am an active student advisor, with an official list of eleven advisees, plus several other students who visit for suggestions regarding their course selection. I also advised several transfer students this year at the Transfer Student Orientation.
- I am on the graduate committee of Joanna Tuk, a Master's student in Multidisciplinary Studies program who is performing an analysis of the Point Peter Brook Watershed, identifying Variable Source Area (VSA) controls on the exports of nitrogen (N) and dissolved organic carbon (DOC) during storm events.
- I have provided Independent Study courses for three graduate students.
- I am the Faculty Advisor for the Wilderness Club.
- I meet regularly with students to assist them with their coursework, address their concerns about assignments and help them along in their college careers.

Community Service:

- I am performing local analysis of the Delaware Park area to assist in a larger effort to track pollutants in the Buffalo area.
- I have also been approached by Gary A. Abraham, Esq., of the Concerned Citizens of Cattaraugus County, Inc. to become a consultant on the Farmersville Landfill issue. I have begun an analysis of the geological and hydrogeologic issues associated with the proposed sitting of the landfill. This is the same topic that we addressed in the Applied Environmental Methods course this semester.
- For the past three years I was an officer in a national not-for-profit, historical re-enactment fencing program and was responsible for overseeing activities in western New York, western Pennsylvania and West Virginia. Last year I initiated a program for youth age 14 - 18 to participate in re-enactment fencing. This is a sports program similar to FIE "Olympic-style" fencing, but training is free and the program is run by volunteers.

Professional Service:

- I am a member in good standing of the Geological Society of America, the American Geophysical Union, the National Ground Water Association and the Clay Minerals Society.