USGS

WATER RESOURCES RESEARCH GRANT PROPOSAL

A. RESEARCH PROPOSAL (Revised)

1. Title: **Nutrient Cycling in Integrated Cropland/Wetland/Reservoir Management Systems**

2. Focus Categories: AG, WL, NU

3. Keywords: Agroecosystems, nutrient cycling, constructed wetlands, drainage management, nitrogen, phosphorus, organic carbon, nutrient delivery to streams, sediment, runoff, subsurface drainage, controlled drainage, subirrigation, ecosystem models, Great Lakes, water reuse and recycling, landscape and watershed management, off-site impacts.

4. Duration: **Two years**, September 1, 1998 to August 31, 2000

5. Federal funds requested: **$38,164**

6. Non-Federal (matching) funds pledged: **$76,772**

7. Principal Investigators: **Scott Subler**, Dept. Entomology, The Ohio State University, Columbus

Larry C. Brown, Dept. Food, Agr. & Biol. Engr., Ohio State University

Norman R. Fausey, USDA-ARS Soil Drainage Res. Unit, Columbus

8. Congressional District: 15th Ohio

9. Statement of critical regional or state water problems

The Midwestern US comprises the most productive agricultural region in the world. The predominant agricultural management systems in this region receive extensive nutrient inputs. However, most of these management systems do not effectively utilize or retain all of the added nutrients, leading to growing problems with nonpoint source contamination of surface and ground waters. Some of these problems may be exacerbated by traditional technologies for managing soil water. In many parts of the Midwest, soil drainage, the removal of excess water from the surface and profile of cropland soils by either gravity or artificial means, is an indispensable agricultural practice. In areas such as northwestern Ohio, once known as the "Great Black Swamp,"

water management practices are critically important for continued prosperous agriculture, the quality of Lake Erie water, the local economy, and for the restoration and preservation of wildlife habitat areas. Landowners there are encouraged to utilize technologies for surface drainage, subsurface drainage, and best management practices necessary for sustained agricultural performance and improved water quality. Nevertheless, the quality of Lake Erie water is still affected by nonpoint source agricultural runoff, and is substantially impaired by current cropping management practices combined with traditional, but effective, surface and subsurface water management techniques. Influxes of sediment, nitrogen, phosphorus, and agricultural chemicals are the greatest environmental concerns.

Ironically, when the original wetlands were converted to productive cropland through the installation of drainage systems, the ecological capacity of the landscape to filter sediment, retain nutrients, and purify surface water arising from the new agricultural land was lost. Inventory data indicate that 22 states have lost 50% or more of their original wetlands. In the North Central Region's dominant drainage states of Ohio, Iowa, Indiana and Illinois, over 85% of the original wetland acreage has been lost.

Within the eight-county Maumee Valley Resource Conservation and Development Area (RC&D), total wetland loss is estimated at 122,555 acres. Loss of wetlands, as associated with declines in wildlife habitat, adverse effects on water quality, and other impairment of healthy ecosystem function, is an important environmental issue. In typical farming communities of northwest Ohio, 80–90% of all land use is agricultural. Voluntary restoration of wetlands in this area has been minimal, largely due to tradition and economic considerations. For successful adoption by landowners, wetland development must make sense within an agricultural context, and must be cost-effective in the absence of government subsidies.

Progressive farmers and their organizations, natural resource conservation agencies, environmental agencies and organizations, and others seek guidance to help society and agriculture better understand how to recreate valuable wetlands, while conserving our existing beneficial wetlands. The development and demonstration of integrated landscape management systems, which combine the productive functions of cropland and improved water use with the ecological functions of wetlands and reservoirs, offer great promise. Exciting and innovative new projects are currently underway to evaluate the management, hydrology, and economics of such cropland/wetland/reservoir (C/W/R) systems. However, critically important questions concerning nutrient cycling through these systems, and their ultimate impacts on water quality, remain to be addressed.

10. Statement of results or benefits:

We propose to investigate and model nutrient cycling dynamics and related water quality impacts of newly developed integrated cropland/wetland/reservoir (C/W/R) landscape management systems in Ohio. Three operational C/W/R landscape management systems function as partially closed loops, through which water and

nutrients are recycled among individual component ecosystems (cropland, wetland, water supply reservoir). In these systems, runoff and drainage from cropland is collected and directed through a constructed wetland, and then stored in an on-farm reservoir. During the crop season, the cropland is subirrigated by supplying water from the reservoir back through the subsurface drainage lines beneath the crops. These systems use appropriate, state-of-the-art water table management technologies to achieve goals of improved water quality, increased wetland acres and biodiversity, and enhanced farm profitability.

Results from this new proposed research will help characterize ecological processes and management factors that influence transport and storage of nutrients in and out of integrated cropland/wetland/reservoir landscape management systems. Ultimately we will use our results to develop an assessment of the actual reduction of plant nutrients normally lost to receiving waters, establish the potential benefits/impact of these systems on nutrient fate at a local level, and subsequently forecast to a small watershed scale. Our expected results from the proposed work will certainly extend well beyond those to be determined by an existing WRRI grant (PIs Brown and Batte). Our research is very important for building a foundation for future GIS/remote sensing and watershed modeling research that can evaluate various application scenarios and predict environmental impacts on watershed and regional scales. All aspects of the proposed project will feed into existing state and regional educational activities conducted cooperatively by Ohio State University Extension, the demonstration project team, the Overholt Drainage Education and Research Program of The Ohio State University, and activities of the new regional NCRE project "Mississippi River Watershed Nutrient Sources and Control." Previously, Brown and Batte predicted that results from all components of the overall project would have implementation implications for the entire Midwest, and within the past year researchers and technical agency personnel from across the Midwest have expressed an interest in developing a new future project with a comprehensive regional application of this technology.