Water Resources Research Institute

Annual Technical Report

FY 2000

Introduction

The FY 2000 Annual Technical Report of the Mississippi Water Resources Research Institute provides a summary of USGS-supported research, education, and information/technology transfer activities. Brief descriptions of five research projects, which completed funding in February 2001 are included in the summary.

Research Program

Basic Information

Title:	Development of a Kenaf-Based Biosorptive Water Treatment Process
Project Number:	B-20
Start Date:	3/1/1999
End Date:	2/28/2001
Research Category:	Water Quality
Focus Category:	Groundwater, Treatment, Toxic Substances
Descriptors:	Hazardous Wastes, Groundwater Quality, Pollution Control
Lead Institute:	Mississippi State University
Principal Investigators:	Mark E. Zappi

Publication

1. Zappi, Mark, An Nguyen, Lance Jarrell, Allison Kirkpatrick, and Tim Burcham, 2000, Evaluation of Chemical Reaction Dynamics Within Swine Raising Facility Underdrains: Implications to Odor Evolution and Assessment of Abatement Strategies, in 2000 Proceedings of the Mississippi Water Resources Conference, Water Resources Research Institute, Mississippi State, MS, 116-124 pgs.
2. Zappi, Mark, Karen Graves, Amanda Aycock, Arun Subramani, and Solomon Tavai, 2000, Mississippi Water Resources Research Institute, Mississippi State University, Mississippi State, MS, 26 pgs.

PROBLEM AND RESEARCH OBJECTIVES

Many of the contaminated surface waters and groundwaters currently undergoing treatment or scheduled for treatment contain organic contaminants at relatively low levels (sub-100 ppm levels); yet, these levels are still well above regulatory requirements requiring treatment prior to discharge. Recent pollution prevention initiatives within industry have resulted in wastewaters that do contain lower levels of contamination; however, these waters still contain contamination levels requiring treatment. The treatment of these waters pose both technical and economic challenges to industry and site owners. With regard to Mississippi, many industries are small businesses that are already stressed by the challenges of today's market conditions. Having to face complex environmental compliance issues, such as water treatment, only further exasperates their situation. However, these water sources do require treatment to preserve/restore the resource quality (and keep the company in compliance).

Currently available treatment technologies usually have problems treating these waters. Therefore, the state of affairs facing engineers and scientists attempting to treat low level contaminated waters using the above discussed technologies results in the selection of a process that has significant short-comings. A technically superior, yet operationally simpler treatment process within a reduced cost bracket is needed to assist industries in meeting environmental regulations. An operationally-simple system would improve the quality of endangered water sources because of increased usage by industry resulting in cleaner discharges.

A novel process is under development that addresses the shortcomings of the technologies discussed above, while meeting the needs of industry. The envisioned process involves adsorption of organic contaminants onto crushed kenaf fibers. Although it produces no fruit, kenaf is a plant that is in the same plant family as okra. Kenaf is an agricultural crop that has recently been found to have many uses including animal litter, paper manufacturing, and composite material construction. The fibers of the kenaf plant are resistant to water logging and are structurally stable when exposed to overburden loads allowing tight, yet sturdy packing. Kenaf fibers will be packed into a column where contaminated water will be passed through the column using up-flow hydraulics to provide intimate contact between contaminated water and the kenaf fibers (all three fiber types of the plant will be tested [surface fibers, core, and mixed chop]). The contaminants will adsorb onto the adsorptive sites on the kenaf and the column operated until all of the kenaf fibers within the column are completely spent (i.e. all sorption sites filled). This approach is very similar to that used with activated carbon adsorbers; however, once the kenaf becomes spent, then the fibers will be removed and placed into a compost bed. The compost bed will be used to reduce waste kenaf volume and degrade the adsorbed chemicals via biotreatment.

Benefits expected with the development of the proposed process are:

a. The kenaf-based biosorptive process is expected to be much cheaper than activated carbon in that kenaf is a renewable resource that is easily cultured within the Southeastern United States.

b. Kenaf fibers are easily stored and extremely stable under high impact and overburden stresses. Activated carbon is easily crushed to useless fines under similar handling conditions.

c. Composting is a well developed process that has been widely used for disposal of plant debris and stabilization of municipal biosolids. The final product from compost systems, including the type proposed within this process, is a humus-based material that has a marketable value as a agricultural amendment.

METHODOLOGY

The overall objectives of this project will be to develop and prove the utility of the kenaf biosorption process for treating contaminated waters. Secondary objectives to be addressed include:

a. Evaluation of the adsorptive capacity of candidate kenaf fibers composed of various plant fractions and/or fibers made from differing processing techniques for three phenolic compounds (phenol, dichlorophenol [DCP], and pentachlorophenol [PCP]).

b. Evaluation of the stability of the various fibers within saturated column reactors under long-term, dynamic operational flows.

c. Evaluation of various composting approaches for both reduction of plant mass and degradation of phenolic compounds.

d. Determination of the extent of mineralization achieved for the phenolic compounds within the compost reactors.

e. Evaluate the impact of chlorination level on the rate of adsorbed phenolic compound degradation within the compost reactors.

f. Evaluate the ability of kenaf to adsorb other adsorbates in order to assess molecular weight and structural impacts on adsorption.

SUMMARY OF TECHNICAL APPROACH

The research objectives of this project will be met through performance of a series of research tasks that are briefly summarized below:

Task 1 - Evaluation of Adsorption Capacity for Candidate Kenaf Fibers - The ability of kenaf to adsorb the test adsorbates will be evaluated using various fibers manufactured from several plant processing techniques already developed by MSU. The adsorptive capacity will be determined using traditional adsorption isotherm techniques.

Task 2 - Kenaf Fiber Stability During Dynamic Column Operation - The stability of the various kenaf fibers will be tested by loading the fibers into 2 inch ID by 24 inch long all-glass columns capped with teflon plugs. Each fiber source will be evaluated in duplicate columns. The columns will be operated by flowing tapwater up through the columns to achieve an empty bed contact time of one hour.

Task 3 - Composting of Spent Kenaf Fibers - The degradation rates of both kenaf fibers and sorbed adsorbates within aerobic and anoxic bench-scale compost systems will be evaluated. Various compost amendments that are typically used at composting operations for disposal of garden and wood debris will be tested initially for fiber volume reduction (kenaf degradation). After optimization for volume reduction, attention will be directed toward contaminant degradation.

Task 4 - Evaluation of Contaminant Mineralization - The extent of mineralization achieved for PCP during composting of the spent kenaf will be determined using radio labeled PCP (^{14}C). Due to the high cost of labeled compounds, this effort will only evaluate PCP mineralization. PCP was selected because it is widely accepted as being the most difficult phenol to biodegrade. If PCP is successfully mineralized, then the other phenols should also be at least similarly mineralized.

Task 5 - Dynamic Column Runs - A series of dynamic column runs will be performed using the optimized process based on the results from the above tasks. This experimentation represents final process verification prior to pilot studies. Duplicate columns will be operated for treatment of DCP and PCP contaminated influent. The columns will be operated until complete breakthrough of both phenols occurs at which the spent kenaf will be composted. The residuals from composting will be analyzed for phenolic content.

Task 6 - Cost Analysis of the Developed Process - An economic evaluation of the various potential design options for the developed technology will be performed. This evaluation will generally follow traditional engineering economics which will provide costs associated with capital investment, O&M requirements, and total unit pricing ($/kgal treated).

Task 7 - Draft Final Report - A final report will drafted that details the results of the experiments, proposes a protocol for system design, and presents an evaluation of relative process economics.

PRINCIPAL FINDINGS AND SIGNIFICANCE

Evaluation of Kenaf Stability Under Dynamic Column Operation

The objective of this effort was to evaluate the stability of kenaf under continual passage of an aqueous influent through an adsorption column packed with kenaf as an adsorbent. To date, one kenaf fiber has been tested for its stability under dynamic flow conditions within a packed column. The fiber tested was crushed whole stalk which represents the cheapest kenaf source (approximately $0.08 per pound [versus] $1.50 per pound of activated carbon]).

The column was operated (single replicate) from June 1999 through December 1999. Within the first two days of operation, the effluent exiting the column had a color very similar to that of tea. This coloration was believed to be caused by dissolution of stalk pigments into the permeant (i.e. the plant material was leaching color much like tea leaves do). After 48 hours, the effluents became almost clear and remained clear throughout the remainder of this experiment. The flowrate of the packed column under a consistent hydraulic head did not change appreciably over time based on periodic flowrate measurements. Visual observations indicated that the column rapidly turned a consistent dark brown and remained that color until approximately 2 months of operation, upon which the column was operated with intentional shut-downs to evaluate the impact of intermittent use on fiber stability. This on/off operation appeared to cause the column to become deeply anaerobic as witnessed by conversion of the column from brown to dark black and the generation of hydrogen sulfide within the column packing (checked via periodic opening of the column).

After approximately 2 additional months of periodic shut-downs (about two eight hour events per week), the column was generally operated at continual flow conditions until December 1999. Over time, after returning to continuous flow operations, the column contents returned to a dark brown color with little or no odors noted. After completion of the experiment, the structural characteristics of the aged stalk fibers were surprisingly strong with little loss in strength observed. However, the finer filaments protruding from fresh stalks were not present indicating that they were likely biodegraded and/or eroded during column operation. In general, the stalk fibers appears to have been stripped of superficial fine filaments (as if acid washed). No loss in solids were observed within the effluents (the effluents were collected within white plastic buckets to facilitate improved visual observations [provides white background against the dark filaments and other fiber components]).

In summary, this experiment yielded surprising results in that the stability of a packed kenaf bed was quite high. These positive results provides a potential framework for designing columns with kenaf packing using designs similar to those used with activated carbon adsorption systems. Additional experiments are scheduled using core material and influents from natural streams and groundwater sources (these waters are not chlorinated and contain chemical matrices more supportive of bacterial growth [increases the potential for biofouling]).

Design of Bench-Scale Composter

The objective of this effort was to design a bench-scale compost system that would allow for evaluation of multiple treatments at the same time while providing process conditions similar to actual beds with a high degree of process control. The center of the system under design is the 2-liter composter reactors. Since the reactors needed to be capable of withstanding temperatures in excess of 70^{o}C, then special considerations were required with all building components. Additionally, several heating techniques were considered because temperature ramping is a key process control within a compost system. Several prototypes were tested and this design decided upon as the most flexible within a realistic cost (about $500 each). This unit allows for analysis of reactor headspace gases while providing provisions for irrigation of the reactor without upsetting experimentation. Multiple sample ports were placed within the reactor cap that is fastened to the reactor body using a stainless pipe clamp. The various ports on the reactor cap can be used for a variety of operations including real-time analysis of headspace gases, collection of ^{14}C radiolabelled carbon dioxide, and/or insertion of thermocouples. A viton gasket will be inserted between the cap and the body to provide loss of reactor gases during incubation. Temperature will be maintained and ramped by placing six compost reactors into a stainless steel walled conventional laboratory oven. It was decided not to use microbial temperature feedback temperature ramping due to the complexity of this approach versus perceived minimum benefit as viewed by the design team. Excavation of the reactor headspaces will be performed periodically by forcing fresh breathing air or oxygen (both supplied by pressurized bottles). The reactor compost pile within the composter can be periodically mixed via shaking the sealed reactor which will simulate windrow composting. Forced air composting will be tested by forcing oxygen sources through the compost pile. The oxygen sources will be aerated through the bottom distribution plate (constructed of teflon and containing approximately 30-1/8 inch holes). Irrigation will be performed by aspirating nutrient solutions into the compost pile within the reactor.

Generation of Adsorption Isotherms

The objective of this experimental phase is to generate adsorption data on the ability of various kenaf fiber sources for adsorption of various adsorbates. The approach used in this experimental phase generally followed the techniques successfully used for many years with the evaluation of activated carbon for treatment of aqueous solutions. During these experiments, dried kenaf core was used as the adsorbent.

Equilibrium Time Determinations - The results tp date indicate that adsorptive equilibrium was reached after one hour of contact. Therefore, a one hour contact time was selected for generation of isotherm data for all of the adsorption experiments. Further testing of this type will be conducted at a later date for other adsorbates of interest.

DCP Adsorption Isotherms - Table 1 summarizes the phase concentrations (water and kenaf) generated from the results of the adsorption experiments. It is interesting to note that the loading concentrations listed for the 100 mg/l DCP generally falls within the range reported by the USEPA for Calgon Carbon’s Filtrasorb 400, which one of the most commonly used activated carbons for groundwater remediation and wastewater treatment. This similarity indicates a high potential for kenaf to effectively compete with activated carbon as an adsorbent. Comparison of these values indicate a high degree of promise for kenaf as an adsorbent. For example, LaGrega et al. list DCP as having K and n values of 157 (mg/kg) and 1/n as 0.15, respectively. These values are well within the range of DCP K values calculated during this project (12 - 517 mg/kg). Also, the DCP K values reported by Dobbs and Cohen (1980) also are within the range calculated from the experimental data generated by the current project. Since K is indicative of ultimate loading, then kenaf appears to have an appreciable loading capacity that is competitive with activated carbon. Comparison of the K value for TNT to the range of values reported by our group for activated carbon indicates that the K value generated from the current project is approximately the same as the one previously reported. We report a K for TNT in actual wastewaters of 0.025 mg/g using activated carbon versus the 0.033 mg/g K value calculated in the current study. The negative aspect of these data is that the DCP 1/n values determined during the current project are much high than those reported by others indicating that kenaf has a much steeper adsorption isotherm for DCP. This indicates that as influent and targeted effluent levels dramatically change, then a much greater impact (potentially adverse if they decrease) on the adsorptive capacity of kenaf than would be observed with using activated carbon as the adsorbent. The results for TNT are more positive in terms of the 1/n value than the DCP data. We reported a 1/n value of 0.14 as opposed to the 0.284 determined in the current study.

Basic Information

Title:	Dechlorination of PCBs, Herbicides and Pesticides in Soils, Sludges and Bulk with Ca/NH3 at Ambient Temperature
Project Number:	B-21
Start Date:	3/1/1999
End Date:	2/28/2001
Research Category:	Water Quality
Focus Category:	Toxic Substances, Groundwater, Treatment
Descriptors:	Bioindicators, Biomonitoring, Invertebrates, Nutrients, Riparian Vegetation, Streams, Suspended Sediments, Water Quality
Lead Institute:	Mississippi State University
Principal Investigators:	Charles U. Pittman

Publication

1. Pittman, Jr., Charles U., Jinbao He, and Guang-Ri Sun, 2000, Amer. Chem. Soc. Div. Environ. Chem. Preprints, 40(2), 784-787.
2. Sun, Guang-Ri, Jinbao He, and Charles U. Pittman, Jr., 2000, Synlett, (5), 619-622.
3. Sun, Guang-Ri, Jinbao He and Charles U. Pittman, Jr., 2000, Chemosphere, 41(6), 907-916.
4. Pittman, Jr., Charles U., and Jinbao He, 2001, Journal of Hazardous Materials, (Accepted).
5. Getman, Gerry D., and Charles U. Pittman, Jr., 2001, in M.A. Tarr (ed.), Chemical Degradation Methods for Wastes and Pollutants: Environmental and Industrial Applications, New York, NY, Marcel Dekker, 25 pp.
6. Pittman, Jr., Charles U., Jinbao He, and Guang-Ri Sun, 2001, in R.L. Lipnick, R.P. Mason, M.L. Phillips, and C.U. Pittman, Jr. (eds.), Environmental Chemistry: Emphasis on EPA and EPA Supported Research, ACS Symposium Series Book, Washington, DC, ACS, (to appear 2001).
7. He, Jinbao, 2000, Dehalogenations of Aliphatic and Aromatic Hydrocarbons by Solvated Electrons, Ph.D. Dissertation, Department of Chemistry, Mississippi State University, Mississippi State, MS, 115 pgs.
8. Pittman, Jr., Charles U., Jinbao He, and Guang-Ri Sun, 2000, Mississippi Water Resources Research Institute, Mississippi State University, Mississippi State, MS, 33 pgs.
9. Pittman, Jr., Charles U., Jinbao He, and Guang-Ri Sun, 2000, Dechlorination of PCBs and CAHs Using Na/NH3: Application to Soil Remediation "in" Mississippi Water Resources Conference Proceedings, Mississippi Water Resources Research Institute, Mississippi State, MS, 200-208 pgs.
10. Pittman, Jr., Charles U., Jinbao He, and Guang-Ri Sun, 2000, Dechlorination of PCBs, CAHs, Herbicides and Pesticides Neat and in Soils at 25 degrees C Using Na/NH3 "in" 2000 Spring Meeting of the American Institute of Chemical Engineers, Symposium on: Environmental Remediation in the 21st Century, Integrated Systems Technologies, Atlanta, GA.
11. Pittman, Jr., Charles U., Jinbao He, and Guang-Ri Sun, 2000, Solvated Electron (Na/NH3) Dechlorination of Model Compounds and Remediation of PCP- and CAH-Contaminated Wet

Soils "in" 220th National Meeting of the American Chemical Society, Symposium on Environmental Chemistry, Emphasis on EPA and EPA-Supported Research, Washington, DC (abstract ENVR 361).

PROBLEM AND RESEARCH OBJECTIVES

Polychlorinated biphenyls (**PCBs**) and other chlorinated aromatic compounds are widely distributed in soils, sludges, estuaries, etc. at **over 400 sites in the United States**. This demonstrates a **national need** for a variety of **rapid remediation methods**. Every state is represented. The EPA's Emergency Response Notification System (ERNS) shows that from 1988 - 1992, alone, almost 3,600 accidents occurred with PCBs (more than for any other category of hazardous substances). This highlights the need to develop remediation technology to decontaminate soils and sludges containing PCBs and to invent portable methods to destroy PCBs not yet released into the environment. Chlorinated aliphatic hydrocarbons (**CAHs**) are widely used for degreasing/cleaning engines, auto parts, electronic components, and dry cleaning. They occur as serious contaminants **at 358 major hazardous waste sites in the United States**. Since CAHs migrate vertically through soils to form dense nonaqueous phase liquids **(DNAPLs)** on aquifer bottoms, *ex-situ* methods of CAH decontamination/destruction are needed for soils, sludges, bulk zones (DNAPLs in the valdose zone) and industrial process wastes. *In situ* remediation of DNAPLs is a very high priority research area at EPA, DOE and DOD in critical need of a variety of solutions. For example, DOEs Hanford site has massive soil and groundwater contamination with carbon tetrachloride with a subsurface plume extending for over 70 sq. miles. Many contaminated sites exist in the Gulf Coast region where the largest concentration of chemical manufacturing plants in North America is located.

The goal of the proposal research is **to develop a generalized technology to decontaminate soils (*in-situ* and *ex-situ*) and sludges contaminated with PCBs, CAHs and even organic nitro and nitrate compounds** (from munition/propellant wastes). **We have now demonstrated that neat PCBs and PCB-contaminated soils (as received clay, loam, sandy soils containing up to 30% water) can be decontaminated in liquid ammonia slurries when treated with Ca/NH_3 and Na/NH_3. PCB-destruction efficiencies >99.9% were achieved in 30 sec. at room temperature.** Chlorine was mineralized as NaCl or $CaCl_2$. We are now determining how much water can be present and still get complete PCB destruction at reasonable Na or Ca consumptions. Can sludges with high fractions of water be economically treated? Will this chemistry destroy carbon tetrachloride, tetrachloroethylene, trichloroethylene, trichloroethane (major **CAH**-polutants) rapidly and in the presence of water? Demilitarization activities have emphasized existing problems with nitro and nitrate compounds (explosives), nitration factory soil contamination, and propellent residues. All of these might be reduced rapidly by Na or Ca/NH_3. Several model nitroaromatics have been very rapidly and quantitively reduced using Na/ethylenediamine in our labs in 1994-95.[11] **The major goal is to develop solvated electron chemistry** (e.g. Na or Ca/NH_3) as a **single, multifunctional, portable technology applicable to both on site** *in-situ* **and on site** *ex-situ* **destruction of PCBs, CAHs, and**

munition/explosive residues. Even if only half of these classes of pollutants can be rapidly destroyed in solvated electron media, this single technology would have broad application. **The major focus and concern is to demonstrate that this chemistry can lead to a new remediaton technology.**

METHODOLOGY

Ca/NH_3 and Na/NH_3 Dissolving Metal Dechlorinations: Procedures/Equipment. Typical CAH dechlorinations of pure compounds and soil samples have been carried out at ambient temperatures in liquid ammonia. At room temperature liquid ammonia is a gas unless it is under pressure. Although these pressures are unlikely to exceed 200 psig, a special ammonia reactor system, designed and operated by Commador Solutions Technology, Inc. has been employed. This reactor allows the easy introduction of solid calcium rods into the ammonia substrate solution at ambient temperature. These metals rapidly dissolve to give a clear blue solvated electron solution. The system is stainless steel with a glass liner. After the reaction is completed, ammonia is conveniently evaporated from the products. Ammonia is readily transferred from a storage tank to the reactor vessel via normal metal transfer lines.

A specific substrate or a contaminated soil sample is weighed into the reactor and the ammonia will be added to dissolve the substrate (or slurry the soil). Introduction of Na or Ca starts the reaction. Conductance may be used to follow the reaction. Aliquots of the ammonia solution (or slurry) are taken vs. time for work up and analysis, or ammonia may be flashed off and the solid residue worked up.

After reisolating the soils they will be reanalyzed by the same GC and GC-MS techniques to establish the contamination level. This can be done after flashing off the NH_3 or after filtering NH_3 from the soil. If NH_3 is removed by filtration, the extracted residues will need to be checked after final NH_3 evaporation. Very small quantities of PCBs can be detected in the Mississippi State Chemical Laboratory (MSCL) located in our chemistry building. They have a **trace analysis laboratory equipped with GC instruments having electron capture detectors**. That laboratory performs routine trace analysis of residual hazardous in environmental samples, foods, and animals, etc., **using EPA-approved methods. This laboratory has regulatory enforcement responsibilities and backs up its analysis and methods regularly in legal proceedings.**

PRINCIPAL FINDINGS AND SIGNIFICANCE

Model chlorinated aliphatic and aromatic hydrocarbons and phenols have been dechlorinated in Ca/$NH_{3(L)}$, Na/$NH_{3(L)}$ within seconds by the solvated electrons formed when sodium dissolves in the liquid ammonia. Furthermore, these same dechlorinations have been carried out in the presence of up to a 50 mole excess of water (over the chlorinated substrate). The minimum amount of Na consumption to completely dechlorinate these compounds was determined by running a series of reactions with incrementally more Na present. The amount of Na consumed per chlorine removed was determined as a function of mode of addition and as a function of the amount of water present. While more Na was consumed in the presence of water, dechlorinations were still efficient with a lot of water present. Clearly, dechlorination was far faster than competiting reactions with water.

Dechlorinations of CCl_4, CH_3CCl_3, 1,2-dichlorobenzene and 3,4-dichlorotoluene were run in the presence of stoichiometric deficiency of Na. Only completely dechlorinated products and recovered substrate were formed . No partially dechlorinated intermediates were formed. For example, equation 1 shows typical results for CCl_4. These results demonstrate solvated electrons react at diffusion controlled rates with chlorinated organic compounds.

Na was superior in soil remediations to Ca. Less Na was consumed per mole of Cl mineralized. Na is increasingly more efficient than Ca as the water level in the soil increases. Less Na is consumed than Li, K or Ca and Na is clearly the metal of choice. Polynuclear aromatic hydrocarbons (PAHs) were found to be effectively remediated (99.99%) in wet soil samples using Na/NH_3.

$$(1)\quad CCl_4 + 2Na \xrightarrow{NH_3} \underset{(45\%)}{CH_4} + \underset{(54\%)}{CCl_4} + NaCl$$

Basic Information

Title:	Benefits of Various Best Management Practices in Reducing Herbicides in Runoff Water
Project Number:	B-22
Start Date:	3/1/1999
End Date:	2/28/2001
Research Category:	Water Quality
Focus Category:	Non Point Pollution, Water Quality, Surface Water
Descriptors:	Agriculture, Herbicides, Pesticides, Rainfall-Runoff Processes, Runoff, Water Quality, Filter Strips
Lead Institute:	Mississippi State University
Principal Investigators:	David R. Shaw

Publication

1. Blanche, S.B., D.R. Shaw, and S.A. Akin, 2000, Weed Sci. Soc., 53:212.
2. Shankle, M.W., D.R. Shaw, and M. Boyette, 2000, Weed Sci., 48:(in press).
3. Shaw, David R., S. Brooks Blanche, Mark W. Shankle, William L. Kingery, and Joseph H. Massey, 2000, Mississippi Water Resources Research Institute, Mississippi State University, Mississippi State, MS, 24 pgs.
4. Shaw, David R., S. Brooks Blanche, Mark W. Shankle, William L. Kingery, and Joseph H. Massey, 2000, Environmental Fate of Fluometuron in Soil Influenced by Best Management Practices (BMPs) "in" Mississippi Water Resources Conference Proceedings, Mississippi Water Resources Research Institute, Mississippi State, MS, 159-166.

PROBLEM AND RESEARCH OBJECTIVES

The major factors causing water quality impairment in the Mississippi Delta, one of the most intense agricultural areas in the U.S., arise from movement of water from land surfaces. The rainfall amount and intensities often are high, causing rapid contaminant movement through the ecosystem. Since agrichemical use is high, applications immediately followed by rainfall create a significant probability of their mobilization in the environment. The erosive nature of precipitation to bare soil disperses soil particles. As they travel across the soil surface with runoff, coarser sediments are left behind. What reaches streams and lakes are highly adsorptive colloidal materials that remain suspended for long periods, are pollutants themselves, and are carriers of pollutants. Although a number of laboratory and small-plot studies have developed potential best management practices (BMPs), data are lacking at the watershed scale, particularly in the Mississippi Delta. A Management System Evaluation Area (MSEA) has been established that focuses specifically on BMPs and their effects on production agriculture and oxbow lake quality in the Mississippi Delta, with maximized profitability and minimized environmental impact. BMPs implemented in this project range from low-input (e.g. vegetative filter strips, riparian zones) to high input (no-till or conservation tillage). In some instances we know that these systems work, but at the watershed level do not 1) understand the mechanisms, and 2) understand how multiple BMPs may interact. To develop recommendations that apply to areas outside these watersheds, a fundamental understanding of these issues is imperative.

This research will have two principal thrusts. The first will be to evaluate the effect of a stiff-grass vegetative filter strip composed of switchgrass in conjunction with conventional and conservation tillage systems on off-site movement of two widely used soil-applied herbicides. It will also evaluate this off-site movement over time within a runoff event. Second, laboratory studies will be initiated to determine herbicide adsorption and degradation in the filter strips, the treated fields, and at various intervals moving into the riparian forest at one of the watersheds. This information will benefit the environment, as well as the producer, by determining maximum benefit of filter strips while minimizing the amount of land taken out of production. These results will provide critically needed data on mechanisms which can effectively reduce erosion, thus meeting compliance with federal conservation programs, and concurrently reduce herbicide content in runoff exiting fields. The dual benefits of reduced sediment and herbicide movement, coupled with other advantages associated with clean tillage between the vegetative filters, will present a clear, viable alternative to other conservation programs which reduce erosion but often lead to increased herbicide movement in runoff. Additionally, determining benefits, if any, of linking multiple BMPs (vegetative filter strips and conservation/no-till) will provide invaluable information for modeling purposes, and for recommendations from various governmental agencies.

METHODOLOGY

The proposed runoff plot research will be conducted at the Black Belt Branch Experiment Station near

Brooksville, MS on established standard USLE (4 m by 22 m) soil erosion plots. Previous studies have indicated that these plots are of sufficient size to estimate losses from watersheds with similar characteristics (Burgoa and Wauchope 1992). Soils at the Black Belt Station are silty clay with high smectitic properties and low slopes, similar to the Sharkey clays of the Delta. These plots are already established and instrumented, thus enabling initiation of the project without excessive cost. Plots are bordered with a metal strip to exclude outside runoff, and each plot is equipped with a 15 cm H-type flume. Two factors will be evaluated in a factorial design, tillage system (conventional tillage, conservation tillage, and no-till planting into a wheat cover crop) and presence or absence of a switchgrass filter strip. Switchgrass will be placed at the base of the plot when needed.

Cotton will be planted into each system, and norflurazon and fluometuron, each at 1.68 kg ai/ha, will be applied to all plots. Plots will be maintained free of weeds throughout the duration of the growing season by hand hoeing as necessary.

A rainfall simulator with an output of 2.5 cm per hour will be used to supplement natural rainfall in order to guarantee a minimum of 5 cm of rainfall at 2-week intervals for a total of 10 weeks. All runoff will be collected from each plot and quantified. Within each runoff event, samples will be collected at five-minute intervals from the initiation of runoff to the conclusion of the runoff event in order to describe herbicide losses both across and within these runoff events. Composite samples will then be obtained and stored at 2 C. Subsequent to the final runoff event, all samples collected will be analyzed by the researcher using appropriate analytical methodology. Norflurazon and fluometuron residues will be determined with a lower detection limit of 250 parts per trillion (ppt) and 100 ppt, respectively. These concentration values will then be combined with the total runoff from the plot in order to determine total herbicide loss at each runoff event on a per hectare basis, and subsequently total yearly loss due to off-site movement in surface runoff. Regression analysis will be used to describe loss patterns across the various combinations of filter strips and tillage systems.

Fluometuron adsorption studies will be conducted on soil collected from different sites within one of the MD-MSEA watersheds. Soil samples will be collected from environments influenced by a established grass filter strip (S_{est} >5 yr), new grass filter strip (S_{new} 1 yr), and riparian forest (R). These BMPs will be compared in combination with watershed tillage practices. Soil samples will be characterized for organic matter, clay type and content, pH, texture, and sum of exchangeable cations by previously mentioned procedures. An adsorption study will be conducted to evaluate soil constituents for their ability to retain and / or be potential carriers of fluometuron in runoff water.

Batch techniques will be used to characterize fluometuron sorption kinetics. Eighteen samples (4 S_{est}, 4 S_{new}, and 10 R) will receive four different fluometuron concentrations with three replications yields a total of 216 samples. Concentrations of 0, 0.01, 1, 4, and 8 g ml^{-1} that contain 0.045 Ci ml^{-1} uniformly ring labeled ^{14}C-fluometuron will be dissolved in a 0.01 *M* CaCl$_2$ solution. Sample suspensions will be prepared by the addition of 5.0g air dried soil into 25-ml centrifuge tubes followed by adding 10 ml of 0.01 M $CaCl_2$ solution (10). The sample suspensions will be shaken for 15 hours to attain equilibrium. After the appropriate shaking time is achieved, samples will be centrifuged and 1 ml aliquots of supernate will be added to a 15 ml water-accepting scintillation cocktail. Liquid scintillation spectrometry will be used to count ^{14}C radioactivity for each sample (10). Adsorption isotherm models will be developed using Freundlich parameters (K_f and [1/n]) calculated via linear regression of log transformed data. Fluometuron adsorption to soil will be evaluated for correlation to soil properties.

Data derived from field and laboratory research in this project will be correlated to data generated from the various watersheds in the MD-MSEA project. Sampling sites within the three watersheds are focusing on runoff water from conventional-tillage and conservation-tillage systems, prior to and after vegetative filter strips, and prior to and after passing through a riparian forest. Modeling efforts planned for the MD-MSEA project will use the watershed-level data for model validation and refinement. Data generated in this research will be useful to understand underlying mechanisms of herbicide reductions effected by various BMPs that are evaluated.

PRINCIPAL FINDINGS AND SIGNIFICANCE

Soil in established filter strips had a greater adsorptivity for fluometuron than soil in the cropped watershed. This was also true from soils in the riparian forest. Most of these increases in adsorption could be attributed to higher organic matter content and higher microbial activity. Fluometuron degradation was accelerated by more than 70% in these soils as well, indicating that soils in BMPs not only retain herbicides more effectively, but also degrade them much more rapidly.

Switchgrass filter strips reduced runoff volume by 35 to 55%. Total norflurazon and fluometuron losses were reduced by 31 to 63%, depending on the tillage system used in conjunction with the filter strip. Switchgrass filter strips, whether used with conventional tillage or no-till systems, reduced herbicide losses more than did a no-till system used without a filter strip.

Basic Information

Title:	Effectiveness of Streamside Management Zones in Protecting Aquatic Habitat in Timber Management Areas
Project Number:	B-23
Start Date:	3/1/1999
End Date:	2/28/2001
Research Category:	Water Quality
Focus Category:	Non Point Pollution, Sediments, Water Quality
Descriptors:	Bioindicators, Biomonitoring, Invertebrates, Nutrients, Riparian Vegetation, Streams, Suspended Sediments, Water Quality
Lead Institute:	Mississippi State University
Principal Investigators:	Stephen H. Schoenholtz, Eric D Dibble

Publication

1. Carroll, G.D., B.W. Young, S.H. Schoenholtz, E.D. Dibble, and A.W. Ezell, 2000, Journal of American Water Resources Association, (In Review).
2. Schoenholtz, Stephen H., and Eric D. Dibble, 2000, Mississippi Water Resources Research Institute, Mississippi State University, Mississippi State, MS, 18 pgs.
3. Carroll, G.D., S.H. Schoenholtz, E.D. Dibble, and A.W. Ezell, 2000, Streamside Management Zones: Do They Protect Aquatic Habitat and Inhabitants from Logging Impacts in Mississippi "in" Mississippi Water Resources Conference Proceedings, Mississippi Water Resources Research Institute, Mississippi State, MS, 71-79 pgs.
4. Young, B.W., S.H. Schoenholtz, E.D. Dibble, and A.W. Ezell, 2000, Assessment of Streamside Management Zones and Their Effectiveness in Silvicultural Operations in the Sand-Clay Hills of Mississippi "in" Mississippi Water Resources Conference Proceedings, Mississippi Water Resources Research Institute, Mississippi State, MS, 80-83 pgs.
5. Young, B.W., G.D. Carroll, S.H. Schoenholtz, and E.D. Dibble, 2000, Are Streamside Management Zones Effective in Maintaining Water Quality in the Sand-Clay Hills of Mississippi? "in" American Water Resources Association Conference Proceedings, American Water Resources Association, Portland, OR.

PROBLEM AND RESEARCH OBJECTIVES

The Federal Water Pollution Control Act of 1972, the Clean Water Act of 1977, and the Water Quality Act of 1987 (Section 319) collectively provide federal legislation designed to control nonpoint source (NPS) water pollution. In response, states in the southern U.S. have designed Best Management Practices (BMPs) to minimize the impacts of forestry practices on water quality. Forestry practices such as harvesting may result in soil erosion, nutrient loss, and resultant NPS pollution in the form of sediment and nutrient delivery to streams that not only produce potential degradation of water quality, but also can potentially alter aquatic habitat and endanger aquatic biota.

Streamside management zones (SMZs), designed to provide intact or selectively harvested forest buffers between silvicultural activities and adjacent streams, are being used as a component of BMPs to maintain streamwater quality, aquatic habitat and maintenance of aquatic biota by minimizing streamwater temperature changes and the transport of sediments, nutrients, and pesticides into surface waters. However, scientifically-based assessment of effectiveness of these measures, particularly in relation to protection of aquatic habitat and maintenance of aquatic communities, has been lacking because monitoring programs have not been widely implemented. If landowners are expected to enthusiastically incorporate SMZs into their forest management protocols, then it is necessary to quantify the benefits of this practice in forested watersheds of Mississippi.

METHODOLOGY

Nine first- or second-order streams within the Sand Clay Hills subsection of Mississippi were accepted for the study. Three streams were randomly selected as reference sites, which will remain unharvested. The remaining six streams are within plantations that have been harvested. Three stands were clearcut to the stream banks and three streams have an SMZ on both sides of the stream. The SMZ treatments were delineated by local industry foresters to comply with company standards. Boundaries of SMZ’s follow elevation contours and resulted in widths on each side of the stream ranging approximately 30-175 m. Selective logging within SMZs was allowed. The unrestricted harvest treatment had timber removal within the riparian zone with skidder traffic allowed along stream banks and across stream channels. Harvesting treatments were initiated in January 2000 and will be completed by June 2000.

Two sampling locations were selected for each stream. One location is downstream from harvesting activity and one location is upstream from harvesting activity. In undisturbed reference streams, downstream and upstream locations are separated by approximately 200 m of stream channel length.

Grab samples have been collected biweekly at upstream and downstream locations in each stream since September 1999 to develop a pretreatment database. Samples are transported on ice to the laboratory and analyzed via ion chromatography for nitrate, orthophosphate, and sulfate within 48 hr. Total suspended sediments are measured by filtration. Biweekly grab sampling is ongoing and will continue for at least one year after harvesting treatments have been completed. Biweekly measurements of stream water temperature, dissolved oxygen, electrical conductivity, and pH are measured *in situ* with a portable water analyzer at the time of grab sampling. Biweekly measures of turbidity are also collected using a portable nephelometer.

Automated water samplers have been established at upstream and downstream locations in each stream. These samplers are programmed to collect water samples once every 12 hr and to provide a composite water sample for two-week intervals. Composite water samples collected in this manner are analyzed for total suspended sediments.

Assessments of physical habitat characteristics have been taken at four monthly sampling dates prior to harvesting and will be taken during the same four months following harvesting. These measurements are conducted across three transects at upstream and downstream sampling locations in each stream. Pre-treatment measurements of water width, depth, and velocity have been taken. Substrate type has been visually determined as silt, detritus, cobble, boulder, clay, or gravel. Assessments of physical habitat heterogeneity were made by counting the number of large woody debris within a measured reach. Wood density was calculated by dividing the number of large wood structures by reach length. At each transect, a determination of bank height, bank width, percentage of canopy cover, and the percentage of vegetation and state of bank erosion was made for each side of the stream. Modified channel cross-sections were taken at each transect. Depth measurements were recorded at six points within the channel, and a depth closest to each bank was taken. The number of small woody debris present was recorded at each interval within the transect.

Fish and macroinvertebrates were sampled in upstream and downstream sampling locations in each stream. Seven streams were sampled once a month, for four months, prior to harvesting. Two streams were sampled once a month, for three months, prior to harvesting. Post-harvest samples will be collected in corresponding months of the year following treatment.

Fish diversity and relative abundance were determined using a Smith-Root backpack shocker and dip-net to collect fish within each sample site. Each site was shocked for approximately 12-15 minutes. Fish were identified in the field, then returned to the stream. When field identification could not be determined, fish were preserved in a 10% formalin solution and returned to the lab for identification.

Macroinvertebrates were quantitatively collected using a Surber sampler. A 5-cm-deep sample was collected within the 30-cm-square frame of the Surber sampler. Macroinvertebrates were preserved in a 10% formalin solution and returned to the laboratory for quantification and identification. Samples are being rough-sorted by elutriation. Suspended invertebrates and detritus from each sample are being poured out of a 7.5-L bucket following swirling. Macroinvertebrates are being identified to order using dichotomous keys and stored in 70% ethanol solution.

Deposition and erosion within the riparian zone of each stream will be measured using transects of erosion stakes. Transects will be placed 40 m apart along the length of each stream between upstream and downstream sampling locations described above. Stakes will be placed at 10 m intervals along a transect that crosses the riparian zone in a perpendicular orientation to the stream. In watersheds that do not receive SMZ’s, transect length will be determined by judging likely boundaries if SMZ’s had been established. Stakes will be placed when harvesting treatments are completed and will be measured for net erosion/deposition depth one year after placement.

Mineral soil exposure will be estimated in a 1 m square area adjacent to each erosion stake at the time of stake placement and again one year after placement. This will be done to estimate degree of soil surface disturbance.

Descriptions of riparian zones will be based on topography and stand composition. Slopes perpendicular to the stream are being measured along each transect of erosion stakes. Basal area and composition of the riparian-zone overstory were measured prior to harvesting. Stream location, SMZ width, and stand boundaries will be measured using GPS equipment and transferred to an ArcView database for development of maps and determination of areal extent of buffer zones and harvesting zones.

PRINCIPAL FINDINGS AND SIGNIFICANCE

Total suspended sediments during five months of pre-treatment sampling ranged from <1 to approximately 32 mg L^{-1}. Patterns correlating to anticipated treatments (i.e., reference, clearcut with SMZ, clearcut without SMZ) were not evident prior to treatment. Turbidity levels during pre-treatment sampling ranged from 5 to 23 NTU and consistent patterns among treatment designations were not evident. Pre-treatment levels of nitrate ranged from 0 to 0.9 mg L^{-1} . Nitrate levels tended to be higher in streams designated for clearcutting without SMZ's from November 1999 through January 2000. This suggests that analysis of covariance may be required to evaluate treatment effects on nitrate levels in the streams. Sulfate levels ranged from approximately 4 to 23 mg L^{-1} prior to treatment and tended to be lowest in streams designated for clearcutting without SMZ's from November 1999 through January 2000. Pre-treatment electrical conductivity ranged from approximately 0.11 to 1.24 S m^{-1} and tended to be highest in streams designated for clearcutting with an SMZ between December 1999 and February 2000. Streamwater pH was highest (approximately 8.5) in September 1999 and steadily declined through January 2000 to a range of 6.2-6.6 among the designated treatments. No pre-treatment patterns in streamwater pH were evident among treatment designations. Water temperature and dissolved oxygen were similar among all streams prior to treatment. Water temperature ranged from a high of 19-23 C in September 1999 to a low of 5-8 C in February 2000. Dissolved oxygen ranged between 5-10 mg L^{-1} during the five months of measurement reported to date. Neither water temperature nor dissolved oxygen showed trends that indicate presence of pre-treatment bias among streams.

Pretreatment measurement of total fish abundance at upstream and downstream locations showed total numbers of fish caught at monthly samplings ranging from 0 to a high of 75. Within-stream variation between upstream and downstream locations was often high within each month and among months. This level of variability prior to treatment suggests that fish abundance may be of limited use under the constraints of the experimental and sampling design of this study.

Comparisons of species richness at upstream and downstream locations in the nine streams showed less variation than counts of total fish present. The number of species found ranged from 0 to 12. No patterns between upstream and downstream locations or among groups of streams designated for specific treatments were obvious.

Basic Information

Title:	Development of a Ground-based Water Analyzer for Remote Sensing of Nitrates and Phosphates in Surface Water
Project Number:	B-24
Start Date:	3/1/2000
End Date:	2/28/2001
Research Category:	Water Quality
Focus Category:	Nitrate Contamination, Non Point Pollution, Water Quality
Descriptors:	Water Quality Monitoring, Non-Point-Source Pollution, Remote Sensing, Nutrients, Nitrates, Phosphates, Fertilizers, Runoff
Lead Institute:	Mississippi State University
Principal Investigators:	Charles H. Henry

Publication

Research Problem and Objectives

Effective environmental monitoring typically suffers from sampling difficulty due to labor-intensive manual sampling resulting in poor data resolution in both temporal and spatial dimensions. This project proposes to demonstrate a proof of concept for rapid, ground-based chemical analyses capable of remote data retrieval. Depending on the application, the specific analytes could easily vary from those selected for this initial prototype. One could imagine deployment of various types of chemical analyzers to cover a wide range of analytes with real-time remote sensing capabilities and the concomitant ability to correlate the chemical data with other satellite data.

The primary goal of this proposed effort is to construct a prototype microfabricated ground-based water analyzer (GBWA) capable of providing remote and real-time monitoring of water chemistry. In particular, nitrates and phosphates will be monitored due to their importance to water quality and connection with agricultural non-point-source pollution. These pollutants are of particular concern in rural, agricultural areas where remote sensing by satellite would be especially useful. The basic idea is to develop a compact and self-contained chip-based analytical device, which would periodically analyze for nitrate and phosphate using capillary electrophoresis (CE). Each unit would be equipped with a radio transmitter capable of relaying the analytical data either directly or indirectly to a satellite for remote sensing of the ground-based measurement. This would allow convenient access to chemical movement data, which could also be correlated with weather data, etc. It is expected that analyzer units would be deployed in the field and remain unattended for an extended period of time.

Methodology

The microfabricated ground-based water analyzer (GBWA) will be constructed using conventional micromachining techniques similar to those used in the production of integrated circuits. The process is a two-part process with a microfluidic channel system fabricated on one substrate and the electrode pattern fabricated on a second substrate. The microfluidic channel network is fabricated by first creating a molding master on a silicon wafer. This master consists of a raised network of interconnecting lines in the pattern desired for the channel system. A viscous polymeric elastomer is poured over the mold and cured. Once cured, the polymer is removed from the master. The raised pattern on the master is transferred into the elastomer as a recessed, three-sided channel network. The electrode pattern is fabricated by first coating a thin piece of glass with a layer of titanium and then gold. The titanium serves as a glue as the gold does not adhere to glass. Once this layer is deposited, it is further patterned using a combination of photolithography and wet chemical etching. The result is a set of discrete electrodes that is capable of driving the separation and performing the electrochemical detection. Finally, the two pieces are sealed together. The glass plate serves as the forth side of the channels in the elastomer, creating a sealed channel network.

Quantification of the phosphates and nitrates will be accomplished with an integrated conductivity detector. A sample is introduced at the entrance of the separation column. A high voltage field is applied down the length of the capillary column, forcing the analytes to move from the entrance toward the exit. As they move down the column, they are physically isolated based on their interaction with the high voltage field. The time it takes for each analyte is specific and therefore can be used to identify each component in a mixture. Quantification occurs as the result of a change in conductance in the presence of the analyte ions. Each zone of analyte possesses a unique conductivity, which can be measured and quantified as it passes through the integrated conductivity detector.

Progress

This project began in April of 2000. During the first quarter progress was made in three crucial areas. The basic methodology needed to separate the three target analytes, phosphate, nitrate, and nitrite has been developed. This was done using a conventional capillary electrophoresis instrument. This methodology will be directly transferable to the GBWA as the separation principles and operating conditions are similar. The fabrication methodology for the construction of the microchip-based analyzers has been worked out. The entire fabrication process can be accomplished in less than 3 hrs and the microchips have a minimum lifetime of 2 weeks. Longer lifetimes are expected, however sufficient time has not passed for this evaluation. Currently the microchips are being studied to understand the their basic operating principles for optimized separations. Currently we have been able to fabricate the CE section and test it using standard markers. This progress is very promising as we are one of only 4 or 5 groups in the world successfully completing this type of research. The final phase of progress during this quarter is the construction of the detection electronics. This involved design and construction of the electronics necessary to apply and excitation signal and record a response. This work has been completed and the electronics are currently in their test phase. Initial results indicate better than part-per-thousand sensitivity with no amplification. When signal amplification and integration with a data collection system (personal computer), then sensitivities of better than parts-per-million can be expected.

Information Transfer Program

Basic Information

Title:	Information Transfer Program - Conferences
Start Date:	3/1/1997
End Date:	2/28/2001
Descriptors:	Conference
Lead Institute:	Mississippi State University
Principal Investigators:	Stephen H. Schoenholtz

Publication

1. 2000, Mississippi Water Resources Conference Proceedings, Mississippi Water Resources Research Institute, Mississippi State, MS, 396 pgs.

PROBLEM AND RESEARCH OBJECTIVE

Need to provide interactions among water resources researchers and federal, state, and local agencies, policy makers and the interested public. Likewise, there is a need for researchers to present their current and ongoing research to this diverse group.

METHODOLOGY

The Mississippi Water Resources Research Institute is the lead sponsor of an annual Mississippi Water Resources Conference which is co-sponsored by the Mississippi Department of Environmental Quality's Office of Land and Water Resources, the Mississippi District Office of the USGS, and the Mississippi Water Resources Association. The Conference provides a forum for the interaction referenced above.

SIGNIFICANCE

The Conference provides a well-known and respected opportunity for researchers, students, agencies, and the interested public to formally discuss current water resources research and informally critique the applicability of that research to priority water resources research needs in Mississippi, the Southeastern United States, and the Nation. The conference's proceedings, which are distributed to all conference attendees and available for sale to others, are perhaps the preeminent source of current information about the diversity of water and related land resources research in Mississippi.

CONFERENCE PROCEEDINGS

2000, Mississippi Water Resources Conference Proceedings, Mississippi Water Resources Research Institute, Mississippi State, MS, 396 pgs.

Basic Information

Title:	Information Transfer Program - Library and Database Services
Start Date:	3/1/1997
End Date:	2/28/2001
Descriptors:	Library, Database Service
Lead Institute:	Mississippi State University
Principal Investigators:	Stephen H. Schoenholtz

Publication

PROBLEM AND RESEARCH OBJECTIVE

Need to operate and maintain a “clearinghouse” of water and related land research publications for researchers, agencies and the general public.

METHODOLOGY

The Mississippi Water Resources Research Institute has a water resources library co-located with the Institute. Upon request, the Institute provides copies of interim and final research reports of USGS sponsored projects at either no charge or for a minimal fee for multiple requests.

SIGNIFICANCE

The library provides a comprehensive, long-term depository for research reports funded through the Institute’s USGS competitive grants competition and other Mississippi-specific water and related land research reports, surveys, and documents.

Basic Information

Title:	Information Transfer Program - Newsletter
Start Date:	3/1/1997
End Date:	2/28/2001
Descriptors:	Newsletter
Lead Institute:	Mississippi State University
Principal Investigators:	Stephen H. Schoenholtz

Publication

1. LORE Newsletter published quarterly, Water Resources Research Institute, Mississippi State, MS, 4 pgs.

PROBLEM AND RESEARCH OBJECTIVE

The need to inform researchers, policy makers, and the interested public about the Institute's activities, the annual conference, and funding opportunities

METHODOLOGY

The Mississippi Water Resources Research Institute's quarterly newsletters -- LORE -- include 1) requests for proposals for USGS competitive grants, 2) a "call for abstracts" for the annual conference, 3) the conference program and 4) summarizes activities at the conference.

SIGNIFICANCE

The newsletter is one of the Institute's primary mechanisms to inform federal, state, and regional agencies in Mississippi and the interested public about the Institute's activities.

Basic Information

Title:	Information Transfer Program - Publications
Start Date:	3/1/1997
End Date:	2/28/2001
Descriptors:	Publications
Lead Institute:	Mississippi State University
Principal Investigators:	Stephen H. Schoenholtz

Publication

1. 2000, In Review for Fiscal Year 1999-2000, Water Resources Research Institute, Mississippi State, MS, 28 pgs.
2. 2000, Annual Report for Fiscal Year 1999-2000, Water Resources Research Institiute, Mississippi State, MS, 30 pgs.

PROBLEM AND RESEARCH OBJECTIVE

It is necessary for Mississippi State University, political and administrative decision-makers, and the interested public to have a mechanism to evaluate the Institute's effectiveness.

METHODOLOGY

These mechanisms take two related but separate forms: 1) a Mississippi State University reporting requirement which encompass a variety of other multi-disciplinary water and related land management research funded through the Institute and related information about the extent and sources of the Institute's funding; and, 2) a discretionary annual report that includes a summary of these assorted projects, their accomplishments, researchers associated with the Institute, and students supported by these projects.

SIGNIFICANCE

The MSU report is necessary for the University to evaluate the effectiveness of the Institute in meeting its mission and goals. The *In Review* publication is discretionary but has historically provided a timely, concise overview of the Institute's activities and associated researchers and students. This discretionary publication is undoubtably the Institute's most widely distributed publication and informs key political and administrative offices about the Institute's direction, goals and accomplishments as reflected by the breadth of researchers, students and projects associated with the Institute.

USGS Summer Intern Program

Student Support

Student Support					
Category	**Section 104 Base Grant**	**Section 104 RCGP Award**	**NIWR-USGS Internship**	**Supplemental Awards**	**Total**
Undergraduate	14	0	0	0	14
Masters	5	0	0	0	5
Ph.D.	3	0	0	0	3
Post-Doc.	2	0	0	0	2
Total	24	0	0	0	24

Notable Awards and Achievements

B-22 - Shaw - Demonstration of the pesticide filtering capacity of vegetative filter (buffer) strips as a Best Management Practice.

B-23 - Schoenholtz - "Habitat Variability and Fishes in Nine Low Order Streams in the Sand-Clay Hills of Mississippi" presented at the American Water Resources Chapter American Fisheries Society Meeting in Jackson, MS, February 2001.

B-23 - Schoenholtz - "Evaluating the Effectiveness of Streamside Management Zones: A Research Approach" presented at the American Water Resources Meeting in Portland, OR, August 2000.

B-23 - Schoenholtz - "Are Streamside Management Zones Effective in Maintaining Water Quality in the Sand-Clay Hills of Missisisppi? Poster presented at the American Water Resources Association Conference in Portland, OR, August 2000.

B-21 - Pittman - Asked to write a book chapter for the following two books: 1) Chemical Degradation Methods for Wastes and Pollutants: Environmental and Industrial Applications and 2) Environmental Chemistry: Emphasis on EPA and EPA Support Research.

Publications from Prior Projects

1. Benson, William H., David S. Block, Jeffery A. Steevens, James C. Allgood, and M. Slattery, 2000, Technical Completion Report, Mississippi Water Resources Research Institute, Mississippi State University, Mississippi State, MS, 67 pgs.