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OVERCOMING TOUGH SITE CONDITIONS AT TABLE ROCK LAKE USING DRIP DISPERSAL IN IMPORTED SOIL

David Casaletto[1], Tom Wallace[2] and Randy Miles[3]

ABSTRACT

Stone County, located in the Ozarks of southwestern Missouri, is home to a significant portion of Table Rock Lake. The lake, which is widely considered to have the best water quality of any in Missouri, is responsible for millions of dollars pumped into the local economy annually from tourism. During the 1990's, local residents, concerned by diminishing lake clarity and explosive population growth, formed Table Rock Lake Water Quality, Inc. (TRLWQ) to address the declining water quality. Failing septic systems are a significant threat to the lake. TRLWQ sponsored a study in 2001 that suggested septic discharges were entering the lake. The Table Rock Lake area, as well as much of the Ozarks is characterized by steep slopes, fractured limestone and thin soils. Thus, septic tank effluent receives little if any treatment from the natural environment, and contributes to the pollution to the lake.

This paper summarizes results the Table Rock Lake National Demonstration Project's use of drip dispersal of treated effluent to overcome tough site conditions. Examples of the design and installation of a number of advanced treatment systems in challenging site characteristics utilizing drip dispersal in imported soil will be discussed. The project also developed an innovative monitoring method to collect water samples after it has traveled through the soil. The results of this monitoring will also be discussed.

INTRODUCTION

Formed in 1998, The Table Rock Lake Water Quality Inc. (TRLWQ) is a not-for-profit water quality conservation group run by a board of directors from the local business communities who have taken it upon themselves to protect water quality in the Table Rock Lake area. They focus on various water quality issues; cause of the problem, origination of the source, other organizations and state agencies working on the problem and how this organization can make a difference. The TRLWQ is therefore an action group, with projects aimed at stopping pollution sources through scientific studies, field observation, influencing political and economic will and education/outreach programs. These activities are aimed toward gaining the support and involvement of a broad range of community leaders.

The Table Rock Lake including the James River watershed and Stone County, the main operating area of the TRLWQ, is located in the Ozarks of southwestern Missouri. Table Rock Lake is the largest lake in Missouri, covering over 43,000 acres. It was formed by the damming of the White River near the town of Branson, Missouri in 1958. The lake provides a multitude of recreational activities for the region, such as boating, swimming, and world-class fishing. One estimate puts the tourism impact at between 30 million and 40 million visitor hours per year (MDNR, 1999). The bulk of these occur during the summer months, particularly between

Memorial Day and Labor Day. The estimated annual revenue from tourism in the counties surrounding the lake exceeds $ 900 million. However, much of this revenue depends on maintaining excellent water quality in the reservoir.

The James River watershed and Table Rock Lake watershed are currently on the 303(d) list for excess nutrients. Failing on-site septic systems have been linked to nutrient pollution in surface waters. A study by Aley and Thompson, 1984, found that 60% of septic systems in Green County, part of the upper James River watershed, were contributing detectable contamination to spring systems. Aley and Thompson also reported that the important factor in water quality protection was found to be the adequacy of individual septic systems to treat the volume of wastewater.

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[1]David Casaletto; Executive Director of Table Rock Lake Water Quality Inc., a not-for profit water conservation association, Executive Director of Ozarks Clean Water Company, a not-for-profit sewer company P.O. Box 606 Kimberling City, MO 65686 (417)-739-4100 dcasaletto@lvbw.net. [2]Tom Wallace; Principal MEC Water Resources Inc. twallace@mecwater.com. [3]Dr. Randy Miles, PhD. University of Missouri milesr@missouri.edu.

The Voluntary National Guidelines for Management of Onsite and Clustered Wastewater Treatment Systems, published by EPA stated that more than half the (onsite wastewater) systems in the United States were installed more than 30 years ago when onsite rules were nonexistent or poorly enforced. In addition the guideline stated that few systems receive proper maintenance because homeowners are either unaware of the need for maintenance or find it a distasteful task. Lack of maintenance can cause systems to fail by becoming clogged with solids, releasing the liquid waste without it being treated.

Due to the increasing rural development in the James River and Table Rock watersheds, there are concerns that septic systems are contributing an increasing amount of nutrient pollution through failed systems and overall inadequacy of the thin soils in this region to support most conventional septic systems. From 1990 to 2005 the population of Stone County increased by over 60% while the average population growth for the entire state during this time was approximately 13%. In neighboring Barry County the population has increased by 30% since 1990. The vast majority of this new population is moving into rural developments that use on-site septic systems to treat wastewater. Home remodels and add-ons rarely upgrade existing septic systems to accommodate extra waste treatment needs. Newly built homes on older sites often use available existing systems without any consideration of this system's capacity to treat the new waste water volume.

The soil potential map of Stone County (Figures 2) illustrates the large area of the watershed that is characterized by high potential for infiltration. As shown in the Stone County soils potential map, the majority of the area around the Lake is unsuitable for conventional septic systems. This is due to the fact that soils in this area, which are the main treatment media for conventional septic systems, are very thin and composed of a high percentage of rock and gravel fragments.

The subsurface or bedrock throughout the Table Rock and James River watersheds is very close to the surface and is composed principally of the carbonate rocks, limestone and dolomite. The Burlington limestone formation is found in the uplands while Jefferson City-Cotter Dolomite predominates in the valleys. The fractured Burlington Limestone formation is very close to the surface and is characterized by numerous springs, caves and sinkholes, and extensive movement of groundwater from one area to another. Failing septic systems therefore are a significant threat to the water quality in the Table Rock Lake and its tributaries as the wastewater is virtually unfiltered and free to flow throughout system. Thus, septic tank effluent receives little if any treatment from the natural environment, and contributes to the pollution of the Lake.

TRLWQ sponsored a study in 2001 that used fluorometer instrument readings to determine that failing septic discharges were impacting the lake. Following this study, the TRLWQ applied for and received a $ 2 million cooperative agreement from the EPA to demonstrate management models for the installation and long-term management of advanced, decentralized treatment alternatives for failing septic systems. This Project became known as the Table Rock Lake National Demonstration Project.

OBJECTIVES

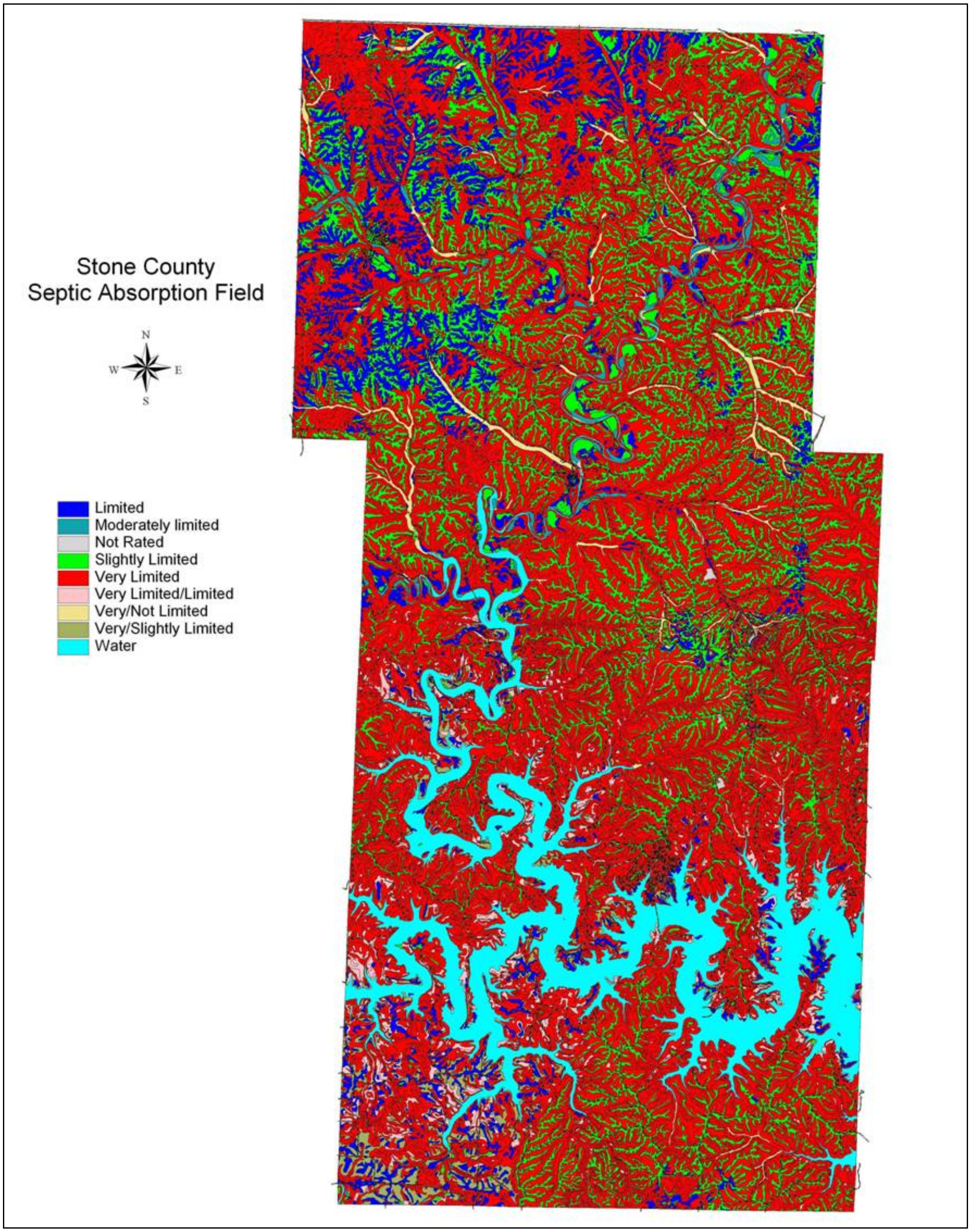
The objectives of the Table Rock Lake National Demonstration Project:

1. Demonstrate advanced on-site wastewater treatment technologies for Table Rock Lake region. This would be done through installation of advanced treatment systems and observation of their effectiveness through monitoring the performance of these systems. This would also generate data to help guide future selection of treatment technologies and management practices.

2. Demonstrate management solutions for advanced systems. This project was designed to be a learning process that would provide invaluable experience and expertise in the field of wastewater management for alternative systems. This experience is only possible through field testing of systems, which is considered one to the most valuable data and information products of this demonstration project.

3. Identify and address legal impediments to a widespread implementation of advanced systems. This Project also seeks to change the status and acceptance of the alternative, ecologically safer on-site wastewater treatment systems in Missouri which are currently considered only experimental systems.

Figure 1 – Map of the Stone County Potential for Successful Wastewater Treatment using Conventional Septic Systems by the United States Department of Agriculture Soil Conservation Service, Soil Survey of Stone County, Missouri



METHODOLOGY

The methodology for this Demonstration Project included Site selection, determination of appropriate alternative systems needed for the site, installation of the system as well as monitoring components and monitoring of sites to show indication of performance.

Site Selection

Sites were chosen for on-site demonstration based on specific criteria and surveys of individual homeowners. Press releases advertised the Project seeking to cost share on remediation of failing septic systems for area homeowners. Once individuals applied to be a part of the project, TRLWQ staff visited homeowners and conducted extensive site visual evaluations to obtain an indication of the environmental need at the site and the interest level of the homeowner or property owner. The staff also assessed the level of cooperation this individual exhibited and their level of enthusiasm for maintaining the system, a critical component to any on-site wastewater treatment system. In addition to these criteria, the property was evaluated to determine if there was adequate area to install a septic system with an appropriately sized leach field. Some homeowners surveyed, especially those in resorts or subdivisions with highly desirable lake frontage, did not have a large enough yard or land area to install and adequate sized treatment system. The only solution for this problem would be a cluster system where several homeowners in the area cooperated to install a larger system on shared land, a very improbable prospect.

System Selection

Drip irrigation was considered the best management practice for wastewater systems in the Table Rock Lake are due to the fact that this treatment design not only pre-treated the septic effluent using aeration and micro biotic activity, but also dispersed the liquid effluent over a wider area allowing for maximum absorption by the thin soils. However, as the project developed, it was determined that the thin soils that existed around the Table Rock Lake area were often not adequate for filtering the wastewater even from drip dispersal. Therefore, soil was imported to the site to create adequate filtration and absorption of the effluent.

Installation of system

Installation was sub-contracted to a septic system installer and excavator with specific installation instructions and plans. Figure 2 shows a drip dispersal field being installed on imported soil. Figure 3 is a closer view of the drip tubing that disperses the liquid into the field and the return lines for the recirculation of the liquid.

Figure 2 – Drip dispersal lines being installed in imported soil and covered with soil layer

Figure 3 – Drip dispersal lines and return lines being installed

There were 4 basic components of the alternative drip irrigation system: the main septic tank that receives the raw waste, and an additional tank to house the biomat and microbiotic aeration chamber through which the liquid flowed and organic components consumed, the holding tank with a pump for dispersal into the drip field and the drip tubing and return lines. Figure 4 shows the tops of a system after it has been installed, but the soil and vegetation has not been replaced. Figure 5 shows a biomat media, foam cubes, for the microorganisms to grow on in one of the biological reaction chambers.

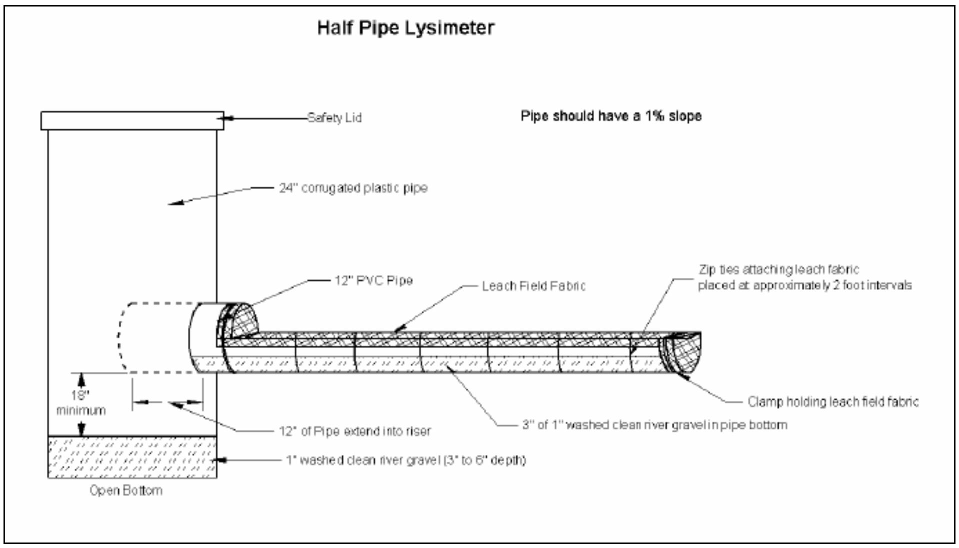
Figure 4 – Tank installation for a drip dispersal system

Figure 5 – Microbiotic biological reaction chamber media, foam cubes

Monitoring

For the monitoring component of the Demonstration Project a 12-inch lysimeter and a lateral sampling line unit was installed underneath drip lines to collect subsurface water samples in the drip field. Other 12-inch lysimeter and lateral sampling line units were used as 'control' units installed away from the dispersal field. The control units provided subsurface water samples that did not contain wastewater discharged through the drip field. Figure 6 shows the design of the 12-inch lysimeter and lateral sampling line used in this monitoring project.

Figure 6 – Sketch of 12-Inch Lysimeter (Midwest Environmental Consultants, 2001)



Figures 7 and 8 illustrate the basic concept and design of the 12-inch lysimeter. A section of 12-inch pipe was cut in half lengthwise to create a trough. The section of pipe that went into the riser was left solid as shown below. The total length of the trough was approximately 15 to 20 feet in length. The riser was constructed of 24-inch corrugated plastic pipe and installed at the edge of the drip field so the trough could extend into the field. The location was placed to be representative of the entire drip field.

Figures 7and 8 – 12-inch Lysimeter installation

RESULTS AND LESSONS LEARNED

The major result of this project has been a change in the way on-site septic systems are installed in southwest Missouri as well as a change in general public perception about the use of alternative on-site wastewater systems for the Table Rock Lake area. In the past these systems were not widely accepted as feasible or practical and contractors in the area did not install these systems. Even those few installers that had some experience with drip irrigation systems did not generally work with imported soil as done in this Project.

Another result which is ongoing and will be seen in future reports is the acquisition of data on the effectiveness of these types of systems for treating wastewater effluent. This data is being collected from the lysimeter sampling systems installed throughout selected on-site drip system sites. This data will help provide regulatory agencies with information and sound evidence to accept these alternative systems as standard rather than experimental.

This project has also provided a vehicle to remove the responsibility of maintenance and ownership of these on-site systems from the developer and homeowner to ensure proper operation and maintenance by forming the Ozarks Clean Water Company. Advanced wastewater systems had received a bad reputation in the past due to system failure when in reality the failure was on the part of the property owner to maintain the system. If we are to improve water quality with advanced treatment wastewater systems we must insure these systems will be maintained in proper working order.

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