COVER SHEET FOR PROPOSAL TO THE NATIONAL SCIENCE FOUNDATION

FOR CONSIDERATION BY NSF ORGANIZATION UNIT(S)
(Indicate the most specific unit known, i.e., program, division, etc.)
Division of Undergraduate Education-Instrumentation for Laboratory Improvement

FOR NSF USE ONLY
NSF PROPOSAL NUMBER

PROGRAM ANNOUNCEMENT/SOLICITATION NO /CLOSING DATE/If not in response to a program announcement/solicitation enter GPG, NSF 95-27
EHR/DUE ILI-IP (NSF #96-10) November 15, 1996

DATE RECEIVED	NUMBER OF COPIES	DIVISION ASSIGNED	FUND CODE	FILE LOCATION

EMPLOYER IDENTIFICATION NUMBER (EIN) OR TAXPAYER IDENTIFICATION NUMBER (TIN)
34-101-1998

SHOW PREVIOUS AWARD NO. IF THIS IS
☐ A RENEWAL OR
☐ AN ACCOMPLISHMENT-BASED RENEWAL

IS THIS PROPOSAL BEING SUBMITTED TO ANOTHER FEDER AGENCY? YES ☐ NO ☐ IF YES, LIST ACRONYM(S)

NAME OF ORGANIZATION TO WHICH AWARD SHOULD BE MADE
Youngstown State University

AWARDEE ORGANIZATION CODE (IF KNOWN)

ADDRESS OF AWARDEE ORGANIZATION, INCLUDING ZIP CODE
One University Plaza
Youngstown, Ohio 44555

NAME OF PERFORMING ORGANIZATION, IF DIFFERENT FROM ABOVE

PERFORMING ORGANIZATION CODE (IF KNOWN)

ADDRESS OF PERFORMING ORGANIZATION, IF DIFFERENT, INCLUDING ZIP CODE

IS AWARDEE ORGANIZATION (Check All That Apply)
(See GPG II.D.1 For Definitions) ☐ FOR-PROFIT ORGANIZATION ☐ SMALL BUSINESS ☐ MINORITY BUSINESS ☐ WOMAN-OWNED BUSINESS

TITLE OF PROPOSED PROJECT
Brownfields Investigations as an Integrated Approach to Sampling, Sample Preparation, and Analysis

REQUESTED AMOUNT	PROPOSED DURATION (1-60 MONTHS)	REQUESTED STARTING DATE
$78,375	12 months	1997

CHECK APPROPRIATE BOX(ES) IF THIS PROPOSAL INCLUDES ANY OF THE ITEMS LISTED BELOW

☐ BEGINNING INVESTIGATOR (GPG I.A.3)
☐ DISCLOSURE OF LOBBYING ACTIVITIES (GPG II.D.1)
☐ PROPRIETARY & PRIVILEGED INFORMATION (GPG II.D.10)
☐ NATIONAL ENVIRONMENTAL POLICY ACT (GPG II.D.10)
☐ HISTORIC PLACES (GPG II.D.10)
☐ SMALL GRANT FOR EXPLOR. RESEARCH (SGER) (GPG II.D.12)
☒ GROUP PROPOSAL (GPG II.D.12)
☐ VERTEBRATE ANIMALS (GPG II.D.12) IACUC App. Date _____
☐ HUMAN SUBJECTS (GPG II.D.12)
Exemption Subsection____or IRB App. Date _____
☐ INTERNATIONAL COOPERATIVE ACTIVITIES: COUNTRY/COUNTRIES _____
☐ FACILITATION FOR SCIENTISTS/ENGINEERS WITH DISABILITIES (GPG V.G
☐ RESEARCH OPPORTUNITY AWARD (GPG V.H)

PI/PD DEPARTMENT

PI/PD FAX NUMBER

PI/PD POSTAL ADDRESS
One University Plaza
Youngstown, Ohio 44555

NAMES (TYPED)	Social Security No.*	High Degree, Yr	Telephone Number	Electronic Mail Address
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CO-PI/PD				

NOTE: THE FULLY SIGNED CERTIFICATION PAGE MUST BE SUBMITTED IMMEDIATELY FOLLOWING THIS COVER SHEET

*SUBMISSION OF SOCIAL SECURITY NUMBERS IS VOLUNTARY AND WILL NOT AFFECT THE ORGANIZATION'S ELIGIBILITY FOR AN AWARD. HOWEVER, THEY ARE AN INTEGRAL PART OF THE NSF INFORMATION SYSTEM AND ASSIST IN PROCESSING THE PROPOSAL. SSN SOLICITED UNDER NSF ACT OF 1950, AS AMENDED.

CERTIFICATION PAGE

Certification for Principal Investigators and Co-Principal Investigators

I certify to the best of my knowledge that:

(1) the statements herein (excluding scientific hypotheses and scientific opinions) are true and complete, and
(2) the text and graphics herein as well as any accompanying publications or other documents, unless otherwise indicated, are the original work of the signatories or individuals working under their supervision. I agree to accept responsibility for the scientific conduct of the project and to provide the required progress reports if an award is made as a result of this application.

I understand that the willful provision of false information or concealing a material fact in this proposal or any other communication submitted to NSF is a criminal offense (U.S.Code, Title 18, Section 1001).

Name (Typed)	Signature	Date
PI/PD Daryl W. Mincey		
Co-PI/PD Scott C. Martin		11/14/96
Co-PI/PD Renee L. Falconer		11-14-96
Co-PI/PD Jeffrey C. Dick		Nov 14, 1996
Co-PI/PD		

Certification for Authorized Organizational Representative or Individual Applicant

By signing and submitting this proposal, the individual applicant or the authorized official of the applicant institution is: (1) certifying that statements made herein are true and complete to the best of his/her knowledge; and (2) agreeing to accept the obligation to comply with NSF award terms and conditions if an award is made as a result of this application. Further, the applicant is hereby providing certifications regarding Federal debt status, debarment and suspension, drugfree workplace, and lobbying activities (see below), as set forth in the *Grant Proposal Guide (GPG)*, NSF 95-27. Willful provision of false information in this application and its supporting documents or in reports required under an ensuing award is a criminal offense (U.S. Code, Title 18, Section 1001).

In addition, if the applicant institution employs more than fifty persons, the authorized official of the applicant institution is certifying that the institution has implemented a written and enforced conflict of interest policy that is consistent with the provisions of *Grant Policy Manual* Section 510; that to the best of his/her knowledge, all financial disclosures required by that conflict of interest policy have been made; and that all identified conflicts of interest will have been satisfactorily managed, reduced or eliminated prior to the institution's expenditure of any funds under the award, in accordance with the institution's conflict of interest policy. Conflicts which cannot be satisfactorily managed, reduced or eliminated must be disclosed to NSF.

Debt and Debarment Certifications

(If answer "yes" to either, please provide explanation.)

Is the organization delinquent on any Federal debt? Yes ☐ No ☒

Is the organization or its principals presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal Department or agency? Yes ☐ No ☒

Certification Regarding Lobbying

This certification is required for an award of a Federal contract, grant or cooperative agreement exceeding $100,000 and for an award of a Federal loan or a commitment providing for the United States to insure or guarantee a loan exceeding $150,000.

Certification for Contracts, Grants, Loans and Cooperative Agreements

The undersigned certifies, to the best of his or her knowledge and belief, that:

(1) No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, and officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure of Lobbying Activities," in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

AUTHORIZED ORGANIZATIONAL REPRESENTATIVE	SIGNATURE	DATE
NAME/TITLE (TYPED) Peter J. Kasvinsky, Dean of Graduate Studies		11/14/96

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NATIONAL SCIENCE FOUNDATION
Division of Undergraduate Education

PROJECT DATA FORM

The instructions and codes to be used in completing this form begin on the next page.

1. Program to which the Proposal is Submitted: ILI-IP
2. Type of Submission: PR
3. Name of Principal Investigator/Project Director (as shown on the Cover Sheet):
   Dr. Daryl W. Mincey
4. Name of Submitting Institution (as shown on the Cover Sheet)
   Youngstown State University
5. Other institutions involved in the project's operation:
   Geneva, Grove City, Hiram, Mount Union, Lake Erie, Thiel, Malone, Walsh, and Westminster Colleges

PROJECT CODES

A. Major Discipline Code: 1 2 Subfields: Envir, Biol., Chem.Civ. Eng., and Geol.
B. Academic Focus Level of Project: B O
C. Highest Degree Code: M
D. Category Code: ____ ____
E. Business/Industry Participation Code: ____ ____
F. Audience Code: W M H S
G. Institution Code: P U B L
H. Environmental Education Code: E N
J. Estimated Number of Undergraduate Students to be Directly Affected by the Activities of the Project During its Operation: 500 over 5 years
K. Estimated Number of Pre-College Students to be Directly Affected by the Activities of the Project During its Operation: ____
L. Estimated Number of College Faculty to be Directly Affected by the Activities of the Project During its Operation: 100 (5 years)
M. Estimated Number of Pre-college Teachers to be Directly Affected by the Activities of the Project During its Operation: ____
N. Total Non-NSF Contribution: $78,375

Project Summary:

The Project Summary should be a concise description of the project limited to 22 lines of 12-point (standard pica type) or larger font on plain white paper.

PROJECT SUMMARY

This proposal will support the development of an integrated course employing, as closely as possible "real-life" techniques and procedures needed to effect Phase I and II property assessments of Brownfields. Brownfields are previously used industrial sites that are presently not being fully utilized because of an uncertainty of long-term costs. Through actions taken by the Ohio EPA, a property owners through a Voluntary Action Plan may have the contaminants on a property assessed, perform sufficient remediation appropriate for the eventual use, and receive from the EPA a "Covenant Not to Sue". Once received, the covenant will limit the liability faced by a property owner. The Phase II property assessment require the integration of sampling, sample preparation, and analytical procedures with quality control, quality assurance, and good laboratory practices. There is data that suggest that an integrated approach will provide environmental studies and other students in chemistry, civil and environmental engineering, biology, and geology, from Youngstown State University and ten local colleges, with an increased appreciation of what is often presented as independent functions. The dependence of an analysis protocol on size, and type of sample collected, type of container and preservatives, collection procedure, the method of sample preparation will be presented in an integrated format. The requested Microwave Oven will permit reproducible and safe preparation of samples collected on local Brownfield sites and will enable students to be experienced with analytical method development on instrumentation encountered in a "working" laboratory. Graphite Furnace Atomic Absorption and Gas Chromatograph-Mass Spectrometers are necessary instrumentation to effect a Brownfield site investigation. They will be networked via the INTERNET to a series of existing data stations, permitting the analysis and data processing, of Brownfields samples in the laboratory courses of several disciplines at seven institutions.

4. **TABLE OF CONTENTS**

1. **Results from Prior Support.** The National Science Foundation has supported the steady development of environmental studies, at Youngstown State University (YSU), through three NSF-ILI awards. Drs. Martin, Mincey, and Schroeder have been involved in two, Dr. Dick has been involved in two and Dr. Falconer in the last one. The first of these supported the creation of an Environmental Science Minor (DUE-8950841). The second supported a course in sub-surface investigations (DUE-9351871) and the third supplied equipment for Environmental Studies (ENST) 601L and 602L, Fundamentals of Environmental Studies Laboratory 1, 2 (DUE-9552347). The number of Environmental Studies majors has risen from 100 to 150 in just one year. The first offering of these laboratories was Spring 1996. To better meet the students needs, this proposal will create a three term, team taught laboratory investigating fundamental issues in environmental studies including basic ecology; biodiversity; global warming; acid rain precipitation; toxins; energy production, air, water, and soil pollution; etc. It will emphasize the scientific method, problem solving, and critical thinking skills integrated in the performing Brownfields investigations. The impact of these awards is detailed in the Narrative.

2. **Narrative.** YSU is an urban public institution located in downtown Youngstown, Ohio, an industrial center situated midway between Cleveland, OH and Pittsburgh, PA. YSU primarily serves the Northeastern Ohio and Northwestern Pennsylvania populations. In 1967, YSU joined the Ohio system of higher education. YSU is a mid-sized, predominantly undergraduate institution, with M.S. programs in the majority of sciences and engineering disciplines. Through two early retirement incentive plans, the University has replaced about one-third of its 400 full-time faculty over the last six years.

The student population of YSU exceeds 14,000, with a student body composition of 51% female, 9% underrepresented minorities, and 26% non-traditional. Recruitment efforts for both students and faculty focus on underrepresented minorities, with particular emphasis placed on retention of minority students beyond the freshman year.

In particular, YSU is actively involved with the local public school systems in Youngstown and Warren Ohio, which have a substantial African-American enrollment, to encourage through grants and scholarships, attendance at YSU.

YSU is the lead institution in a formal Public/Private college and university alliance designed to foster sharing of resources, both physical (particularly instrumentation) and intellectual. Institutions participating in the alliance with YSU include Hiram College, Mount Union College, Thiel College, Grove City College, Lake Erie College, Malone College, Geneva College, Westminster College and Walsh University. In the science and engineering disciplines, there are over 100 faculty members, most holding Ph.Ds. The Alliance facilitates the "virtual" operation of Instrumentation and data transmission through the INTERNET increasing faculty and student access to expensive laboratory equipment for educational and research activities. Several Ohio Board of Regents' Investment Fund Grants have provided the hardware and software necessary for "linking" the Alliance institutions with various equipment such as, a nuclear magnetic resonance spectrometer and X-ray Diffractometers.

The faculty at YSU is committed to quality in teaching, scholarship, research and public service. YSU actively seeks faculty who combine these talents in ways that bring excitement to the classroom, and stimulate enthusiasm and eagerness to learn amongst students. The faculty is active at all levels of undergraduate education, and students are provided with the opportunity to receive individual instruction that effectively matches the level of preparation and the abilities of the student. This unique approach to higher learning is showcased in the research and internship courses offered in the sciences that culminate in a short thesis or productivity report that is reviewed and evaluated by a faculty advisor and other faculty members..

YSU's newest B.S. degree program, Environmental Studies, has its basis in this educational approach. The program is the product of three years of intensive work and research by a dedicated faculty and staff committee representing 16 academic departments in four colleges. Its beginnings can be traced to the State of Ohio supported research efforts of Dr. Scott Martin, Civil and Environmental Engineering Dept., Dr. Daryl Mincey, Chemistry Dept., and Dr. Lauren

Schroeder, Biology Dept. A 1989 NSF ILI grant provided support to this team to initiate an Environmental Science Minor.

In March of 1992, the YSU Board of Trustees directed the University to develop a B.S. program in Environmental Science, based upon growing national interest in environmental issues. A university committee was formed to accomplish this task. The committee was charged to develop a premier program that had the following characteristics:

- responsive to employment opportunities and employer expectations
- emphasized an inter- and multi- disciplinary approach to environmental education
- fostered a robust, vertically integrated research program
- strengthened community interaction and cooperation
- effectively utilized the resources available in Northeastern Ohio
- articulated and cooperated with two-year colleges
- participated in the Public/Private Alliance

The committee's scope was expanded shortly after its formation, and its name was changed to the Environmental Studies Committee. The step by step approach to program development included the following tasks:

- a review of twenty five other B.S. programs in Environmental Studies/Environmental Science
- a survey of 50,000 Ohio employers to determine the job opportunities for environmental employees in knowledge areas, skills, and experiences
- a survey of 2,900 high school juniors and seniors who intend to attend college to determine the level of interest in environmental studies programs
- establishment of an external advisory committee, consisting of non-academic environmental specialists.
- review of the program by an external consultant
- establishment of an advisory committee with representatives from 10 community and technical colleges to relate the YSU program to area two year programs

- an inventory of personnel in Northeastern Ohio who by virtue of talent, education or experience could participate in the program
- an inventory of environmental education resources in Northeastern Ohio

In January of 1994, a preliminary proposal was submitted to the Ohio Board of Regents (OBOR). The completed proposal was approved by the YSU Board of Trustees in May of the same year. The Center for Environmental Studies was established in August of 1994, and after being granted OBOR approval in October of 1994, the program accepted its first students in January of 1995. As approved, the program consists of four parts:

- The general university course requirements for a B.S. degree of 50 quarter hours (qh), including customized courses with an environmental focus
- A "core" of Environmental Studies courses required of all Environmental Studies students (the curriculum development for the Environmental Studies 601 course was funded by an NSF-ILI grant).
- Four tracks or areas of specialization; Public Affairs, Health, Science, or Technology.
- A requirement for all students to complete a 200 hour internship or research experience.

Skills identified by employer surveys and Program reviewers, which are believed to be essential to the Program, are being infused into all aspects of the Program including communications, teamwork, problem solving, statistics, and computer literacy. Departments offering courses required by the Environmental Studies program are Allied Health, Biology, Chemistry, Chemical Engineering, Civil and Environmental Engineering, Computer and Information Sciences, Economics, English, Geology, Geography, Mathematics, Philosophy and Religious Studies, Physics, Political Science, Speech and Communications, and Sociology and Anthropology. Areas within the University with pending or planned involvement in the Environmental Studies Program are the College of Business, College of Education, Center for Urban Studies, Center for Peace and Conflict Studies, Ethics Center, History, Psychology, Social Work, and Labor Studies.

a. **Current Situation**

By the Fall of 1996, over 150 YSU students were identified as Environmental Studies majors. Articulation agreements have been signed by several two-year schools. Cooperative research and academic efforts have been formed between members of the Public/Private Alliance. About 30 Internships have been established with area businesses, industries, and governmental agencies per quarter. About 20 students are conducting research in environmental topics.

Science and engineering departments involved in the Environmental Studies Program, particularly the Science and Technology tracks, are housed in two six-storied buildings with a combined floor space of about 140,000 sq. ft. They contain state-of-the-art facilities with the engineering building, remodeled last year and the science building, renovated five years ago. Support staff includes secretaries, stock room personnel, instrumentation, mechanical and electronic technicians, graduate student laboratory instructors, and undergraduate assistants. Authorization for two new positions, one as an electronics repair/development technician and another as a computer network and software specialist, was given this Fall.

The science and engineering departments are fairly well equipped with a variety of analytical instrumentation. As an example, funds from NSF have served as a partial match for the Chemistry department toward the purchase of instrumentation, such as two X-ray Diffractometers worth about $200,000 (NSF-Materials Division). Three NSF-ILI Grants have supported environmental curricular development: 1) Biol, Chem, Civil Engin.: 751-2, Water Quality Analysis; 2) GEOL 709, Subsurface Investigation; and 3) ENST 601, Fundamentals of Environmental Studies I. A listing of major equipment is given in Appendix 6.b. All Program instrumentation is available for hands-on use by students through instructional laboratories and independent research and internship opportunities.

The Maag Library holdings in Environmental Studies and related fields are extensive and include journals, books, and reference materials. Through an INTERNET service titled "OHIOLINK" access to the holdings of all state supported institutions is convenient with an average retrieval time of two days.

The curricular deficiency to be addressed by this proposal involves students needing experience with sampling protocols, sample preparation methods, and analytical procedures that are commonly encountered in "real-life" industrial/governmental settings such as the investigation of "Brownfields" for redevelopment. Not only would the collection and analysis of actual samples from any of a number of local Brownfields provide useful skills sought by employers but also students tend to relate best to activities that are interpreted to be relevant to society and their own life. In addition, data collected may favorably effect the redevelopment of presently unused land.

Brownfields are abandoned, idled, or under-utilized industrial and commercial facilities where expansion or redevelopment is complicated by real or perceived environmental contamination.[1] The U.S. EPA estimates that there are as many as 425,000 sites potentially requiring investigation and remediation. The concept of Brownfields redevelopment was first conveyed in the State of Ohio Amended Substitute Senate Bill 221 sponsored by, at the time, State Senator Sherrod Brown. This Bill created the Ohio Voluntary Action Program (VAP) whereby a person can perform a voluntary cleanup action at a property and receive a release from the State of Ohio for further cleanup activities. State EPA inducements are offered to commercial, real estate and investment banking communities to provide financial assistance to private entities undertaking VAP's. U.S. EPA Administrator Carol Browner announced EPA's Brownfields Action Agenda on January 25, 1995. It is stated to be one of the agency's top priorities. It is to be modeled off of the Ohio Brownfields legislation. Over one-half of the states now have their own VAP's. Often the cleanup levels are based on risk relative to future use.

At present an environmental sampling methods course, ENST 810, has been suggested but never implemented and the only environmental analysis course is water quality analysis, BCE 751-2. When developed these courses reflected the principle area of expertise of Drs. Martin, Mincey, and Schroeder and served students in the minor quite well. However, as the scope of the Program has changed and new faculty added, it is now time to add other types of sample media, and to present a more formal, realistic, and integrated treatment of sampling, sample preparation, and analysis; specifically interrelating these three areas of environmental data gathering. Faculty with

expertise in the sampling, sample preparation, and analysis of soils, air, and hazardous waste are now available. Much of the equipment, such as soil and air sampling devices, are presently available, as is some of the analytical instrumentation to analyze them. However, none of the major analytical equipment was specifically acquired to support the Environmental Studies Program and, except for the ICP, most are not appropriate. What is now needed are several automated and state-of-the-art pieces of equipment to accommodate the volume of samples required to effect a Brownfield investigation that would illustrate essential concepts, such as variability, reproducibility, quality assurance, and quality control. At present Chemistry, Biology, and Engineering posses several outdated atomic absorption spectrometers and mostly manual methods of sample digestion and extraction. This equipment is extensively used by the individual departments creating problems for Environmental Studies (especially with the large number of majors now involved), such as finding sufficient instrument time as well as and contamination difficulties, particularly with a GC/MS, due to the relatively low levels of analyte in most environmental samples.

b. **Development Plan**

- To enable us to provide an integrated treatment of sampling, sample preparation, and analysis we propose to replace ENST 810: Environmental Sampling Methods with ENST 710: Environmental Sampling and Sample Preparation. The goals in making this change are to help the student:
- Understand Data Quality Objectives.
- Understand basic concepts of pollutant transport within and between media (water, sediments, air, and soil).
- Understand sampling planning, including: QA/QC samples and procedures, logistics, and incorporating Data Quality Objectives, DQO's.
- Learn sampling equipment and procedures: water, soil, air, and storage containers.

- Gain familiarity with common preliminary sample processing steps: sample preservation, phase separations, digestions, and extractions; relate these techniques and principles to a "real-life" Brownfields investigation.

The existing courses BCE 751,52 will be changed to include the analysis of non water media such as air, soil, sediments, and storage containers. Combined, they will provide the student with an insight into the EPA's concept of Data Quality Objectives including: precision, accuracy, completeness, representativeness, comparability, and the documentation of data quality. Without proper data quality objectives little confidence can be placed in the conclusions drawn from a sampling, preparation, or analysis procedure. Data quality objectives, unlike measurement quality objectives, require an integrated approach to sampling, sample preparation, as well as analysis procedures. Joint involvement of data users, samplers, and analysts in the planning of sampling, sample preparation, and analysis is a necessary consequence of establishing data quality objectives. If specific methods are required by federal or state protocols, such as EPA clean laboratory practices, (CLP such as EPA 3510 and 3520), or FDA good laboratory practices, (GLP), or Standard Methods then the analysts must be consulted for such requirements as sample size, sample preservation, or a maximum holding time.[2,3] With regards to the sampler, sampling types, (such as random, systematic, or judgmental) are specifically suited to different analytical methods and the number of samples that are taken. Types of environmental pollutant transport mechanisms and the effect of composite samples are another consideration. For example, if the analytical method for a particular pollutant lacks sufficient sensitivity, composite samples may dilute the pollutant below the detection limit of the instrumental method employed.

ENST 710 will present sampling theory and methods for water, sediment, soils, hazardous wastes, and air. It will be based on the ACS Short Course presented by Dr. Lawrence H. Keith (attended by Dr. Mincey).[4] Included in this course will be field experiences conducted by Drs. Dick, soils and storage containers, Falconer, soil, water, and air, Martin, water, and sediments, while Ms. Laura Lyden of the University's Center for Engineering Research and Technology will cover methods needed to properly site an area to EPA specifications. Principles

such as sample size requirements, sample inhomogeneity considerations, particle size distribution effects, and other possible sources of sampling errors will be covered. Aspects of sampling theory to be covered are: sizes and types of samples, sampling devices, sample containers, sample compatabilities, QA/QC definitions and importance, types of sampling blanks, background samples, and field spikes. Analyte types and sampling procedures discussed will include: water sampling: including spatial and temporal heterogenities, contaminants, sampling depths, differences between fresh, ground, and salt waters, precipitation sources, site selection using global positioning systems, GPS equipment, sampling devices, and sample preservation; air sampling: source assessments of meteorological and/or site conditions, site reviews, pollutant transport mechanisms, indoor vs. outdoor sampling, and sampling devices (canisters, bags, impingers, foams, etc.); soil and sediment sampling (especially with biological components): homogeneity, extraction efficiency, physical and chemical properties, sampling devices (scoops, augers, etc.), contaminations, and preservation techniques; hazardous material sampling: composition determination, safety, and sampling devices. Field exercises will be performed on a site requiring the collection of soil, surface- and groundwater, air, sludge, and sediment samples. The site will be mapped, the number and size of each sample type will be determined (with consideration of the relevant transport mechanisms) various sampling methods and devices will be employed, and proper containers, preservatives, and blanks will be used.

Also in ENST 710, samples will be prepared by the students by both manual and automated methods such as hot-plate and microwave digestions, Toxicity characteristic leaching procedures (TCLP) soxlet and microwave extractions, and microwave fusions. Drs. Mincey and Falconer will supervise this phase of the curriculum. Sample preparation methods will be EPA approved and will include methods such as TCLP and microwave digestion protocols.

Once samples are properly prepared, Drs. Falconer, Martin, and Mincey will provide instruction in the necessary analytical procedures, including atomic absorption, inductively coupled plasma, and GC/MS in BCE 751,2. The equipment will be automated and capable of handling a high volume of samples. Types of analysis procedures will include: nutrient

concentrations by spectrophotometry on soil extracts; algal biomass (chlorophyll a) on natural waters, pH, alkalinity, and hardness of drinking waters; coliform bacteria, organic matter (BOD, COD) on wastewaters, metals in air samples by AA and ICP; particle size distribution of sediments; total and volatile organics, organics in air, (such as PCBs (209 analytes) pesticides, by GC/MS; heavy metals in soils by graphite furnace AA, anions in natural waters by ion chromatography; and TCLP organics by GC/MS. Others from two-year schools and members of the Public/Private Alliance will be provided the opportunity to participate in these activities. The specific goals to be obtained in BCE 751,2 are to: expand the course scope to include the analysis of soil, air, and sediments; provide "real-life" experiences with common laboratory analyses performed on environmental samples commonly employed in Brownfields investigations, e.g. TCLP; provide experiences on state-of-the-art environmental instruments, GC/MS, AA, ICP.

Upon completion of this course sequence, the student will be better able to understand the integral relationship between sampling, sample preparation, and analysis. They will be prepared to participate in any part or all aspects from sampling to analysis that are required in Brownfields investigations. Even if students are never required to do any of the steps of sampling, sample preparation, and analysis directly, the "hands-on" experience gained from this will provide the student with a better ability to judge the worth of data collected by others in the "real" world. Anagrams, such as DQO, MQO, GPL, QA, and QC, will have "real" significance to them.

During the summer of 1997, faculty from the other Public/Private alliance institutions will be invited to take these courses, free of charge, so they will be able to and will present this information to their own students. Students from these schools will then be able collect their own samples from nearby Brownfields, prepare, and analyze them using YSU equipment and instrumentation. In addition, this equipment will be available for other courses such as Chem. 803,4: Instrumentation. The graphite furnace AA and GC/MS will be of particular benefit to several departments' research and teaching efforts.

c.1. **Equipment Requests** To meet our needs for equipment and procedures capable of handling large volumes of samples and still providing a realistic experience, as closely similar to an

operating environmental contract or research laboratory, we require a microwave digestion system capable of acid digestions, solvent extractions, and high-temperature fusion procedures. A specially manufactured microwave oven by CEM (Model MSP) capable of digestion, extraction, and fusion is recommended. In addition, a highly automated graphite furnace atomic absorption spectrometer with computer mediated sample insertion, calibration, matrix modifier addition, and quality assurance and quality control. A Perkin Elmer, Model SIMAA 6000, Atomic Absorption Spectrometer will best serve this purpose. Thirdly, a GC/MS with a robotic sampler and trace organic pollutant detection capabilities will be needed. A Fisions, Model TRIO-1000 Quadrupole Mass Spectrometer and 8000 series GC with capillary interface is most suited for environmental purposes. To provide prior experience with the AA and GC/MS and to transfer data from submitted sample analyses to off-site participants, the computer systems will be attached to the Department's INTERNET site. The AA and GC/MS software will contain a realistic, "virtual", tutorial system. On-site visits will be provided to the students from participating colleges and universities for sample preparation and their hands-on experience of instrument operation.

c.2. **Equipment on Hand for the Project.** The departments involved in this proposal have equipment found in an analytical laboratory, however some of the equipment is dated and none of the equipment was acquired for the specific needs of the Environmental Studies Program. Sampling equipment, such as augers, air filtration monitors, water and sediment sampling devices, and sampling preparation equipment, such as a TCLP rotator, automated pipettes, and a CEM MDS1 manual microwave digestion system is available through Geology and Chemistry. Some analysis instrumentation is available in the departments of Biology, Chemistry, Civil Engineering, and Geology. UV/VIS spectrometers, flame and cold vapor atomic absorption spectrometers, two over-ten-year old graphite furnace atomic absorption spectrometers and an Inductively Coupled Plasma AE Spectrometer, as well as, various gas, ion, and high performance liquid chromatographs are available from the same departments.

c.3. **Implementation and Maintenance** YSU has a five-person electronics maintenance staff available at no charge to the Program. In addition an instrumentation technician will be available

to monitor the operation of this equipment. The participating departments have a combined operating and repair budget of approximately $200,000 and $50,000 respectively. Additional "instructional" lab fee funds of about $150,000 are available to support and upgrade laboratory equipment.

d. **Faculty Expertise** The faculty in this proposal has combined about 60 years of experience in sampling, sample preparation, and analysis. They are well prepared to present this curriculum change in a clear and concise manner. See the Biographical Sketches for specific details of each individual's expertise.

e. **Dissemination and Evaluation.** This integrated approach to sampling, sample treatment, and analysis using the proposed instrumentation, will be presented at regional and national conferences, particularly those suited to undergraduate audiences. Several Ohio environmental associations such as, the Ohio River Basin Consortium, would be interested in disseminating the results of this project. YSU will institute a summer program for faculty in the Public/Private Alliance for the transfer of this curriculum to their institutions. They in turn will be able to bring their students to YSU during the school year and perform the same experiments as students resident at YSU. They will be able to submit samples for analysis and results will be transferred via INTERNET. Feedback from those reviewing this information via the INTERNET will be asked for a critique of the project. A positive evaluation of this project will be inferred by the number of samples analyzed by the students and their ability to perform site inspections and analyses during their research or internship phases of the Program. The knowledge and skills gained by "off-campus" participants will be tracked by "on-line" exams and "unknown" laboratory problems. For students that pursue additional education, their higher degree institutions will be surveyed to gain feedback on the project. Employers of our graduates and those of aligned institutions will also be surveyed for feedback on the level of competence of our graduates. The final results of this proposal will be presented in the Journal of Chemical Education and similar journals.

References Cited

1. Environmental Strategies Corporation, *Making Industrial Site Redevelopment a Reality: A Strategy Reusing Industrial Land,* ***December, 1995,*** *pp.1-92.*
2. EPA, *Test Methods for Evaluating Solid Waste, Third Edition*, **November,1986**.
3. Eaton, A.D., et. al, *Standard Methods,* ***1995***, pp3-1-3-20.
4. Kieth, L.H., *Sampling Methods,* **June, 1994**.

Biographical Sketch for Daryl W. Mincey

Department of Chemistry, Youngstown State University, Youngstown, OH 44555

A. Vitae.

Daryl W. Mincey received his B.S. degree in Chemistry from the University of Cincinnati in June, 1972. He then continued his education at the University of Cincinnati under the direction of Dr. Joseph A. Caruso. He received his M.S. in Analytical Chemistry in June, 1974. His research dealt with the synthesis of various non-aqueous solvents and studying their physical properties. Dr. Mincey continued working with Dr. Caruso and received his Ph.D. in Bioanalytical Chemistry in June of 1979. His thesis described the first time an electrochemical reaction was monitored by nuclear magnetic resonance spectrometry directly within the probe of the instrument. While receiving his Ph.D., Dr. Mincey was the graduate student operator of all NMR instruments at the University of Cincinnati.

In the winter of 1978, Dr. Mincey took a temporary position at Youngstown State University as a sabbatical replacement. In the fall of 1978, he was employed as an Assistant Professor of Chemistry. The following year Dr. Mincey returned to Youngstown State University, where he earned the ranks of Assistant Professor in 1980, Associate Professor in 1985, and Professor in 1991. He was selected Assistant Dean of Arts and Sciences in 1993 and was elected Chairperson of Chemistry in 1995. While at Youngstown State University his duties have included teaching graduate in analytical and clinical environmental chemistry and undergraduate courses in introductory, analytical, biological, and environmental chemistry. Three new courses were developed to reflect changes in the direction of analytical chemistry. They are Chemical Toxicology, Chemical Instrumentation Interfacing and Chemical Literature. The direction of undergraduate and graduate research has been a significant responsibility. Twenty-eight master students our of a departmental total of sixty have received degrees under his direction.

Dr. Mincey is a member of the American Chemical Society, Penn-Ohio Border Section. He served as Treasurer 1980-1981, Chairperson-elect 1981-1982, and Chairperson 1982-1983. He is also a member of Sigma Xi, the honorary research society. He served as Chairperson-elect 1990-1991, and Chairperson 1991-1992. Dr. Mincey was the founding Director of the District 15 of the Ohio Junior Academy of Science, an organization dedicated to the promotion of science education through hands-on research. The District 15 Science Fair has a yearly attendance of 400 students. Many district winners have also been highly successful at the Ohio State Science Fair.

Dr. Mincey has received two Youngstown State University recognitions, Research Professor in 1983-1984 and Distinguished Professor in 1985-1986. He either independently or I collaboration with others has various state and national agencies. He received an Education for Economic Security Act 207C grant of $60,000 for his work in promoting science fair involvement in 1988. Dr. Mincey was awarded a $32,000 grant from the Ohio Board of Regents' Research Challenge Program in 1989 to study the interaction between various drugs and model lipid membrane systems by ATR-FTIR. Also in 1989, he cooperated with Dr. L. Spiegel, R. Varma, and F. Bharudi in a $32,000 study of the correlation between vitamin C and zinc concentrations and sickle cell anemia. Dr. Mincey, with Drs. G. Sutton, S. Martin, L. Schroeder, and I. Khan, have received two grants of $78,000 in 1986 and $72,000 in 1988. These grants developed techniques to model pollutant transport in the Mahoning River.

Drs. Schroeder, Martin, and Mincey have worked with the Youngstown State University Technology Development Corporation on a $372,000 Ohio Department of Development Grant titled: "The Mahoning River Corridor Redevelopment Project." Drs. Martin (PI), Mincey, and Schroeder received a National Science Foundation College Science Instrumentation Grant Program grant of $68,000 in 1989 and another Schroeder (PI) in 1995. Equipment was acquired to enhance a recently development environmental science curriculum both minor and major.

B. Referred Journal Publications

1. Monitoring of Electrochemical Reactions by Nuclear Magnetic Resonance Spectrometry, **Daryl W. Mincey**, Marc J. Popovich, Patrick J. Faustino, Marilyn M. Hurst, and Joseph A. Caruso, Analytical Chemistry, **1990**, 62, 1197-1200.

2. A Microprocessor Regulated Constant Voltage, Current, Wattage and Temperature Electrophoresis Power Supply, **Daryl W. Mincey**, Kenneth J. Kuzior, Leslie H. Allen III, Jennine S. Frease, and Irene N. Strasser, Analytical Chemistry, **1991**, 193, 168-172.

3. The Analysis of Steel Samples Employing Ion Chromatography/Sequential Inductively Coupled Plasma Atomic Emission Spectroscopy, Jeffrey J. Giglio, **Daryl W. Mincey**, and James H. Mike, Analytica Chemica Acta, **1991**, 254, 1-2, 109-112.

4. Temperature Controlled Microwave Oven Digestion System, **Daryl W. Mincey**, Richard C. Williams, Jeffrey J. Giglio, Gale A. Graves, and Anthony J. Pacella, Analytica Chemica Acta, **1992**, 264, 97-100.

C. List of Other Collaborators

1. Dr. Kenneth Rosenthal, Department of Physiology, Northeastern Universities College of Medicine, Rootstown, Ohio.

D. Names of Mentors

1. Ph.D. thesis advisor, Dr. Joseph A. Caruso, Department of Chemistry, University of Cincinnati, Cincinnati, Ohio.

SCOTT C. MARTIN

Position: Professor, Department of Civil & Environmental Engineering
Address: Youngstown State University, Youngstown, OH 44555.

Education: Ph.D. Clarkson University, Civil & Environmental Engineering (1984)
M.S. Clarkson University, Civil & Environmental Engineering (1979)
B.S. Clarkson University, Civil & Environmental Engineering (1977)

Expertise: Nutrient dynamics; eutrophication; water quality modeling; applications of GIS and GPS; pollutant-sediment interactions; aquatic chemistry; constructed wetlands.

Honors and Awards:

International Association for Great Lakes Research - Chandler-Meisener Award (1982)
Youngstown State University - Distinguished Professor Award (1988 and 1994)
Youngstown State University - Sabbatical Leave (1991-92)
Engineer of the Year - Youngstown (OH) Branch of ASCE (1995)

Selected Publications:

Martin, S.C., R.J. Ciotola, P. Malla, N.G.S. Urs, and P.B. Kotwal, 1994. Assessment of Sediment Phosphorus Distribution and Long-Term Recycling in St. Albans Bay, Lake Champlain. Lake Champlain Basin Program Tech. Rep. No. 7c. Prepared for Lake Champlain Management Conference, Grand Isle, VT, 202 pp.

Martin, S.C., S.C. Hinz, P.W. Rodgers, V.J. Bierman, Jr., J.V. DePinto, and T.C. Young, 1995. Calibration of a Hydraulic Transport Model for Green Bay, Lake Michigan. *Journal of Great Lakes Research*, **21**(4):599-609.

Bierman, V.J., J.V. DePinto, T.C. Young, P.W. Rodgers, S.C. Martin, and R. Raghunathan, 1992. Development and Validation of an Integrated Exposure Model for Toxic Chemicals in Green Bay, Lake Michigan. Final Report for Cooperative Agreement CR-814855, ERL-Duluth, Large Lakes and Rivers Research Branch, Grosse Ile, MI, 48138, 350 pp. (September, 1992).

Martin, S.C., S.W. Effler, J.V. DePinto, F.B. Trama, P.W. Rodgers, J.S. Dobi, and M.C. Wodka, 1985. Dissolved Oxygen Model for a Dynamic Reservoir. *Journal of Environmental Engineering*, **111**(5):647-664.

Martin, S.C., J.V. DePinto, and T.C. Young, 1984. Biological Availability of Sediment Phosphorus Inputs to the Lower Great Lakes. USEPA Environmental Research Lab, Duluth, MN. EPA-600-03-84-100.

Other Collaborators (last 48 months): L.A. Schroeder, D.W. Mincey, J.C. Dick, W.C. Dyer; R.J. Dulberger; L. Lyden, J. Alam.

Graduate Advisors: J.V. DePinto; J.K. Edzwald

Graduate Advisees: J.S. Evan; B.A. Abbas; W.M. Mohammad; P.B. Kotwal; W. Kirubakaran; R.Vora, E. Viggeswarapu, H. Bircher.

Biographical Sketch for Renee L. Falconer

Department of Chemistry, Youngstown State University, Youngstown, OH 44555

A. Vitae. Renee L. Falconer obtained her B.S. degree in Chemistry in 1990 from Grove City College. She immediately started graduate work at the University of South Carolina and earned her Ph.D. in Analytical Chemistry in 1994 under the direction of Dr. Terry F. Bidleman. While there, Renee received the Joseph Bouknight Award for Excellence in Teaching (Fall 1990 and Spring 1991) and the Patricia R. Harris Graduate Fellowship (U.S. Dept. of Education, Fall 1991-Spring 1992). The title of her dissertation was "Physico-chemical Properties and Partitioning of Organochlorine Compounds in Air and Water". From 1992-94 she was employed as a contractor by Atmospheric Environment Service, Environment Canada to study vapor-particle partitioning of Polychlorinated Biphenyls (PCBs) and to develop separation techniques for different PCB congeners. In June 1994, Renee won the International Association for Great Lakes Research Hydrolab Award for Best Student Paper. Both her dissertation work and contract work entailed the use of mass spectrometry for analysis of trace contaminants. In September 1994, Renee began her current position as Assistant Professor in the Department of Chemistry at Youngstown State University.

Dr. Falconer is a member of the American Chemical Society, the International Association for Great Lakes Research and the Society for Environmental Toxicology and Chemistry and is presently serving on the Executive Committee of the Penn-Ohio Border Section of ACS.

B. **Refereed Journal Publications**. Five most relevant publications.

(1) Falconer, R. L.; Bidleman, T. F.: "Vapor Pressures and Predicted Particle/Gas Distributions of Polychlorinated Biphenyl Congeners as Functions of Temperature and Ortho-chlorine Substitution." *Atmos. Environ.* **1994**, *28*, 547-554.

(2) Falconer, R. L.; Bidleman, T. F., Gregor, D. J.: "Air-Water Gas Exchange and Evidence for Metabolism of Hexachlorocyclohexanes in Resolute Bay, N.W.T." *Sci. Total Environ.* **1995**, *160/161*, 65-74.

(3) Falconer, R. L.; Bidleman, T. F., Gregor, D. J., Semkin, R.: "Enantioselective Breakdown of α-Hexachlorocyclohexane in a Small Arctic Lake and its Watershed." *Environ. Sci. Technol.* **1995**, *29*, 1297-1302.

(4) Falconer, R. L.; Bidleman, T. F., Cotham, W. E.: "Preferential Sorption of Non- and Mono-ortho Polychlorinated Biphenyls to Urban Aerosols." *Environ. Sci. Technol.* **1995**, *29*, 1666-1673.

(5) Bidleman, T. F.; Falconer, R. L.; Walla, M. D.: "Toxaphene and Other Organochlorine Compounds in Air and Water at Resolute Bay, N.W.T., Canada." *Sci. Total Environ.* **1995**, *160/161*, 55-63.

C. **List of Other Collaborators**

None

D. **Name of Mentor**

Ph.D. Advisor. Dr. Terry F. Bidleman, Environment Canada, Ontario, Canada, M3H 5T4; Adjunct Professor, University of South Carolina, Columbia, SC, 29208

Biographical Sketch for Jeffrey C. Dick

Department of Geology, Youngstown State University, Youngstown, OH 44555

A. Vitae.

Jeffrey C. Dick received his B.S. degree in Geology from Kent State University in June, 1980. He then continued his education at the Kent State University under the direction of Dr. A. Shakoor. He received his M.S. in Geology in June, 1982. His research dealt with mudrock durability. Dr. Dick continued working with Dr. Shakoor and received his Ph.D. in Applied Geology in June of 1992. His thesis described the effects of lithologic characteristics on mudrock durability.

In January1992, Dr. Dick took an Assistant Professor of Geology position at Youngstown State University . He earned the ranks of Associate Professor in 1996. He has developed new courses in soil sampling partially supported by an NSF-ILI grant. Dr. Dick has directed the research activities of several undergraduates. In addition he has been the director of the District 15 of the Ohio Junior Academy of Science. for the past four years. In 1996 he was awarded a Research Professorship from Youngstown State University for the 1996-97 academic year.

B. Referred Journal Publications

1. Dick, J.C. and Shakoor, A., 1990, The Effects of Lithologic Characteristics on Mudrock Durability: Proceedings of the 6th International Congress of the International Association of Engineering Geology, Amsterdam, The Netherlands, Vol. 4, pgs. 3061-66.
2. Dick, J.C. and Shakoor, A., 1991, A Mudrock Durability Classification System Based on Lithologic Characteristics: Proceedings of the 34th Annual Meeting of the Association of Engineering Geologists, Chicago, Illinois, pgs. 189-196.
3. Dick, J.C. and Shakoor, A., 1992, Lithologic Controls of Mudrock Durability: Quarterly Journal of Engineering Geology, London, Vol. 25, pgs. 31-46.
4. Dick, J.C., Shakoor, A., and Wells, N.A., 1994, A Geological Approach Toward Developing A Mudrock Durability Classification System: Canadian Geotechnical Journal Vol. 33, No. 1, pgs. 17-27.
5. Dick, J.C. and Shakoor, A., 1995, Characterizing Durability of Mudrocks for Slope Stability Purposes, in Haneberg, W.C., and Anderson, S.A., eds., Clay and Shale Slope Instability: Reviews in Engineering Geology, Volume 10, pgs. 121-130: Geological Society of America.

GRANTS AND AWARDS

Principal Investigator

National Science Foundation, 1993, ILI Support for academic project: "Subsurface Investigations: An Integration of Geological Principles" Grant No. DUE-9351871, Amount $46,430 (with match)

Ohio Board of Regents, 1995, Eisenhower Professional Development Program: "Experience Earth Science! - A Practical Application of Ohio's Model Competency-Based Science Program:

Grant No. 5-85, Grant Amount $74,959.84 (with match)

Co-investigator

National Science Foundation, 1995, ILI Support for academic project:
"An Investigative Science Laboratory"
Principal Investigator: Lauren Schroeder
Co-investigators: Daryl Mincey, Scott Martin, and Jeffrey Dick
Grant No. DUE-9552347, Grant Amount $25,000 (plus match)

C. List of Other Collaborators

None

D. Names of Mentors

1. Ph.D. thesis advisor, Dr. A. Shakoor, Department of Geology, Kent State University Kent, Ohio.

4. ILI-IP DETAILED BUDGET (EQUIPMENT LIST) FORMAT

Item (Descriptive name, probable brand and model)	How Many	Unit Price (List)	Unit Price (Discounted)	Total Cost (Discounted)
CEM, Model MSP Microwave Digestion, Extraction, and Fusion System.	1	22,000	13,200[1]	13,200
Perkin Elmer, Model SIMAA 6000, Simultaneous Multi-Element Automated Graphite Furnace Atomic Absorption Spectrometer with Autosampler.	1	72,000	64,800	64,800
Fisons, Model TRIO-1000 Quadrupole Mass Spectrometer, 8000 series GC with capillary interface..	1	78,000	70,200	70,200
Fisons, AS 800 Autosampler	1	9,500	8,550	8,550

1. 40% special discount for attending a CEM Wrkshop on Smple Peparation, by D. Mincey, August, 1995.

Total project cost:	$156,750
Non-NSF contribution (including any overmatch):	$78,375
NSF request:	$78,375

Use additional page(s) if needed.

Current and Pending Support

See GPG Section II.D.8 for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Daryl W. Mincey

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

9552347: An Investigative Science Laboratory (Lauren Schroeder, Jeffrey C. Dick, Scott C. Martin, Daryl W. Mincey, Renee L. Falconer)

Source of Support: NSF-ILI

Total Award Amount: $25,000 Total Award Period Covered: 1996

Location of Project: Youngstown State University

Person-Months Per Year Committed to the Project. Cal: 6 Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

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Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

Source of Support:

Total Award Amount: $ Total Award Period Covered:

Location of Project:

Person-Months Per Year Committed to the Project. Cal: Acad: Sumr:

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

NSF Form 1239 (7/95) USE ADDITIONAL SHEETS AS NECESSARY

Current and Pending Support

See GPG Section II.D.8 for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Scott C. Martin

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title:
9552347: An Investigative Science Laboratory (I. Schroeder, Jeffrey C. Dick, Daryl W. Mincey, Renee L. Falconer)
Source of Support: NSF-ILI
Total Award Amount: $25,000 Total Award Period Covered: 1996
Location of Project: Youngstown State University
Person-Months Per Year Committed to the Project. Cal: 6 Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title:

Source of Support:
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NSF Form 1239 (7/95) USE ADDITIONAL SHEETS AS NECESSARY

Current and Pending Support

See GPG Section II.D.8 for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Renee L. Falconer

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

Project/Proposal Title:

9552347: An Investigative Science Laboratory (I. Schroeder, Jeffrey C. Dick, Daryl W. Mincey, Renee L. Falconer)

Source of Support: NSF-ILI

Total Award Amount: $25,000 Total Award Period Covered: 1996

Location of Project: Youngstown State University

Person-Months Per Year Committed to the Project. Cal: 6 Acad: Sumr:

Support: ☐ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support

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NSF Form 1239 (7/95) USE ADDITIONAL SHEETS AS NECESSARY

Current and Pending Support

See GPG Section II.D.8 for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

Investigator: Jeffrey C. Dick

Other agencies (including NSF) to which this proposal has been/will be submitted.

Support: ☒ Current ☐ Pending ☐ Submission Planned in Near Future ☐ *Transfer of Support
Project/Proposal Title:
9552347: An Investigative Science Laboratory (I. Schroeder, Jeffrey C. Dick, Daryl W. Mincey, Renee L. Falconer)
Source of Support: NSF-ILI
Total Award Amount: $25,000 Total Award Period Covered: 1996
Location of Project: Youngstown State University
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NSF Form 1239 (7/95) USE ADDITIONAL SHEETS AS NECESSARY

6a MAJOR EQUIPMENT

Examples of major instrumentation held by various departments at Youngstown State University are listed below:

Equipment	Year Purchased	Estimated Cost
Mobil Drill Minuteman portable soil augering and soil sampling unit	1993	16,014
Analyzer, Electrophoresis, Zeta-Meter	07/24/85	7,530
Analyzer, Mercury, Buck Scientific Model	07/14/88	3,000
Analyzer, Thermal-mechanical with TMA, DMA, and DSC modules, DuPont 9900	07/29/85	80,181
Bison 12 channel seismic refraction unit	1993	14,631
Centrifuge, (3)	1983-87	16,000
Chromatograph, Gas with FID, Hewlett Packard	1994	10,000
Chromatograph, Gas with TC detector, IBM GC/9630	12/26/84	8,085
Chromatograph, Gel Permiatation, Various	1992-94	8,000
Chromatograph, Liquid, Isco 2350/60	07/22/87	6,357
Chromatograph, Liquid, with ultraviolet, refractive index, fluorescence and electrochemical detectors (2), IBM LC/9533	08/06/84	41,000
Chromatograph, gas, Shimadzu, Model GC9AP	01/16/84	8,515
Chromatograph, HPLC, Model 338, Beckman (2)	1990	30,000
Chromograph, Ion, Dionex 2000i	06/10/84	9,170
Delivery System, Solvent, Millipore, Model M600	03/30/87	11,468
Detector, Photodiode array, Millipore, Model 990	03/30/87	20,468
Electrochemistry Programmer, Princeton Applied Research Model 175	06/15/84	3,700
Electrochemistry System, Bioanalytical Systems CV-27	06/28/84	2,968
Furnace, Graphite, Perkin-Elmer HGA-300	06/05/85	7,502
Gamma Counter (4), EG & G Ortec	06/14/84	14,124
Digitizer and Color Plotter, Cal Comp Model 9500 and HP Design Jet	1993	13,227
Gamma Spectrometer (7), The Nucleus Model 2010	09/09/82	9,359
Glove Box, Vacuum/Atmosphere	1980	15,000
GPC Columns (5)	1993-94	5,000
Hydrogenation and medium pressure reaction apparatus, Parr	02/12/87	4,279
Incubators, Percival, Lighted, Model I-25LLVL (3)	06/14/85	13,641
Incubators, (3)	1980-88	7,000
Instrumental Impact System, Tinius 620	09/06/84	18,515

Microscope, Scanning Tunneling	1994	12,000
Microwave Digestion CEM	09/02/86	7,190
Potentiostat/galvanostat, EG & G PAR, Model 273	09/24/84	8,860
Diffractometer, X-ray, Rigaku powder	1993	106,954
Shear Apparatus, Direct (2), Hogentogler S6564	08/07/84	9,716
Spectrofluorometer, Model RF-50000, Shimadzu	1985	17,000
OYO earth resistivity unit	1993	13,210
Spectrometer, Atomic absorption, (3)	1983-85	60,000
Spectrometer, FTIR, (3), Digilab FTS 40, IBM-IR-32, PE-1600	1984-88	120,000
Spectrometer, Inductively-coupled plasma, Allied Analytical Plasma 200	07/20/84	42,225
Spectrometer, Inductively-coupled plasma, ARL Model 3410	1985	60,000
Spectrometer, Laser-Raman, Spex DM-3000	05/10/88	42,318
Spectrometer, Mass with GC, Finnigan-MAT 1020	07/09/84	128,900
Spectrometer, Nuclear magnetic resonance, IBM NR/80	02/07/83	120,692
Spectrometer, Nuclear magnetic resonance, Varian 400 MHz Gemini 200 with VT and Multinuclear	1994	166,000
Spectrometer, Nuclear magnetic resonance, Varian EM-360	06/01/73	55,000
Spectrometer, Ultraviolet, (7), Beckman, Shimadzu, DU	1977-87	80,000
Spectrometer, Ultraviolet-visible, Diode array, Hewlett Packard HP8452A	03/06/87	7,127
Sterilizer, Laboratory/isothermal, AMSCO, 2300	10/07/85	42,188
Timer, Mercury drop and controller, Princeton Applied Research, 264A-3	05/01/87	5,769
Ultracentrifuge, Beckman L-8	10/08/79	23,657
Washer apparatus, Activator & Spiral (2), MTS	02/08/85	16,694
Geometrics proton magnetometer	1993	4,982
Weight apparatus, Osomatic molecular, Wescan Recording Osmometer	10/30/78	7,250
Furnace, Linberg High Temp. Tube	06/94	5,000
Microscope, Electron, Transmission	1992	used
Diffractometers, X-ray, single crystal (2)	1994-95	200,000

Cop Cost

6. APPENDIX b. COURSE DESCRIPTIONS

603, 604 Quantitative Analysis 1, 2. Chemical equilibrium, stoichiometry, theory or errors, and volumetric and gravimetric procedures as applied to quantitative determinations. Introduction to electroanalytical and spectrophotometric methods. Emphasis on development of technique. Three hours lecture and six hours laboratory. Prereq.: CHEM 517 or 592 for 603. 5 + 5 qh.

ENROLLMENT IS APPROXIMATELY 155 STUDENTS PER YEAR

650 Introduction to Undergraduate Research. An introduction to the methods of chemical research under the direction of a faculty member. This may include literature searching and analysis, instructional laboratory development, and/or original basic or applied research. May be repeated for a maximum of six q.h. Prereq. or concurrent: CHEM 516 or equivalent and approval of department chair. 1 or 2 qh.

ENROLLMENT IS APPROXIMATELY 2 STUDENTS PER YEAR.

803, 804 Chemical Instrumentation 1, 2. The theoretical foundations of instrumental procedures and use of instruments in analytical work. CHEM 803: Two hours lecture and six hours laboratory. CHEM 804: Two hours lecture and three hours laboratory. Prereq.: CHEM 604 and 741. 4 + 3 qh.

ENROLLMENT IS APPROXIMATELY 15 STUDENTS PER YEAR.

850 Undergraduate Research. Research participation under the direction of a faculty member. May be repeated to a maximum of nine q.h. Prereq.: CHEM 603 or 719 and approval of department chair. 2 or 3 qh.

ENROLLMENT IS APPROXIMATELY 6 STUDENTS PER YEAR.

6. APPENDIX c. SUBJECT AREA MAJORS

Year	Total	To Graduate School*	To Medical, Dental, Law School	MS Obtained or in Progress	Graduate Schools Attended
1995-96	53	7	39	30	**
1994-95	50	4	24	22	**
1993-94	45	3	13	21	**
1992-93	35	2	19	18	**
1991-92	47	6	22	15	**
1990-91	30	5	6	7	**
1989-90	49	7	28	13	**
1988-89	62	6	31	11	**
1987-88	52	4	21	15	**
1986-87	49	8	21	23	**

* Does not include students proceeding to our MS program.

** Over the last several years, our BS graduates have gone on do to Ph.D. degrees at The Ohio State University, Kent State University, The University of Akron, The University of Cincinnati, Penn State University, University of Pittsburgh, The University of Texas, as well as to our own MS program from which many subsequently went on to do Ph.D. degrees at the above universities.

6. APPENDIX d. STUDENT RESEARCH

UNDERGRADUATE RESEARCH 1990-present

Falconer, R.
- "Analysis of PAH's in Air and Water Samples", Brian Roshenbacher, 1996

Hunter, A.
- "Fun With Inert Atmosphere Techniques", Lisa Bernard, 1993
- "Organometallic Compounds Using Inert Atmosphere Techniques", Lisa Bernard, 1993
- "Synthesis and Characterization of the Chromium Complexed Aromatic Polymers from Polymerizations of p-Phenylenediamine Chromium Tricarbonyl and m-Phenylenediamine Chromium Tricarbonyl", Steven J. DiMuzio, 1993

  "Synthesis and Characterization of the Chromium Complexed Aromatic Polymers from Polymerizations of p-Phenylenediamine Chromium Tricarbonyl and m-Phenylenediamine Chromium Tricarbonyl", Steven J. DiMuzio, 1994

Mike, J.
- "The Effect of Methanol on the Activity of the Enzyme Choloylglycine Hydrolase", Laura A. Lyden, 1990
- "Chololylglycine Hydrolase: The Effect of Pore Size on Enzymic Activity", Francine A. Byrdy, 1991
- "Determination of Palmitic Acid by Solvent Extraction, Michael J. McKee, 1991
- "Choloylglycine Hydrolase: Glycocholic Acid Salt", Thomas Smith II, 1991
- "A pH Study of the Mobile Phase to be Utilized in the Detection of Conjugated Bile Acids Using HPLC and Immobilized Choloylglycine Hydrolase", Gina Terrago, 1991
- "Immobillization of Glucose Oxidase with 2-amino-4,6-dichloro-S-Triazine", Paul Bassett, 1992
- "Detection of Formaldehyde Using 4-Amino-5 Hydrazino-4H-1,2,4-Triazole-3-Thiol", Michael J. Patrick, 1992
- "Determination of Mirex in Soil Samples", Kevin Lawrence, 1993
- "Packard Electric Research Project", Joseph Potkonicky, 1993
- "Experiments in Ion Exchange", Michael Simonsic, 1993

  "Synthesis of Calixarene for Use as a Stationary Phase in HPLC", Shannon Phillips, 1996

Mincey, D.
- "Trace Metal Analysis Employing Ion Chromatography - Inductively Coupled Plasma Atomic Emission Spectrometry", Jeff Giglio, 1990
- "A Square Wave Voltammetric Detection System for Anion Chromatography", Terri Rulick, 1990
- "The Determination of Zinc, Iron, and Copper Concentrations in the Blood of Sickle Cell Disease (SCD) Children by Way of Inductively Coupled Plasma (ICP) Emission Spectrometry", Melissa Spin, 1992
- "Determination of the Extent of Contamination of Soils for the Mahoning River Redevelopment Project", Kathy Scott, 1993

  no title, Heather Shandor, 1993

Phillips, R.
"Pyridines Effects on a Silica-Alumina Surface, Gretchen Metz, 1995

Schildcrout, S.	"Recycling & Reconditioning of Heavy Duty Diesel Engine Coolant", William F. Booher, 1995
Serra, M.	"O-acetylation of Gly-Tyr, Stephen Ray, 1996
Spiegel, L.	• "The Determination of Zinc, Iron, and Copper Concentrations in the Blood of Sickle Cell Disease (SCD) Children by Way of Inductively Coupled Plasma (ICP) Emission Spectrometry", Melissa Spin, 1992
	• "Sickle Cell Anemia: Analysis of Trace Elements", Dianne Braho, 1993
	"Lipid Content of an Italian Macaroni Product by Thin Layer Chromatography, Dawn Skala, 1994
Wagner, T.	• "Perovskite Synthesis", Angella Ferrett, 1993
	• "Perovskites and Oxide Superconductors", Mario Petrino, 1993
	• "Syntheses to Precursors of Fluoride Analogues to Layered Oxide Structures", Sharlene Barb, 1994
	• "Synthesis of Compounds Related to Magnetoplumbite and Beta-alumina Phases and Characterization by X-ray Powder Diffraction, Amy Cecil, 1994
	• "Attempted Synthesis of $BaSc_{12}O_{19}$ as a Model", Vincent Lucarelli, 1996
Dick, Jeff	• "Develop. of a Method for Quantifying the Abundance of Clay", Bruce Leskey, 1994
	• Assessing Contamination of Soil, Ground Water and Surface Water", Kim Fasselman, Heather Will, 1995
	• Evaluation of the Impact of Coal Surface Mine Water Seepage, Chuck Mahn, Bill Dennis, 1996

6. Appendix e.

Sample Experiments

Experiment for GC-MS---PCBs in Brownfields

EPA Methods 8240-8280.
Standard Methods 6210, 6220, 6230, and 6431.

Polychlorinated biphenyls were used in electrical transformers up until the 1970's and are still a ubiquitous environmental pollutant mostly due to lack of proper disposal and leakage. This experiment would be to look at PCBs in the soil, water and air around a Brownfield to determine background levels (air) as well as any possible contamination from leaking transformers (soil) or any transport to nearby waterways (water). The experiment would include sample prep, sampling, extraction, analysis and data analysis. It would help students to see the need for planning the sampling excursion by looking at probable background levels and acceptable sampling, extraction and analysis procedures (through literature searches). It would also teach students about typical analysis problems encountered everyday by environmental scientists: sample matrix complexity (209 different PCBs), detection limits (trace levels usually found in air), interferences (other organics) and QA/QC practices. At the same time students would be studying a well known and important pollutant which they learned about in other classes.

Experiment for Graphite Furnace Atomic Absorption Spectrometer Heavy Metals in Brownfields

EPA Method 7000: Atomic Absorption Methods.
EPA Methods 7470,71: Mercury in liquid Waste, Mercury in Solid and Semisolid Waste.(Graphite Furnace equivalent employing Pd matrix modifiers).
EPA Method 7060: Arsenic.
EPA Method 7740: Selenium.
Standard Methods 3000 including 3113 specifically.
Extensions on EPA methods including other matrix modifiers, gas conditioning and other sample types
Microwave Oven Procedures

EPA Method 3351 with comparison to EPA 3350.
Standard Methods 3030.
Solvent extraction procedures specified by the manufacturer but not yet approved by the EPA.

Title:Brownfields Investigations as an Integrated Approach to Sampling, Sample Preparation, and Analysis
Type:Award
NSFOrg:DUE
Date:April11,1997
File:a9751151
Award Number: 9751151
Award Instr.: Standard Grant
Prgm Manager: Herbert H. Richtol
DUE DIVISION OF UNDERGRADUATE EDUCATION
EHR DIRECT FOR EDUCATION AND HUMAN RESOURCES
Start Date : May 1, 1997
Expires: Apri 30, 1999(Estimated)
Expected
Total Amt. : $78,375 (Estimated)
Investigator: Daryl W Mincey dwmincey@cc.ysu.edu
Renee L Falconer
Scott C Martin
Jeffrey Dick
Sponsor: Youngstown St University
Youngstown, OH 445550001 330/742-3000
NSFProgram:7400UNDERGRADINSTRM&LABIMPROVE
Fld Applictn: 0000099 Other Applications NEC
Abstract:
This project is developing an integrated course employing realistic techniques and procedures needed to affect PhaseI and II property assessments of Brownfields. Brownfields are previously used industrial sites that are presently not being used because of an uncertainty regarding long-term costs. Through actions taken by the Ohio EPA, a property owner may have the contaminants on a property assessed, prepare the land for eventual use, and receive a "covenant not to sue" from the EPA. Once received, the covenant will limit the liability faced by a property owner. The PhaseII property assessment requires the integration of sampling, sample preparation, and an analytical procedures with quality control, quality assurance, and good laboratory practices. There is data that suggest that an integrated approach may provide students of environmental studies, chemistry, civil and environmental engineering, biology, and geology, with an increased appreciation of what is often presented as independent functions. The dependence of an analysis protocol on size and type of sample collected, type of container and preservatives, collection procedure, and the method of sample preparation is being presented in an integrated format. The new microwave oven will permit the reproducible and safe preparation of samples collected at local Brownfield sites and enable students to experience analytical method development on instrumentation encountered in a working laboratory. Graphite Furnace Atomic Absorption and Gas Chromatograph-Mass Spectrometers are necessary instrumentation to affect a Brownfield site investigation. They will be networked, through the INTERNET, to a series of existing data stations, permitting the analysis and data processing of Brownfields samples in the laboratory courses of several disciplines at seven local Public/Private Alliance institutions.

reproducible and safe preparation of samples collected at local Brownfield sites and enabling students to experience analytical method development on instrumentation encountered in a working laboratory. Graphite Furnace Atomic Absorption and Gas Chromatograph-Mass Spectrometers are necessary instruments to affect a Brownfield site investigation. They are being networked, through the Internet, to a series of existing data stations, Startpermitting the analysis and data processing of Brownfields samples in the laboratory courses.

NATIONAL SCIENCE FOUNDATION

Based on NSF Form 1 (2/92)

PROPOSAL EVALUATION FORM

PROPOSAL NO.	INSTITUTION	PLEASE RETURN BY
97-51151	Youngstown State University	

PRINCIPAL INVESTIGATOR	NSF PROGRAM
Daryl W. Mincey	ILI-IP

TITLE

Brownfields Investigations as an Integrated Approach to Sampling, Sample Preparation, and Analysis

Please evaluate this proposal using the criteria presented on the back of this review form. Continue on additional sheet(s) as necessary.

Project Summary

This proposal describes a course structured around performing the techniques and procedures for property assessments of Brownfields.

The panel found many strengths in this project, including field work, practical value of the work, and the potential employment opportunities participation in the course would afford the students. We thought that the development plan was well thought out. The fact that the project was driven by local industrial need and necessity was noted and commended.

The dissemination plan in which faculty from the Public/Private Alliance would participate in a summer program will likely result in broad adoption of this approach. In addition, the investigators might consider outreach programs at the high school level. The panel thought that instructors at that level would also be interested in learning about the program at Youngstown State University.

Results of prior support from NSF appear to be commendable (p6). Student profiles are typical of such a city with a commendable active pursuit of the retention of underrepresented minorities. The alliance with other colleges YSU forms as the leader appear to be significant in its scope to the stated colleges in its consortium. This is a definite a positive experience for those attending any of the institutions.

The recently established Environmental Studies program originated and continues to serve the commercial community of the service area.
The curricular deficiency was adequately stated (p 6) and identified. The reason for the proposal is to change the sampling protocols that students need to acquire if they are to maximize their total learning experience. This is anticipated to increase their effectiveness in the work force. This appears to be the next logical step in the evolution of the program and thus courses. Such equipment would basically equip a new course (ENST 810).

Internet distribution of collected/recorded data is great and should be pursued no matter the outcome of this proposal.

An excellent proposal that uses a very integrated approach to learning about the environent especially field sampling and it analyses.

The proposal seeks funding for equipment for a course that would give environmental science students "real-life" experience in the techniques and procedures involved in Phase I and II property assessments of previously used industrial sites.

This serves several constructive purposes. First, valuable hands-on experience is provided for students in a practical real-life situation. Second, a significant percentage of the sites are probably contaminated, and the work conducted by the students will provide valuable information that could be used in the cleanup of these sites. Third, this approach is very innovative and could serve as an effective model that could be adopted by several institutions across the country.

The proposal is clear and well written. The principals are well qualified and the

General: This proposal eloquently describes the development of an integrated course employing field sampling of Brownsfields, previous industrial sites. The proposal is well thought out, contains lots of details, and describes great in-field application science! This provides a unique opportunity for students to collect samples and design experiments for sample testing. Many oppportunities to discuss accuracy, precision and experimental design exist. It is hoped that if funded, the personnel will provide educational opportunities with local high schools. As described, the sites are not used due to concern over possible contaminants yet no mention of if and what specific precautions might be needed to ensure the safety of the participants in the program.

Research performance competence: Several well-qualified faculty were cited as potential investigators.

Intrinsic merit of the research: There is a strong liklihood that fundamental advances within the environmental sciences field will occur if this project is funded.

Utility or relevance of the research: It is highly likely that the research can contribute to the achievement of increased education in the environmental sciences field. This approach to active, interactive learning would make a great nation-wide model for any site where these Brownsfields exist.

If funded, please address any necessary safety aspects to the program and incorporate possible outreach opportunities.

This proposal describes in depth an integrated course that examines the necessary testing for property assessments of Brownfields. This project is likely to have a broad based impact for two reasons. First, faculty from the Public/Private Alliance member institutions will be invited to participate in summer workshops and thereby utilize the facility at Youngstown State University. Second, the facility will be remotely accessible to faculty from these member institutions and other local schools.

This course arises from both a local need for people trained in the methods of Brownfields analysis and the relatively new Environmental Studies Major at the University. This major has been extensively supported via NSF funds in the past and the successful implementation of those funded projects has been in part responsible for the increase in the number of Environmental Studies majors in recent years.

The proposed course seeks to rectify a curricular deficiency (p. 6). The existing equipment in the departments of chemistry, biology, and engineering appear to be in high demand by students of those departments. The acquisition of additional AA and GC/MS spectrometers to serve this growing student population is warranted and not simply a upgrade of old, outdated equipment.

This grant proposes to develop an integrated course assessing used industrial sites and their remediation. The strengths of this project include: 1) This grant is truly inter-disciplinary (as opposed to just multi-disciplinary) with investigators from several different science fields. 2) This is an innovative program and with new course offerings. 3) This will provide students with an excellent "hands-on" approach to applied sciences. Students will have the opportunity to collect data in the field and then return to the lab and perform data analysis. 4) This project is very focused and the personal are available and trained to see this project through till its completion. 5) There will be an outreach program to other institutions in their alliance. Environmental science is a growing field both at this university and in the country, and this proposed project will certainly benefit undergraduate education at

This project is for the acquisition of equipment to be used in an integrated approach to environmental site assessment. This approach will used as a tool of introduce students to several analytical techniques. Environmental Studies is a recent major at the university and course development is underway with faculty from several departments involved in implementation.

This proposal takes an interesting integrated approach, utilizing the analysis of sites classified as unsuitable by the EPA. This is a unique opportunity to gain practical experience that will directly benefit them in industry. It is expected that students will gain the technical skills needed to obtain employment in environmental assessment. Additionally they will gain an appreciation for field work, the collection of data, and the details of scientific inquiry. A good course plan is presented focusing on one course. The practical, applied aspects of this project are exceptional.

Various departments at the university already have significant relevant equipment being utilized in environmental studies courses. However, the requested equipment will provide enhanced instruction for students and will be designated for environmental studies courses. The purchase of dedicated equipment is not unreasonable in this case. It is expected that the equipment will be integrated into other courses as well. Enhanced undergraduate research programs would also be an expected outcome.

Faculty expertise and institutional support appear to be good. Plans for outreach to alliance institutions might be enhanced by outreach to local high schools. There are several logical audiences for dissemination of results of the analytical portions of this project. The PIs should consider also finding avenues for dissemination of the integrated educational aspects of their project.

One troubling concern is the safety aspect of the sites to be utilized. It is anticipated that the PIs will be certain that they and their students are not put in danger by visiting and studying these sites.