



## **WATER RESOURCES RESEARCH GRANT PROPOSAL**

**Title:** Watershed Issues Field Trip for Secondary Students

**Focus Categories:** EDU, M&P, and WQL

**Key Words:** education, ecosystems, land use, land-water interactions, landscape management, watershed management, water quality monitoring and management, decision models, economics, policy, socioeconomic issues, weeds, soil erosion, sedimentation, streams, and wildlife management

**Duration:** One Year – March 1, 2000 to February 28, 2001

**Federal Funds Requested:** \$2,235

**Non-Federal (2:1 matching) funds pledged:** \$4,532

Principal Investigator: Robert D. Pfister\*

University Address:

The University of Montana  
School of Forestry  
Missoula, MT 59812

Due to the nature of who is allowed to be a PI at the School of Forestry, Robert D. Pfister will be the PI but Carolyn H. Durgin, also of University of Montana School of Forestry will develop and carry out the project (see attached resume) phone 243-6655, e-mail chd@forestry.umt.edu fax and address are the same as Robert D. Pfister.

**Congressional District:** Congressional District # 1

### **Statement of Critical Regional or State Water Problems**

Montana has a critical need to address sources of nonpoint source pollution and develop Total Maximum Daily Loads (TMDL's) and watershed scale plans for improving water quality for the many endangered streams on it's 303 d list. In order to accomplish these improvements, it is critical that the public be educated about the nature of TMDL's, the issues related to TMDL's, how water monitoring and land use plans are conducted and the need for watershed based planning and management. Although there are water related educational programs and terrestrial related forestry, grazing, and mining related educational programs, few if any spend much time on the direct connections between the aquatic and terrestrial parts of the watershed. For example, water monitoring and watershed tours raise people's awareness of water quality issues, the sources of nonpoint source pollution and the need for TMDL's as well as train people to monitor water

quality. Educational programs in forestry, mining and grazing also cover methods for assessing their resources and a bit about decision making. However, few if any go into any detail or give local examples of the land use decision making process, Best Management Practices (BMP), and the connection between specific upland, midland and lowland land uses and watershed management.

This project will help teachers and students investigate the practical implications of watershed management including TMDL's by learning about terrestrial components of monitoring. They will learn how to assess the condition of upland forests, midland developed areas, and lowland grazing areas and how Best Management Practices are designed to help reduce potential non point source pollution in a watershed. It will also raise participants' awareness of the complex decision making process a group of land managers went through in order to address the specific social, political, ecological, and economic concerns related to a specific creek sized watershed. This new knowledge will supplement participants knowledge of the causes of nonpoint source pollution by helping them to better understand and appreciate the social, political, and economic concerns that sometimes cause land owners to continue land uses that contribute to the TMDL's of a watershed in spite of the ecological evidence that they might be polluting the water supply. With this knowledge, students will better understand the complex TMDL aspect of water shed planning that involves determining the contaminating factors, setting a total allocation for each cause, and determining remedies. This project will not assess the creek for TMDL's.

### **Statement of Results or Benefits**

This project will Result in:

1) increased teacher and student awareness of:

- a) the complexity of economic, ecological, social, and political factors considered in land use decisions and their impacts on watersheds.
- b) how to assess the condition of land being used for forestry, range, and development
- c) how specific land use decisions may have affected point and non-point source pollution; a topic not currently covered in the level one teacher workshops of the Clark Fork Watershed Education Network.
- d) BMP's designed to reduce the impacts of these land uses

2) the creation and demonstration of models for:

- a) pre field trip teacher inservice
- b) interactive student issues field trip

This project will also provide several benefits:

- 1) it may aid water related legislation since the field trip and teacher workshop would help current voters (parents and teachers) and future voters (students) become more informed about Montana's watershed concerns including TMDL's.
- 2) it would provide an additional "hook" that "grabs" the interest of teachers and students and motivates them to take ownership in a stream in their area by participating in the volunteer water monitoring program.
- 3) it would provide the necessary connection between the monitoring of the actual stream channel (aquatic) and riparian areas done in the Volunteer Water Monitoring Program and the upland, lowland, and midland land (terrestrial) uses that might be contributing non point source pollution to the stream.
- 4) it would supplement the broad scale efforts of the Get to Know Your Watershed Program by giving teachers a small scale more easily conceptualized model for a one day field trip.

### **Nature of the Project**

This project will take what Carolyn Durgin will learn in the spring of 2000 from a pilot test of a uniquely interactive watershed issues field trip in Deer Creek and implement it on an issues field trip in the Swan Valley. Carolyn will receive help from the local Swan Ecosystem Education Specialist and a student who just finished a watershed and environmental education course in the area. Together these two will plan and organize a pretrip inservice for the teachers going on the field trip and the field trip itself. It will also provide the basis for developing a model for inservice training and issues field trips. The field trip is unique since it will include students participation in hands on data collection activities that both illustrates different land uses and the condition of the ecosystem in each area and provides opportunities for students to work along side resource specialists and land owners as they learn how to collect the data. It also provides a unique opportunity for students to discover specific examples of social, political, and economic concerns the land owners were faced with when making a specific land use decision for one portion of the creek watershed. These interactions will be designed to help students discover the complexity of land use decisions and efforts to reduce the cumulative effects of nonpoint source pollution from forestry, grazing, and development activities in the upland, midland and lowland parts of the creek watershed. Other water monitoring programs do not get into this kind of detail about the causes of non point source pollution, the conflicts and interactions of different land uses and areas of the watershed,

and the complex factors that land owners must consider when deciding whether or not to take action to protect their creek from the results of their land use decisions and needs.

### **Scope of Project**

This new project will include planning and conducting during the Fall of 2000 one teacher pre trip inservice training for approximately five teachers and one “issue” field trip on a small creek sized watershed in the Swan Valley for approximately 60 students. The results of these two events will be developed into a model for pre trip inservice training and issues field trips during the winter of 2000-2001. Following the close of this grant, the model will be disseminated to teachers and agency educators via the variety of methods mentioned in the page 6 procedure (after the field trip) This project will neither cover 1) the creation of teacher inservices and issues field trips specific to other watersheds nor 2) the assessment of TMDL’s for the creek.

### **Objectives of the Project/Research**

- 1) To organize and conduct an after school inservice teacher training that prepares teachers for an issues field trip
- 2) To organize and conduct a one day student field trip for watershed issues on a small creek in the Swan Valley of Western Montana that is preferably on the 303 d list
- 3) Upon completion of the issues field trip participants will be able to:
  - a) describe what a TMDL is, why it is a critical issue in Montana today, why it is one concern for watershed management, and why the cumulative effects of nonpoint source pollution are a major contributor to TMDL’s for Montana streams
  - b) describe why in addition to water monitoring efforts, land use planning at a watershed scale is necessary to address the contribution of non point source pollution to TMDL’s
  - c) describe at least one economic, social, political and ecological factor that contributed to the complexity of land use decisions made in the uplands, midlands, and lowlands of a small creek watershed.
  - d) explain the positive and negative impacts land use decisions may have on the forest, range, wildlife, soils, and vegetation resources and nonpoint source pollution in the creek watershed.
  - e) describe what BMP’s might be done to reduce potential nonpoint source pollution on a small creek in the Swan Valley

4) To use the pilot teacher in-service and student field trip to create models that can be presented to, and used by a variety of programs across the state. The model will illustrate and investigate the practical implications of water shed management including TMDL's, terrestrial monitoring techniques, and the land use decision making process for a small creek watershed.

### **Methods, Procedures, and Facilities:**

#### Methods:

The planning process for this teacher inservice and issues field trip will use an educational technique known as "service learning". This service learning experience will provide a university of montana student an opportunity to apply what he/she just learned about the watershed and environmental education during her watershed Dynamics and Environmental Education and Communication course work to a service project that helps organize a teacher prefield trip inservice and student issues field trip.

In addition, this field trip will have a more hands on approach that goes beyond the traditional "walkie talkie" lecture in the field by having the participants actually collect data and use comparisons of the data they gained from each site to understand the differences between the upland, midland and lowland ecosystems and land uses. Students will be taught by resource specialists the data collection techniques resembling those described in Extension Forestry's Forest Stewardship workshop for landowners and Project Learning Tree's Forest Assessment activity in its new book Forest Ecology. These forest assessments include collecting data on tree height and diameter, species, undergrowth, snags, down wood, wildlife signs, grasses, forbes, shrubs, weeds, slope, aspect, and forest structure.

This issues field trip will provide the stimulus necessary for discovery learning, inquiry learning, and constructivist methods of teaching. It does this by providing the hook (issues) necessary to interest students in discovering more about this topic. It also provides the first phase of inquiry learning that includes assessing what students know. Together after the field trip, the teacher and students can start phase two of inquiry learning and constructivist learning by designing activities to construct a learning experience in which they learn about the water quality topics they discovered they would like to know more about. Students learning will be evaluated in a variety of ways. The culmination of the field trip will involve an alternate assessment of students learning that uses a giant puzzle activity that requires their knowledge of the issues covered during the trip to complete the puzzle. Teachers will follow-up this exercise by having students write a journal entry about what they learned during the field trip. These journal entries along with teachers written evaluation of the strong and weak points of the issues field trip and teacher pre field trip inservice training will provide the basis for a qualitative assessment of the students learning. A pre and post test will provide a quantitative evaluation of students' learning on the field trip that can be compared to the qualitative evaluation.

## Procedure:

### Prior to the Field Trip

In the spring of 2000 Carolyn Durgin will work with Becky Garland and Wendy Moore to refine a model for an issues field trip she has developed to fit in as a school application of what teachers typically learn in the Know Your Watershed Tours and a component of the advanced watershed monitoring training the Clark Fork Watershed Education Network provides. In the Fall of 2000, a student will participate in the Landscape and Livelihood field semester in the Swan Valley (sponsored by North West Connections and including courses in Watershed Dynamics, Forests and Rural Communities, Outdoor Education and Communications, Independent Study, and Biogeography of Northwestern Montana).

During the latter part of the Landscape and Livelihood semester they will work with Diann Ericson and Carolyn Durgin to 1) choose the location for an issues field trip for a small creek sized watershed in the Swan Valley (preferably on the 303d list) and 2) develop and coordinate an after school teacher training session and a full day watershed issues field trip that uses the field areas and data that the student observed during the first part of the semester. Diann Ericson will help the student refine the field trip model and use what the student learned during the environmental education part of the semester courses to plan a one to two hour teacher inservice that introduces teachers to possible pre and post field trip activities as well as what will occur on the issues field trip and how students will be monitoring a variety of variables within that small watershed. The student will then take care of the logistics of organizing and setting up the issues field trip and a teacher inservice for November 2000 weather permitting.

### During the Field Trip

Carolyn Durgin and Diann Ericson will lead the issues field trip with logistical help from the student and content help from local agency related resource specialists and private landowners. During the issues field trip secondary students will investigate issues for a small watershed in the Swan Valley by comparing their own field data from upland, midland, and lowland sites that have varying land uses. Resource specialists will help students collect this data and tell them about the management process as the students collect the data. Students will compare their data for each of the upland, midland and lowland sites. These investigations will be designed to help students both observe how these land uses and mitigation efforts impacted the natural resources and the interactions occurring within the natural resources in the ecosystems. Students will discover for themselves how specific social, political, and economic concerns added to the complexity involved in making land use decisions for this watershed.

Particular attention will be paid to how the above listed concerns contributed to the decision whether or not to follow Best Management Practices and how these practices have the potential to help reduce the current total maximum daily load (TMDL). Although each plot will assess vegetation, wildlife, and physical aspects the actual results

of each plot will differ slightly. The trip will culminate with an interactive giant puzzle activity which requires students to know at least one social, political, economic, and ecologic concern was addressed by the land use decision and how that decision contributed to or helped reduce the non point source pollution. We believe that this issues trip will be the “hook” that gets at least one class to begin a monitoring program for this small watershed.

### After the Field Trip

A generic model that can be adapted to land use issues field trips in other watersheds throughout Montana will be developed by Diann Ericson and Carolyn Durgin from evaluations of the field trip. This will be shared with the Montana Watercourse’s Get to Know Your Watershed and Montana Volunteer Water Monitoring Project coordinators between January and March of 2001. After the grant is over this model will be shared with other programs via presentations at the Montana Education Association (3,000 teacher participants) and Montana Environmental Education Association (150 participants) annual conferences between March and October 2001.

Carolyn Durgin is also planning on disseminating this model across Montana through her established contacts with state wide and regional groups such as the Earth Observing System (EOS) and the Missoula Curriculum Consortium (see letter of support). Other programs Carolyn interacts with that have the potential to use the model include: Forest Discovery Days, Project Learning Tree (PLT), Project Wet, Project Wild, The Montana Natural History Center, Teller Wildlife Refuge, and the BEAR Cooperative. Past work with these groups has indicated that a model such as this one would provide good context for these programs’ reality based multi-disciplinary learning activities.

### Facilities:

Swan Ecosystem Center’s 50 person meeting room, changing forest trail and museum, and a creek in the Swan watershed; preferably one on the 303 d list.

### **Related Research**

In personal conversations with Carolyn Durgin, the following people agree that although the Watershed Tours and the Volunteer Water Monitoring Project appear to cover similar topics, they do not duplicated but rather complement each other. Maryanne Wolfe, director of the Montana Water Course and supervisor of both of these programs, felt that this watershed issues field trip did not overlap since it mainly targets students and the other two programs target teachers; it uses a smaller scale which is better for students; and it concentrates on decision making which is covered at a much broader scale in the watershed tours. It also provides an excellent model that gives teachers one more tool to use since her program can not cover all the watershed education that is needed. It would provide a good follow-up for teachers going on the tours and context for the monitoring program.

John Etgen, director of Project Wet (just took another position in the Montana Watercourse) and involved with the Get to Know Your Blackfoot Watershed Tour added that the watershed issues field trip would provide a good context for future water monitoring projects since it had participants walk through the watershed and had local decision makers sharing with students the basis for their land use decisions in the creek watershed. It also included smaller scale travel from the ridgetop to the lowlands of a small creek rather than the larger scale trip from the source to the mouth of the river that takes place in the teachers watershed tour. Becky Garland coordinator of the Get to Know Your Blackfoot Watershed Tour agreed with John about the possibilities for the watershed issues field trip.

Erik Ringelberg of the Clark Fork Watershed Education Network (WEN), a watershed educational program resulting from the Montana Volunteer Water Monitoring Project felt that although his program does cover watershed issues, water quality, riparian health and the impacts of point and non point source pollution, there would not be a problem since the context of the issues field trip is the Swan which is at the edge of their programs jurisdiction. He also felt that our issues field trip would be an asset to the Swan Ecosystem Centers programs. He felt that good communication with The WEN would promote educational transference and prevent overlaps. He also felt that they did not overlap since his covers the aquatic, not the terrestrial aspects of watershed management (personal conversation and letter of support).

Other board members of the Clark Fork Watershed Education Network, Wendy Moore and Debbie Fassnacht, agreed that this workshop would complement their advanced workshop which covers advanced aquatic insect identification and riparian health assessment. They felt the issues field trip is needed since it will go into detail on the decision making process and talk about how this may be affecting what was happening to water quality in the uplands. Their workshop only mentions these causes since it does not have time to go into detail about how these practices cause problems and how these problems can be reduced. In addition, their program seeks to train people so they can start their own watershed monitoring programs, it does not go into detail on the management issues of a specific watershed (personal conversations). I did not include comments from the new coordinator of the Montana Volunteer Water Monitoring Project since he is too new in his position to comment on my project.

Kris Kuschel of the Missoula Curriculum Consortium also told me in a personal conversation and her letter of support that this field trip would provide excellent context for inquiry and integrated curriculum methods that are now required throughout the curriculum.

The literature shows that science teachers need to use inquiry based models for education and they need help integrating environmental education principles with education principles. Other aspects of the literature show the need for education on terrestrial processes and local applications of the decision making process. The watershed issues field trip concept would help teachers do the above. Since the literature also shows that TMDL assessments for watersheds are quite complex, we decided that it would be

inappropriate for this one day issues field trip to try to do any kind of assessment of the aquatic part of the watershed. Rather, we decided to concentrate on introducing students to the terrestrial measurements and how they relate to the decision making concerns including TMDL's within the creek watershed.

The complexity of watershed assessment is indicated in the following quote from the Compendium of Tools for Watershed Assessment and TMDL Development. "One challenge faced by water quality managers is the lack of integrated, scientifically sound approaches to identify problems in watersheds and to predict the results of potential control actions on receiving water quality and aquatic habitat. In setting priorities and gathering information for the development of a TMDL, it might be necessary to use several techniques, models, or analytical tools in assessing different components of the complex watershed system. Because of the limitations on applicability and predictive capabilities, care must be taken when selecting a model or analytical tool for watershed assessment and TMDL development" (p. 4).

This type of issues field trip is invaluable since it will help teachers both follow principles set up in the inquiry learning model and integrate environmental education and teaching standards into their lessons. According to an article by Edward L. Pizzini, teachers need help figuring out how to "do" inquiry learning. He stated that many science teachers do not use this model because they are confused as to the meaning of inquiry learning (p. 111). He also concluded that the responsibility to include open-inquiry activities such as problem solving rests with the science teachers, since science textbooks and supplemental activity guides are not designed to facilitate open-inquiry teaching (p. 120). According to Fletcher Brown there is also a need to integrate environmental education and teaching standards. He states in his 1997 article "Inquiry Based Environmental Education Teaching Model" that by incorporating the two reform efforts an educational experience can hopefully be created that will help increase students' understanding of environmental concepts and promote student action with regards to environmental problems. This watershed issues field trip integrates the environmental education standard for skill building and action orientation, putting information into context, feelings are involved in issues, and fairness and accuracy of materials with the schools standard for giving students opportunities to apply their knowledge to scientific investigations that involve problem solving experiences related to local issues.

For example, The Environmental Education Materials: Guidelines for Excellence of North American Association for Environmental Education NAAEE supports the idea that learning skills (eg. upland monitoring in a local area) are important. According to this guide skill building and an action orientation include: 4.1) a sense of personal stake and responsibility - learners are provided with opportunities to reflect on the effects of their actions and to sort out their opinions about what if anything they should do differently. Materials convey the idea that many individual actions have cumulative effects, both in creating and addressing environmental issues. and 4.2) self-efficacy materials include a variety of individual and community strategies for citizen involvement and provide learners with opportunities to practice these strategies through projects they generate individually in their school or in the larger community (p. 12). Putting the information

into context is addressed in Depth 2.3) Environmental concepts should be set in a context that includes social and economic as well as ecological aspects. Feelings are covered in 2.1) Awareness materials should acknowledge that feelings, experiences, and attitudes shape environmental perceptions and Issues (p. 7). .1.1) Fairness and accuracy states that information comes from primary sources which provide context rather than from reviews or newspaper articles that simply provide bits and pieces of arguments or evidence.(p.5).

The Montana Standards for Science indicate there is a need for students to apply their scientific knowledge to a local context with real life problems. They state that by end of grade 8 students will 2. select and accurately use appropriate equipment and technology to measure, gather, process and analyze data from a scientific investigation (p. 2) and model collaborative problem solving and give examples of how scientific knowledge is shared, critiques, and scrutinized by other scientists and the public (p.6) 3. and investigate local problems and or issues and propose solutions or products that address a need, which considers variables 4. apply scientific knowledge and process skills to understand issues and everyday events. (p. 6).

On a different note, evidence of the need for education about terrestrial processes and land management planning can be found in the Forest Service Conservation Education Task Force 1998 Report and Recommendations Vision-to-Action Strategy. It states that its core themes are sustainability of natural and cultural resources in forest, grassland, and aquatic ecosystems. and awareness and understanding of interrelationships in natural systems and between people and the land. It goes on to say that for Land Management Planning and Collaborative Stewardship its vital priority is to both incorporate educational principles and techniques into the land management planning process and to make a direct connection between conservation educational and collaborative stewardship. (p. 10).

Lastly, little if any curriculum is available on measuring terrestrial ecosystems in a watershed context. Although Project Learning Tree covers the terrestrial system it does not cover the links between the aquatic and the terrestrial systems that are required in watershed planning. The closest a curriculum comes to connecting these two systems is the Wonders of Wetlands and the Streamkeepers Guide. These curriculum provide good background material. They do not however, repeat the issues field trip materials since they do not go into detail on the uplands but rather concentrate on the stream channel, riparian areas, and wetlands. The Wonders of Wetlands is a good source of information but it does not cover TMDL's and it does not have local case studies and it does not go into inventory for non wetland areas. It does however, have a great background section on the ecology of wetlands and the types of management and restoration options available. Both of these sections would be good reference materials should the issues field trip participants decide to do a full fledged inventory and monitoring and action project in the area after the field trip.

The Adopt-A-Stream Foundations Streamkeeper's Field Guide - Watershed inventory and stream monitoring methods, on the other hand, also does not repeat but rather extends our field trip concept. Although it mentions inventorying the uplands as part of the

inventory, it does not go into detailed observations of the uplands, it does not give specific examples of the social, political, and ecological concerns in the decision making process in the two case studies it covers and the two case studies are not about local examples. It also does not mention TMDL's. Should the students going on the issues field trip become interested in watershed monitoring, this guide would be a great one for them to follow for a more thorough investigation of their watershed. The book recommends that it include: mapping, physical and biological and historical, regulatory and land ownership data, field inventory methods, monitoring program design, stream reach survey methods, physical characteristics, macroinvertebrates, water quality measurements, quality control of data, presenting data and types of action one can take to fix specific problems. This book contains a great page (p.13-14) on nonpoint source pollutants, their sources, and water quality impacts that would serve as a good handout on our field trip.

### **Information Transfer Plan**

#### 1. Subject matter and problems to be addressed

- a) methods for assessing the current condition of a forest, range, or developed area
- b) Best Management practices that help reduce the amount of non point source pollution coming from forest, range, and development land uses
- c) the complex interplay between social, political, economic, and ecological concerns in specific land use decisions made in a creek watershed
- d) the theoretical connection between land uses and nonpoint source pollution and TMDL's
- e) one method (model) for conveying the above to students via a one day issues field trip
- f) one method (model) for preparing teachers for the one day issues field trip

#### 2. Target audience -

- a) students and their teachers and parent volunteers (inservice and issues field trip)
- b) teachers and agency educators (dissemination of the model)

#### 3. Strategies to be used -

- a) field test of the models
- b) presentations of the model at conferences
- c) word of mouth as Carolyn Durgin interacts with teachers interested in forestry education

4. Cooperators - Swan Ecosystem Center, Swan Valley Schools, Camus Prairie School, and North West Connections (for other supporters see list in methods - after field trip)

## **References**

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