

# *GIS Mapping of Surface Discharge Septic Systems*

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# Introduction

- Thanks to the Illinois Water Conference
- Thanks to the sponsors of the event
- Personal Info



# Presentation Outline

- I. EPA rulings on Decentralized Waster Treatment
- II. Problems With Surface Discharge Septic Systems
- III. Illinois Private Sewage Disposal Code
- IV. New Possibilities With Technology
- V. Designing a Surface Discharge Geographic Information System
- VI. Future Of Septic Regulation

# Terminology

- Decentralized Wastewater Treatment Systems
- Onsite Wastewater Treatment Systems
- Onsite Sewage Disposal System
- Septic Systems
- Surface Discharge Systems

# EPA and Decentralized Waste Treatment

- 1997 Response to Congress on Use of Decentralized Wastewater Treatment Systems
- Clean Water State Revolving (CWSRF)/319 Funds
- National Pollution Discharge Elimination System (NPDES)/Municipal Separate Storm Sewer System (MS4) Permits
- Ground Water Rule (GWR)

# EPA and Decentralized Wastewater Treatment Systems

- In 1997 the EPA released the Response to Congress on Use of Decentralized Wastewater Treatment Systems
- The Document listed some of the strengths and weaknesses of Decentralized Wastewater Treatment Systems
- The Document outlined steps to address Decentralized Wastewater Treatment System problems

# Decentralized System Benefits

- Decentralized systems can protect public health and the environment
- Typically have lower capital and maintenance costs for rural communities
- Appropriate for varying site conditions
- Suitable for ecologically sensitive areas when adequately managed.

# Decentralized System Detriments

- Lack of awareness about system maintenance requirements
- Public misperception regarding system performance and capability
- Regulatory and legal constraints,
- Lack of management,
- Fear of liability (financial disincentive for engineering consultants, and financial constraints.)

# EPA Strategic Goals and Actions to Meet the Challenges

- 1) Strengthened internal and external partnerships
- 2) Improved system performance through improved practitioner competency, management practices, and technology transfer,
- 3) Improved accountability, control and oversight through enhanced state and local program implementation and regulatory reform
- 4) Improved local decision-making through improved public awareness.

# Other Recent Developments in Decentralized Wastewater Treatment System Regulation

There have been other developments over the last decade that indicate a heightened interest in decentralized wastewater treatment systems. Here are some highlights.

# Clean Water State Revolving Funds (CWSRF)

- The general authority for the CWSRF program is stated in section 601(a) as “a water pollution control revolving fund for providing assistance...(2) for the implementation of a management program established under section 319 of this Act...”
- Publicly Owned Water Treatment Systems were the most common recipients of CWSRF funding

# Policy Memo CWSRF 00-4

- An EPA policy memorandum from 2000 discussed using Clean Water State Revolving Funds to Solve Nonpoint Source Problems with Point Source Solutions. The memo states, “public ownership is not required for the smaller cluster treatment technologies employed in onsite, decentralized systems where the state determines that the decentralized solution is protective of human health and the environment, and where operation and maintenance is assured.”

# Significance of the Memo

- The memo continues, “failing onsite septic systems which are causing NPS problems could be funded with CWSRF loans to individuals.” While projects to install new systems in areas without existing development are ineligible, management plans for existing failing systems that incorporate point source technology can use CWSRF loans.

# A Recent Web Seminar Series Addressing CWSRF Loans

- The EPA submits evidence of environmental health needs to Congress to receive funding for various programs. The series talked about needs categories that would be reported to congress for fund requests. The seminar reported that a new category had been created for septic system needs, category XII Decentralized and Onsite Systems (public and private).

# The National Pollution Discharge Elimination System

- “Under the NPDES Program, all facilities which discharge pollutants from any point source into the waters of the United States are required to obtain an NPDES permit.”
- EPA Region 2 is changing statutory language in order to include septic systems in illicit discharge detection and elimination (IDDE) management plans.

# New Statutory Language

- *b. Develop, implement and enforce a program to ensure that onsite wastewater treatment (septic) systems are inspected and where necessary, maintained or rehabilitated at a minimum frequency of once every three years. Program development shall include the establishment of the necessary legal authority to implement the program.*
- Elizabeth Dietzmann, an environmental law attorney, comments that the permit essentially requires, “that MS4s (Municipal Separate Storm Sewer System) become management entities for onsite septic systems.”

# Meaning of MS4

- Municipal separate storm sewer system...is easier to understand if we break it down. First, separate storm sewer system includes ditches, curbs, gutters, storm sewers, and similar means of collecting or conveying runoff that do not connect with a wastewater collection system or treatment plant.
- And to be a "municipal separate storm sewer system" (MS4), the system must be owned or operated by a public agency—for example: a city or town, a municipal utility district, flood control district, or other special district, a county, or a state or federal agency.”  
([www.tceq.state.tx.us/permitting/water\\_quality/stormwater/WQ\\_ms4\\_definition.html](http://www.tceq.state.tx.us/permitting/water_quality/stormwater/WQ_ms4_definition.html))

# Section 319, NPDES, Pointsource, Nonpoint Source

- Interestingly, while the Section 319 and NPDES both address water quality, they approach it from different perspectives. Section 319 deals with non-point source pollution while MS4 permits under the NPDES addresses point source pollution.

# EPA Definitions of Nonpoint Source and Point Source Pollution

- “NPS pollution is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, coastal waters, and even our underground sources of drinking water.” Among the examples the EPA gives on this page is, “bacteria and nutrients from livestock, pet wastes, and faulty septic systems.”

<http://www.epa.gov/owow/nps/qa.html>

# Point Source Pollution

- Point source pollution is pollution from a specific source. For example, we know that mining from runoff is point source, outfall pipes are a point source.

([Http://yosemite.epa.gov/R10/ECOCOMM.NSF/b724ca698f6054798825705700693650/1ae69a9b5833e60a882571f100833f42?OpenDocument](http://yosemite.epa.gov/R10/ECOCOMM.NSF/b724ca698f6054798825705700693650/1ae69a9b5833e60a882571f100833f42?OpenDocument))

# Where Do Septic Systems Fit?

- Septic systems begin to blur the lines between point and nonpoint source pollution. On the one hand, each system has a discharge point. On the other hand, an aggregation of septic systems viewed from the perspective of a state or regional agency could argue that septic systems produce nonpoint pollution.
- What's important to remember is that both NPS and PS programs are looking to regulate decentralized waste systems

# Other Programs Related to Decentralized Systems

- In the Ground Water Rule Summary the EPA explains, “EPA is promulgating the GWR rule to provide for increased protection against microbial pathogens, specifically viral and bacterial pathogens, in public water systems that use ground water sources. EPA is particularly concerned about ground water systems that are susceptible to fecal contamination because these systems may be at risk of supplying water that contains harmful microbial pathogens.”

# GWS, Fecal Coliform and Decentralized Waste

- Since fecal coliform is one of the most common contaminants associated with surface discharge septic systems promulgators of the ground water rule will work with decentralized waste systems in monitoring and evaluating ground water systems.

# Increased Interest In Decentralized Wastewater Treatment Systems

- Increased information about faulty systems and resulting health affects have compelled government and health officials to act
- Powerful data systems, especially Geographic Information Systems, have finally made it possible to monitor and evaluate surface discharge systems and their pollutants.
- Regulatory possibilities have made surface discharge systems a potential source of revenue for environmental and public health agencies

# Problems with Private Sewage Disposal Systems

- Salvato
- Marshfield Medical Research Foundation
- U of I Extension
- Illinois Surface Discharge Data

# Salvato Says About Sewage

- Improper disposal of human excreta and sewage is one of the major factors threatening the health and comfort of individuals in areas where satisfactory municipal, onsite, or individual facilities are not available.”
- 5 to 10 percent of the population carries *Entamoeba histolytica*, which causes amebic dysentery and 25 percent of the population are carriers of ascarid, hookworm, or tapeworm
- Areas that have primitive sewage systems have rates of parasitic infection rates of 50 percent.

# Marshfield Medical Research Foundation

- A 1997-1998 study by Marshfield Medical Research Foundation in Wisconsin found that illegal wastewater disposal was the major cause for an unusually high number of viral diarrhea
- Their data showed a 22% increase in viral diarrhea cases for each holding tank added to a 40-acre area

# U of I Extension Says

- A news release from the University of Illinois Extension discussed a survey of surface discharge systems in Illinois that found 20 to 60 percent of the systems fail in Illinois depending on region
- Duane Friend, U of I extension natural resources educator, says, "While they do provide a viable option for wastewater treatment in areas where conventional septic systems will not work, surface discharge systems can pose a threat to human health if they are not properly maintained."

# Surface Discharge in Illinois

- The Private Sewage program collected data from the years 1996-2002 in order to estimate the number of surface discharging systems in Illinois. The estimate for that period was around 140,000 systems. Now the total number of systems may be closer to 170,000. These estimates are for new permits issued by the state, they do not include already existing systems. Due to the sheer number of individual systems in Illinois there is very little regulatory follow up to these systems.

# More Studies...

- A study of aeration-type waste-water treatment systems in southwestern Illinois' sinkhole plain found that those (surface discharge) systems “can be a significant source of Na<sup>+</sup>, Cl<sup>-</sup>, nutrients, and bacterial contamination to ground water in areas with highly vulnerable aquifers.”

# Illinois Private Sewage Disposal Code

- Protecting the health of Illinois Citizens
- Promoting innovation in sewage treatment
- Monitoring surface discharge systems
- Effluent classes
- NSF/ANSI Standard 40
- Systems that produce class one effluent

# Illinois Private Sewage Disposal Code

- Class 1 Effluent, determined by ANSI/NSF Standard 40, can be discharged three different ways.
  - A. It can be discharged into a receiving stream, lake, or pond which provides greater than 5 to 1 dilution of the effluent.
  - B. It can be discharged into a common collector.
  - C. It can be discharged to the ground surface where surface discharge points average no greater than 1 per acre.

# Systems Producing Class 1 Effluent

- There are several types of systems that produce Class 1 Effluents.
  - A. Buried sand filters
  - B. Recirculating sand filters
  - C. Waste stabilization ponds
  - D. Aerobic treatment systems.

# What Constitutes Class 1 Effluent?

- NSF/ANSI Standard 40 determines the class of an effluent
- Standard is based on MCL of contaminants found in sewage

# Other Surface Discharges

- Sewage discharges in Illinois that aren't class 1 effluents are illegal, often called “wildcat systems”
- They pose a serious problem to public health and safety
- They are very hard to regulate due to the vast number of systems spread out over such a large area

# Possibilities with Geographic Information Systems

- GIS benefits
- Meet EPA decentralized goals
- GIS software
- Examples of successful GIS projects

# Why GIS?

- It allows the collection and processing of massive amounts on information
- Information can be distributed to the public easily
- Can cut down on busy work in public agencies
- Facilitates a spatial understanding of information
- Increases efficiency of public administration, especially with environmental issues

# Strategic Goals and Actions Facing Public Sector Management Information System

- 1) Strengthened internal and external partnerships
- 2) Improved system performance through improved practitioner competency, management practices, and technology transfer,
- 3) Improved accountability, control and oversight through enhanced state and local program implementation and regulatory reform
- 4) Improved local decision-making through improved public awareness.

# GIS Options

- There are many GIS software providers.
- ArcGIS is GIS propriety software, also the most widely used product
- There are also Open Source options such as Quantum GIS
- Wikipedia has a neat page of many GIS software providers, both proprietary and Open Source
- For this presentation I researched ArcGIS and Quantum GIS software

# ArcGIS

- Product of ERSI
- Most widely used and known GIS
- Excellent support and training available
- Very expensive
- More cataloging capabilities
- Regional offices all around the US
- Many state and federal agencies already have license agreements with ESRI

# Quantum GIS

- Open Source GIS system
- Inexpensive, often free
- Can use data from ISGS, USGS, US Census
- Can visualize coordinate data from a GPS system
- May not be as easy to import addresses that proprietary software
- Less training and support available for agencies

# Using GIS to Monitor Private Sewage: Three Examples

- Lake County, Illinois Surface Discharge Septic Systems GIS
- Zanesville/Muskingum County Health Department Ohio
- Hamilton County Environmental Priorities Project

# Lake County Surface Discharge GIS System

- Lake County has mapped 16,540 private sewage systems
- Uses Property Identification Number (PIN) to create point shapefile
- All surface discharge units are more accurately mapped with latitude and longitude coordinates-staff is collecting the data for each sample site with a landscreener
- Surface discharge layer is helpful in monitoring non-community wells and possible septic failures
- The Department is considering using GPS units to map even more accurately surface discharge systems

# Attributes of a Surface Discharge Database

- Type of System
- UV Disinfection
- Chlorine Disinfection
- Aerobic Unit
- Peat Filter
- Sand Filter
- Textile
- Wetland Constructed
- If There is a Yearly Sample
- Address, PIN, Owner Name

# Zanesville/Muskingum County Health Department

- Used ArcGIS 9.0 Software
- Utilized Microsoft Access database of sewage treatment system information
- First attempt was made to the address point files in order to place points as close as possible to actual systems
- Systems unable to match with point files were geocoded to the centerline file to approximate location
- A sketch of properties was included in the sewage treatment database for more accuracy

# Results of Project

- Of 10,426 systems, 8,386 (80.4%) were geocoded to the address point file, 1,801 (17.3%) were geocoded to centerline file and 239 (2.3%) couldn't be geocoded
- Private sewage layer was added to soil types, land contours, land parcels, flood plains and orthophotography
- Information was made accessible to appropriate environmental health staff
- Access to the various layers makes site assessments easier for sanitarians, especially for new sewage treatment systems

# Hamilton County Environmental Priorities Project

- One of the Primary Accomplishments: acquire or link a large amount of water quality data sets from diverse sources and, in turn, share them with the community using a geographic information system (GIS)
- Graphic illustration of GIS mapping on website-layers of failing private sewage systems, fecal coliform information, population, income, and combined and sanitary sewer overflows together help track private sewage effects, problem areas, environmental justice, etc...

# Keys of GIS Layering

- Collect as much data as possible in order to gain a better understanding of the public and environmental health
- Coordinate with other organizations and share data-data is more valuable when combined with other data
- Use this data to make sound monitoring, evaluation, and regulatory decisions

# Geographic Information Systems for Local Health Departments (LHD)

Several Keys to Success:

- Training rooted in problems specific to LHD-  
Staff should require training specific to problems faced on a daily basis
- Require LHD to develop a project with a timeline using GIS-  
This activity helped staff to begin considering how they could apply GIS on familiar projects, solidifying participant understanding of GIS concepts

# More Keys...

- Provide ongoing technical support for staff

Giving LHD staff the opportunity to work with a GIS technician in a familiar computing environment based on the LHDs specific database and equipment. It also informed technicians what concepts were retained and which weren't

- Provide subgrants to allow LHDs get past software and hardware constraints-

Additional resources were needed for LHDs one the initial hardware and software was purchased

# More Keys...

- Develop a network of relationships among LHDs and other professional GIS users-

LHD staff working in similar fields helped train each other. Building relationships with GIS professionals and other county agencies was also helpful

- Senior Leadership at LHDs who were supportive of the professional development activities by staff-

Greater understanding and involvement on the behalf of management lead to increased resource contribution to the project and beneficial data management practices

# Future

- Funding
- Government (Local, State, and Federal)
- Private Sewage Regulation

# Funding Issues: NPDES

- In 2007 EPA proposed an NPDES fee incentive for Clean Water Act (CWA) Section 106 grants.
- Fee is designed to provide financial incentive to States to utilize an adequate fee program when implementing an authorized NPDES permit
- The Association of Washington Cities believes this proposal “strongly suggests that EPA plans to discontinue funding for state NPDES programs in the future

# Funding Issues: CWSRF

- CWSRF can go in different directions
- Slumping economy may affect ability of municipalities and community members to pay off loans
- Slumping stock market may encourage investors to seek out “safer” municipal bonds, providing more infrastructure investment

# Near Future Government

- Governments will be looking for ways to be more efficient with less money
- GIS capabilities will become *very* valuable in government agencies

# Governments That Don't Adapt...

- Will spend more time collecting data than using it to generate meaningful information
- Will make decisions with less information than agencies with GIS
- Will become more dependent on the Federal Government for regulation

# Local Governments Must Take the Initiative

- Convince local leaders that GIS technology is important for regulation
- Acquire proprietary GIS software license agreements, learn the possibilities of open source GIS
- Train staff in GIS software applications
- Provide information to the public whenever possible-(to avoid unnecessary political obstacles)
- Build relationships with public, increase “sewage awareness” in the community

# Critical Stage in Regulation for Private Sewage

- Political and economic values will become very prevalent in the next few years (accountability, regulation, revenue generation)
- Homeowners with private sewage systems are prime targets for regulators (Federal, State and local)
- Technology can facilitate increased public participation in public affairs
- Sewage and infrastructure are keys to have an advanced civilization

# Finish



