

University of Wisconsin – Extension



University of Wisconsin – Madison

**Review and Comment on the
NE Wisconsin Karst Task Force Report**

December, 2007

Dennis Frame and Fred Madison

Co – Directors

U.W. – Discovery Farms Program

Introduction:

The staff at the Discovery Farms Program (DFP) was asked by representatives of Wisconsin's dairy industry to review and comment on the NE Wisconsin Karst Task Force Report; the following paper represents our response to that request.

What is the Discovery Farms Program and why should it be called on to comment on this report?

The DFP was initiated nearly six years ago as a cooperative effort between working farmers involved in varying enterprises in the state in diverse physical settings and UW-Madison and UW-Extension. Its goal was to examine environmental challenges faced by Wisconsin farmers and to work with farm families to develop solutions to those challenges that make both economic and environmental sense.

Between them, the DFP co-directors have over 50 years of experience as Extension specialists in the state working on nutrient management planning, farmer adoption of nutrient management plans, farm financial planning, water quality impacts of livestock and poultry wastes, and manure management and handling. Their expertise is complimented by a competent project staff. Since its inception, the DFP has developed a strong working relationship with the farm community. The mitigation of the major impacts of the Karst report on the farm community and the implementation of the report's recommendations will depend on trust and understanding within the farm agency and university communities and a thorough knowledge of the complexities of nutrient management, particularly on livestock farms; this all falls well within the range of expertise of the DFP staff.

In order to bring some fresh insights into its programmatic efforts and to review its activities, the DFP requested a program review by a group of nationally recognized experts in farming systems research, phosphorus management and soil and water conservation. The external review team included:

- ***Dr. Tommy C. Daniel; Crop, Soil and Environmental Sciences Department, University of Arkansas,***
- ***Dr. Brian E. Haggard; Biological and Agricultural Engineering Department, University of Arkansas,***
- ***Dr. Andrew Sharpley; Crop, Soil and Environmental Sciences Department, University of Arkansas,***
- ***Dr. Martin Shipitalo, USDA-ARS, North Appalachian Experimental Watershed, Coshocton, OH***

Following are some excerpts from the review panel's final report:

The Discovery Farm Team (DFT) continues to ask appropriate scientific questions regarding agricultural nonpoint source pollution specific to Wisconsin's stakeholders, successfully assess the environmental issues of primary concern, and provide USGS the required direction to design a successful water quality monitoring program. USGS has a long and well-founded history of conducting high caliber water quality monitoring programs in field scenarios and their involvement in the Discovery Farms Program (DFP) greatly enhances the scientific credibility of the applied data generated. In addition, the USGS has its National Water Information Systems (NWIS) database that can be used to warehouse all collected stream discharge and water quality data in a publicly available and long-term maintained web site.

Because the program is designed and implemented in real world setting, the data generated is rare, very difficult to collect, and is of great interest to scientists, policy makers, agricultural stakeholders and state/federal agencies. Information obtained by the DFP will be of particular value to ongoing national efforts to assess nutrient and sediment load reduction efficiencies of various conservation practices in a technically sound manner.

The DFP fills a critical niche in agricultural research/extension that has been neglected or ignored in many states, thus it can serve as a role model for similar programs in other jurisdictions. The majority of farmers wish to be excellent stewards of the natural resources on their farms, but are hampered by a lack of knowledge of the offsite impact of their operations as well as the most efficient measures available to correct these problems. Information currently produced by university and extension is often too technical or too generic for farmers to have enough confidence in to make major changes in their operations without assurance of their technical and economic viability. Models can be used to extend results derived from research on experiment station farms, but are not a substitute and will never be as effective as on-farm research.

An interesting observation about the DFP came from a representative of one of the state's major agricultural organizations who said:

“We do not always like the information that Discovery Farms provides; but we trust and believe what Discovery Farms says and we will listen and work to adopt their recommendations”.

Some observations and comments on the Karst report:

The Karst report begins by providing background information on two groundwater concerns that exist in the northeast region of Wisconsin:

- Pathogen contamination,
- Nitrate contamination.

The report provides information on the members of the task force and identifies the four goals they were charged to examine:

- Determine where our impact on the karst aquifer begins,
- Evaluate the best methods to reduce the impact of agriculture on groundwater quality,
- Prioritize the implementation of available technologies to prevent future problems,
- Determine where gaps are in our knowledge base.

The background section concludes with five guiding assumptions which can be paraphrased as:

1. Prevention of all surface contamination of groundwater is a physical impossibility, however there are actions that landowners can take to reduce potential contaminations from livestock manure, human waste and other contaminants,
2. There is a serious need for better mapping of Karst features,
3. The recommendations are based on scientific knowledge and professional judgment,
4. The recommendations are focused primarily on agricultural issues (in fact, almost entirely on manure). While the other issues (septage, industrial waste, on-site sewage treatment, etc.) could be a significant part of the contamination problem, they are beyond the scope of this task force.
5. A uniform approach that provides a stable framework for environmental protection is needed.

What follows is the recommendation section of the report and our comments will focus largely on this section of the report.

Recommendations:

The Karst report contains a wide range of observations and recommendations on the many land use activities in the carbonate bedrock area of Northeast Wisconsin that currently impact groundwater quality and quantity. All of these activities are important and any efforts to reduce groundwater degradation must recognize the range of issues and must include strategies to deal with all of them. However, the task force chose to focus primarily on livestock agriculture although it does present suggestions for dealing with some of the other issues. That there are problems is not the issue; the city of Sturgeon Bay has utilized very sophisticated treatment techniques for its municipal water supply for many years. The challenge is to develop strategies that effectively deal with the problems and will be adopted and implemented by the majority of the people involved.

It is perhaps not a good assumption for the authors of this report to propose that their recommendations apply only to a 3 or 4 county area in the northeastern part of the state. Carbonate bedrock with associated sinkholes and fractured rock overlain by shallow soils occurs in many areas of Wisconsin. Some areas are already looking to the Karst report for ideas and directions as they deal with the carbonate bedrock issue. The recommendation of the Task Force that the legislature enable multi-county areas with carbonate bedrock to work together to identify problem settings as well as land areas better suited for more intensive land use activities makes a great deal of sense. Such a multi-county partnership could be developed to serve as a conduit for funding, much needed by local governments, to deal with these issues.

The co-directors of the DFP are neither carbonate rock geologists nor hydrogeologists and are not qualified to comment on portions of the Karst report that deal with carbonate bedrock. There was sufficient expertise on the Task Force to more than adequately cover these issues. The research efforts of Professors Bradbury, Kraft, Muldoon, Stieglitz and others over the years have documented the complexities of fracture flow in carbonate rocks. Although the issue is extremely complex, one fact that is clear, and generally agreed upon, is that once percolating waters containing contaminant loads move into the rock fractures, the potential for contaminant attenuation is negligible and the introduction of those contaminants into the groundwater system is inevitable.

This leads to a discussion of what is perhaps the most significant series of recommendations contained within the report. These recommendations are based largely on a table reprinted below.

Level of Protection required	Landscape Criteria	Relative vulnerability to contamination
1	Less than 5 feet (60 inches to carbonate bedrock, and/or closed depressions or any drainage areas that contribute water to sinkholes/bedrock openings)	Extreme
2	5-15 feet to carbonate bedrock	High
3	>15-50 feet to carbonate bedrock	Significant
4	Greater than 50 feet to carbonate bedrock	Moderate

The issue is the land application of animal waste, which is applied to the soil either to supply nutrients for agronomic plant production or to immobilize materials in those wastes that have the potential to become environmental contaminants if not contained. As indicated earlier, the potential

for contaminant attenuation in the carbonate rock system is very limited so as the table above indicates, the potential for reducing environmental impacts lies in the soil and other unlithified materials above the carbonate bedrock.

When the carbonate bedrock is near the surface (< 5 feet), the ability of the soil to adequately treat either livestock or human waste decreases dramatically as the soil layer gets thinner (Level 1). Where there is 5 to 15 feet of soil and unlithified material overlying carbonate rock there is still a potential for movement of contaminants through fractures, particularly in the unlithified materials. An incident in Dodge County in February of 2005 demonstrated that waste materials could move through fractures in medium textured, unlithified materials to depths of 15 feet. This is a setting in which the hazard exists but the risk is difficult to define. Certainly, the risk decreases as the depth increases (Level 2).

It is our opinion that the Karst report overstates the risk on medium and fine textured materials that are between 15 to 50 feet thick (Level 3). Research currently underway suggests initially that movement of water through these materials is extremely limited. Therefore, the potential for water movement through medium and fine textured materials greater than 50 feet thick (Level 4) is probably non-existent. If the relative vulnerabilities in Table 1 of the report are modified to reflect the suggestions presented above, then a template for landscapes in carbonate bedrock areas can be developed that would show the distribution of soil and unlithified materials. Once the coverings of materials on the landscape are established, appropriate waste application rates can be developed, nutrient management plans written and producers can begin working with consultants and manure applicators on implementation strategies that reduce the risk of contamination.

To expand on recommendations made by the Karst Task Force, we suggest that a mapping program which identifies the thicknesses and distribution of soils and unlithified materials at scales appropriate for agricultural producers be developed. The Wisconsin Geological and Natural History Survey (WGNHS) should serve as the lead agency in this effort as it would compliment work already underway related to the arsenic in drinking water issue. The WGNHS would need to establish close ties with the Natural Resources Conservation Service (NRCS), county Land Conservation and Land Information departments, and Regional Planning Commissions, wherever appropriate. This information on the thickness of unconsolidated materials on the land surface is of critical importance to the agriculture community.

A particularly complex issue that arises as a result of many of the recommendations contained in the report is the question of liability. It is going to be difficult to define and/or assign liability if a spill or runoff event occurs resulting in groundwater contamination or other environmental problems. The people that need to be involved working with producers and agency personnel to solve many of the problems associated with production agriculture in carbonate bedrock areas are going to be reluctant to get involved unless unanswered liability issues are clarified.

The Task Force report also makes a series of recommendations regarding well construction, maintenance, and testing. These are sound ideas that basically involve educating homeowners about their wells. Extension in the state of Pennsylvania has developed a new program called The Master Well Owners Program based on the highly successful Master Gardeners Program. Homeowners are trained on the many aspects of well construction and maintenance; their participation then requires

them to provide similar training to an additional 20 people over a defined period of time. To date, the effort in Pennsylvania has been highly successful and has spread to several eastern states. Currently, a web-based training program is being developed to facilitate participation in the program.

The DFP co-directors suggest that a similar program be established in Wisconsin. UW – Extension could house this program either under the Community, Natural Resources and Economic Development (CNRED) program area or the Basin Educator Program. Extension needs to work with the WGNHS and its staff of hydrogeologists to deliver the education and training portions of this program. Many of the recommendations of the Task Force could be effectively implemented through a program patterned after the highly successful Pennsylvania program.

To meet many of the challenges identified in the Karst report, the state needs to create a statewide initiative with stakeholders who are qualified to deal with the complex issues involved. This committee needs to make recommendations on more than livestock manure and should contain experts on septage, industrial waste, on-site sewage treatment, well construction, GIS, soils and agriculture. Our recommendation would be to have an advisory committee that can lead the process and several subcommittees that take on specific issues. It is critically important, especially since a significant portion of the land in this area is in production agriculture that producers make up a larger part of whatever committees are created. The Karst Task Force included extensive representation from the agency and University communities and only two producers. This imbalance in representation needs to be rectified in the future.

The research and training recommendations of the Task Force are sound and need to be implemented. Waste (livestock and human) management issues in the carbonate bedrock areas across the state are extremely complex and require immediate attention. This effort must combine the efforts of the production agriculture community with those of the University and agency communities. Training efforts should be expanded and must include producers, agency staff and service providers. Nutrient management plans must be implementable and followed by producers if nutrient and sediment loads are going to be effectively reduced.

The application of livestock manure in these carbonate bedrock settings must be seen as a year around challenge. Research on the Discovery Farms has shown that soil moisture content is a critical factor in the timing of waste applications. Excessive moisture in the soil and applied wastes, particularly if there is a rainfall or snowmelt event, will simply runoff. Data from applications at intermediate soil moisture levels indicate that application rates should be reduced. Finding the appropriate balance of application rate to soil moisture levels is an on-going research need.

Brown water in northeastern Wisconsin has, historically, been a problem in spring when soils are saturated. These are times when wastes should not be applied. As the Task Force report suggests, winter application of wastes should be limited in those landscapes with the greatest vulnerabilities.

Producers should consider early maturing crops such as canning crops or winter wheat to provide land for manure applications during the summer. During this period the soil moisture contents are lower and rainfall usually meets the evaporation and transpiration needs. Cover crops can be utilized to hold nutrients in the soil where necessary. The late fall manure application window

is also important when the soil moisture content is appropriate. Manure should be applied when soil temperatures are at a level that reduces microbial activity so that the nutrients stay in the soil to be utilized for crop growth in the following year.

The Task Force report makes a series of recommendations regarding the uniformity of codes covering the land application of numerous waste materials. Differences in factors such as depth to bedrock or groundwater, surface water setbacks, setbacks from wells, and the like exist in the various state and local codes that govern these activities. Different agencies may control the application of different waste materials to the same parcel of land. As complicated as it may be, these differences should be ironed out so that landowners hear a uniform message regardless of the type of waste.

Wastes are land applied so that as they decompose, nutrients released can be utilized for agronomic plant growth. Realistic crop nutrient needs therefore dictate application rates. It may not be possible to apply septage or municipal sludge to croplands that are also receiving livestock manure. The codes should be tailored such that this kind of nutrient over loading does not occur.

Farmers involved with the Task Force brought a team together to develop a very useful brochure entitled "Agriculture and Karst Features: Teamwork for a Safe Environment". This valuable brochure, relegated to Appendix 3 in the report, provides a solid, management framework for producers dealing with animal wastes in carbonate bedrock areas. The recommendations contained in this brochure should be discussed with producers throughout the karst region.

Conclusion:

The Northeast Wisconsin Karst Task Force final report properly focuses attention on groundwater contamination issues in that part of the state, particularly "brown water". However, the report deals primarily with livestock manure and doesn't provide recommendations that protect groundwater from other sources of nitrates. As stated in the beginning section of the report, nitrate levels are a concern; therefore all sources of nitrate contamination need to be evaluated (agricultural, municipal, septage and horticultural).

The report also provides recommendations that require manure injection and fails to identify UV radiation and drying as methods which significantly reduce pathogen concentrations. Three years of data from seven sites on Discovery Farms indicate that 93% of the annual runoff occurs between January and June 1st while the remainder occurred in early June. This means that surface manure applications could be made from late June – January (depending on weather forecasts) with little risk of runoff or infiltration. As stated earlier in this report, producers need to think about manure management as a year round practice and look for windows of opportunity to safely apply manure.

While the report contains some valuable recommendations, its assessment of the vulnerability of the unlithified materials in the area appears overstated. It does seem that once a better understanding of the distribution and thickness of those unlithified materials is developed and maps are produced at appropriate scales, wastes can be applied to those landscapes with little or no impact on the fragile groundwater system in the carbonate bedrock aquifer.