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The Honorable Michael B. Coleman
c/o Policy Unit
City of Columbus
90 W. Broad St.
Columbus, Ohio 43215

Dear Mayor Coleman:

I am writing to comment on the proposed Columbus Metropolitan Facilities Plan Update. This is an important opportunity to incorporate advances in wastewater treatment research and development to reach the national and state goals of eliminating the discharge of pollutants to our navigable waters. Information on these advances will help shape the public policy and land use planning decisions that you and other elected officials are charged with making. Changes in the way we view future development of environmental infrastructure will also likely improve the "livability" of the City of Columbus.

As shown in my Vita, I have twenty years of experience helping local officials learn more about wastewater treatment so they are better prepared to make the difficult and expensive decisions they must make. My first career accomplishment was working with a central Iowa community in the late 1970's. This community now serves as a national model providing wastewater treatment services to protect the environment while both stimulating desired development patterns and saving the community money.

To help engineers, planners, regulators, and decision makers better understand the details and application of newly developed and proven wastewater treatment technologies, I have authored a series of award-winning design manuals for Ohio.

Bulletin 860	Reuse of Reclaimed Wastewater Through Irrigation for Ohio Communities
Bulletin 813	Mound Systems for On-Site Wastewater Treatment
Bulletin 876	Sand Bioreactors for Wastewater Treatment

Drawing from my research and educational programs on wastewater treatment, I can offer some insights into how you can develop a plan to meet the needs of the Columbus Metro Area. My comments address Sections II and III of your proposed plan.

Land application of wastewater is a well established wastewater technology that is currently underutilized in Ohio. Since land application to reuse wastewater offers some real opportunities to both eliminate the discharge of pollutants to waterways and preserve open space in developing communities, it is being proposed for many situations in Ohio.

To ensure that wastewater reuse systems are viable for decades and protect public health and the environment, I have published Bulletin 860. This manual addresses proper siting, sizing, application rates, storage, management, and monitoring for safe application in Ohio. Fortunately, wastewater reuse through irrigation has been used in Ohio and surrounding states in a few communities for up to 30 years. I was able to incorporate their experience into the technical recommendations put forward by The Ohio State University.

People are understandably worried about over application of wastewater in irrigation systems. The recommended application rates in Bulletin 860 take into account wetter than average years to avoid over application. The oldest systems in Ohio were designed with average years in mind. Now 20 to 30 years later they do have to over apply wastewater in wetter than average years. This has yielded some valuable information about the impact of over application and those impacts are different from what most people expect. Over application does <u>not</u> result in discharge of pollutants to streams even through subsurface tile drains. It does result in puddles and puddled, stagnant water presents the potential for odors. Excess water also overwhelms plants which can reduce crop yields.

One important misunderstanding about wastewater reuse systems is the impact of irrigation of fields with subsurface drainage ("tile") systems. Much of Ohio's agricultural land is drained to lower a seasonal high water table a foot or more to below the active root zone of plants. As recommended in Bulletin 860, a minimum of one foot of unsaturated soil is needed to reuse and disperse treated wastewater. Therefore, wastewater <u>can</u> be safely reused on fields with agricultural drainage systems. In fact, both the oldest and the largest reuse systems in Ohio are on fields with subsurface drainage systems. Both of these systems hold NPDES permits, monitor the quality of the tile flow, and report it to the Ohio EPA. Fortunately, no water pollutants have moved into these subsurface drains from these reuse systems and they do indeed protect Ohio's streams.

Routine monitoring of subsurface drains remains an important management tool to protect the environment. Through simple, inexpensive tests a wastewater reuse system can guard against "renegade" connections of untreated sewage directly to subsurface drains that flow to streams. Property owners are sometimes tempted to avoid the expense of wastewater treatment and make "direct" connections to a nearby pipe that flows away to a ditch or stream. I might point out that this is a problem in the "sewered" areas of Columbus where people discharge polluted water into the city's storm sewers.

All reused wastewater must first be treated before irrigation. Fortunately, the level of treatment is different than for stream discharge systems. Components of wastewater that are water pollutants, like ammonia or organic matter, are not soil pollutants. Organic matter and ammonia are nutrients in soil not pollutants. Therefore, wastewater treatment systems that may not be appropriate for stream discharge, like lagoons, are the most appropriate for wastewater reuse. Not only do lagoons provide an appropriate level of treatment for reuse systems they also provide the necessary seasonal storage. Mechanical treatment plants, that have high energy and labor requirements, are a poor choice for wastewater reuse systems. In fact Bulletin 860 only recommends using mechanical treatment plants in reuse systems, with the added necessary storage, if a community already has one.

I am glad that onsite wastewater treatment systems were included in the plan. Extension of sewers to serve every dwelling and building in the Columbus area is not only extremely expensive, it is not compatible with the retention of open space in a livable community. Carefully matching the natural soil resources with appropriate treatment technologies is the underlying principle in my teaching and research.

Unfortunately, the systems currently used and proposed for use for onsite wastewater treatment in Franklin County do not match the soil natural resource and therefore fail to protect the public health and the environment. I would encourage you to adopt research-based, appropriate technologies in your plan. I recommend these include:

1. Septic tank-soil absorption systems in deep, permeable soils
2. Mound systems (Bulletin 813) in shallow, permeable soils
3. Sand bioreactors (Bulletin 876) in very shallow soils with onsite irrigation (Bulletin 860)
4. No onsite wastewater treatment in hydric soils

One key element to the success of all wastewater treatment systems is proper management. No maintenance-free systems exist! The mechanical treatment plants with stream discharge demand the most management. Highly skilled, attentive operators, constant electrical demand, and sludge management is required on a daily basis for all mechanical systems. This is true whether the plant serves thousands of homes, dozens of homes, or only one home.

Columbus chooses to provide this necessary, intensive level of management for the large, mechanical treatment plants serving the city. However, Columbus does not provide this same necessary level of management for the small and individual aerobic systems used in the city, so it is no wonder they fail to operate. The annual inspections you propose in your plan for home aerobic units is not enough. The current research shows that even two mandatory inspections per year with mandatory maintenance contracts is not enough. If you select mechanical treatment systems in your plan, regardless of size, you must include the provisions for daily maintenance.

Other treatment technologies require less management, and I would urge you to specify those in your plan. Sand bioreactors for one or a group of homes require much less attention, only a small amount of electricity, and produce no sludge. Most importantly, if neglected, they "back-up" making them fail-safe. The negligent operator is penalized, not the environment. Even wastewater reuse systems require management. The requirements are lower and are different than for stream discharge systems.

Ensuring the necessary management in the Columbus area plan is your biggest challenge. Right now, the public policy is only directed toward systems that discharge to streams. Operating permits with all of their management requirements are issued by the Ohio EPA as NPDES permits. To ensure ongoing, proper management, public policy will have to grow to include new technical advances such as operating permits for non-discharging systems. Columbus can take the lead in showing other Ohio communities and the Ohio EPA how it can and should be done.

I have recently visited other communities in the United States that have managed non-discharging systems for 20 to 30 years. Their success can help Columbus build a model wastewater management program.

Sincerely,

Karen Mancl, Professor and
Water Quality Specialist

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Enclosures

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Morrone, M. K. Mancl, K. Carr. (in press) Development of a Metric to Test Group Differences in Ecological Knowledge as One Component of Environmental Literacy. Journal of Environmental Education.

Mancl, K. M. Vollmer. (in press) Management of Individual Mechanical Sewage Treatment Systems – How Much is Needed? Journal of Environmental Health.

Jones,D. G. McCluer, K. Mancl, T. Mescher 2000. Neighbor Attitudes About New or Expanding Livestock Facilities in Rural Ohio. Swine Housing Conference. ASAE, St. Joseph, MI.

Liu, Q., K. Mancl, O. Tuovinen. 2000. High Fat Wastewater Remediation Using Layered Sand Filter Biofilm Systems. Proceedings of the International Symposium on Animal, Agricultural and Food Processing Wastes. ASAE St. Joseph, MI.

Xi, J. K. Mancl, O. Tuovinen. 2000. Biological Treatment of Cheese-Processing Effluents with Gravel/Sand Filtration. Proceedings of the International Symposium on Animal, Agricultural and Food Processing Wastes. ASAE St. Joseph, MI.

Liu, Q., K. Mancl and O. Tuovinen. 1999. Study of the use of fine media biofilm reactors to renovate high fat wastewater. Small Flows Journal. 5(1):4-11.

Mancl, K. 1999 Survey of Permitting Practices for Onsite Sewage Treatment Systems in Ohio. Ohio Journal of Science. 99(3):38-43.

Mancl, K., K. Carr and M. Morrone. 1999 Environmental Literacy of Ohio Adults. Ohio Journal of Science.99(3):57-61.

Mancl, K. 1999. Septic Tank. Encyclopedia of Environmental Science. Kluwer Academic Publ. Hingham MA. P. 558.

Mancl, K. 1999. Sewage Treatment. Encyclopedia of Environmental Science. Kluwer Academic Publ. Hingham MA. P. 559-561.

Lagucki, T. and K. Mancl. 1999. Dry hydrants provide fire protection in rural areas. Tree Farmer. May/June p. 26-27.

Liu, Q., K. Mancl, and O. Tuovinen 1998. Effect of Inoculation on the Formation of Aerobic Biofilms to Degrade Butterfat/Detergent Mixtures. Bioresources Technology.64:27-32.

Liu, Q., K. Mancl and O. Tuovinen. 1998. Removal of Butterfat COD and BOD5 in Inoculated Sand Columns. Applied Engineering in Agriculture. 14(3):287-291.

Peeples, J. and K. Mancl. 1998. Laboratory Scale Septic Tanks. Ohio Journal of Science. 98(4/5):75-79.

Mancl, K., B. Forintos, J. Sticha, C. Johnson, P. Liepold, H.B. Calvert and B. Leonard. 1998. Working Effectively With Small Communities. Proc. of the 8th National Symposium on Individual and Small Community Sewage Systems ASAE.

Liu, Q., K. Mancl, and O. Tuovinen. 1998. Biodegradation of Butterfat Supplemented with Surfactant and Detergent Formulation in Bench-Scale Sand Column Biofilm Systems. Proc. of the 8th National Symposium on Individual and Small Community Sewage Systems ASAE.

Mancl, K. 1998. Educational Program in Wastewater Treatment for Public Officials. Proceedings of North Carolina 14th Annual On-site Wastewater Conference. NCSU Raleigh. Pp. 60 - 64.

Mancl, K. 1998. Wastewater Pretreatment Systems. Proceedings of North Carolina 14th Annual On-site Wastewater Conference. NCSU Raleigh. Pp. 65-68.

Mancl, K. and D. Rector. 1998. Discharge vs. Irrigation: Benefits abound for recycling treated wastewater. Resource. 5(5):12 and 22.

Mancl, K. 1997. Our Dairy Farms Run on Water. Hoard's Dairyman. 4 pages.

Mancl, K. 1997. Quality Water for Home and Farm. Ohio Veterinary Medical Association Annual Meeting. pp. 209-224.

Mancl, K. 1996. Water Quality Distance Education Program For County Extension Agents. Ohio Journal of Science. 96(4/5):89-92.

Mancl, K. and G. LaBarge. 1996. Educating Youth in Water Quality Land Use Principles Through Outdoor Education. Ohio Journal of Science. 96(1):23-26.

Mancl, K.M., M.A. Veenhuizen, and M. Watson. 1996. Educating County Extension Agents in Waste Management. Applied Engineering in Agriculture. 12(4):501-507.

Widrig, D., J. Peeples and K. Mancl. 1996. Intermittent Sand Filtration for Domestic Waste Water Treatment: Effects of Filter Depth and Hydraulic Parameters. Applied Engineering in Agriculture. 12(4): 451-459.

Mancl, K. 1996. 4 Ways to Improve Water Quality. Country Guide. November 115(11):10-12.

Mancl, K. 1996. Poor Water Quality Chops into Production. Country Guide. October. 115(10): 7-8.

Heimlich, J.E., A. Fentiman, K. Mancl, and R. Christensen. (Accepted for Publication). The Epistemological Basis of Fear Toward Radioactivity. Journal of Environmental Education.

Wagenet, L., K. Mancl, and M. Sailus. 1995. Options for Home Water Treatment. Consumer Research. 78(3):30-35.

Fentiman, A.W., R.N.Christensen, B.K.Hajek, J.E.Heimlich, and K.M.Mancl. 1995. Environmental Engineering Education for the Public. ASEE Annual Conference Proc.

Mancl, K.M. 1995. Water Treatment Options for Dairy Operations. Cornell Nutrition Conference for Feed Manufacturers. Cornell University.

Mancl, K., J.Heimlich, A. Fentiman and R. Chistensen. 1994. General Public Awareness of Sources of Radiation in Their Environment. Ohio Journal of Science. 94(5):134-137.

Wu, J., K.M. Mancl, O.H. Tuovinen. 1994. Biodegradation of Vegetable Oils Using Fixed-Film Systems. Proc. of the 7th National Symposium on Individual and Small Community Sewage Systems ASAE.

Mancl, K. 1994. Needs Analysis Techniques. 17th Annual National Environmental Training Conference.

Hajek, B.K., A.W. Fentiman, R.N.Christensen, K.M.Mancl and J.E. Heimlich. 1993. Development of Unbiased Educational Materials for the General Public - Identifying the Stakeholders and Making Effective Use of ALL Their Opinions. 5th Annual US Dept. of Energy Low-level Radioactive Waste Management Conference.

Mancl, K. 1993. Improving Small Community Wastewater Treatment. Journal of Extension. Winter, pages 24- 26.

Veenhuizen, M.A. and K.M. Mancl. 1993. Educating County Extension Agents in Mechanical Ventilation. Applied Engineering in Agriculture. 9(5):469-477.

Mancl, K. and M. Veenhuizen. 1993. Dealing With Waste Management and Related Issues - A Perspective from Other Midwestern States. Proc. of Livestock Waste Management Conference. University of Minnesota. pp. 14-18.

Veenhuizen, M. and K. Mancl. 1993. Ohio Experiences Related to Political and Social Issues of Animal Waste Management. Proc. of Livestock Waste Management Conference. University of Minnesota. pp. 133-138.

Mancl, K.M., M.A. Veenhuizen, and M. Watson. 1993. County Extension Agent Training in Waste Management. ASAE Paper No. 93-5509.

Veley, R.J. and K. Mancl. 1993. Water Systems for Small Communities - A Workshop for Local Officials. ASAE Paper No. 93-2532.

Mancl, K. 1993. Education County Extension Agents in Water Quality Through Distance Education. Proc. Water Resources Education: A Lifetime of Learning. American Water Resources Association.

Mancl, K. and M. Eastridge. 1993. Approaches for Handling Problems with Water Quality. Proceedings of Tri-state Dairy Nutrition Conference. Ohio State Univ., Michigan State Univ., and Purdue Univ. pp. 75-85.

Veenhuizen, M.A. and K.M. Mancl. 1992. Inservice Curriculum in Ventilation for County Agents. ASAE Paper No. 92-5529.

Mancl, K. 1992. Small Community Needs Assessment and Planning. Small Community Involvement Conference, Water Environment Federation.

Gerber, D., K. Mancl, M. Veenhuizen and G. Shurson. 1991. Ammonia, Carbon Monoxide, Hydrogen Sulfide and Methane in Swine Confinement Facilities. Compendium on Continuing Education for the Practicing Vetrinarian. 13(9):1483-1489.

Miller, M. and K. Mancl. 1991. The Readiness of Community Leaders to Learn About Wastewater Treatment Alternatives. Proc. of the 6th National Symposium on Individual and Small Community Sewage Systems ASAE.

Peeples, J., K. Mancl and D. Widrig. 1991. Intermittent Sand Filter Treatment Efficiency as it Relates to Media Depth, Infiltration Rate, and Detention Time. Proc. of the 6th National Symposium on Individual and Small Community Sewage Systems ASAE.

Mancl, K. and J. Peeples. 1991. One Hundred Years Later: Reviewing the Work of the Massachusetts State Board of Health on the Intermittent Sand Filtration of Wastewater from Small Communities. Proc. of the 6th National Symposium on Individual and Small Community Sewage Systems ASAE.

Wulfhorst, P. and K. Mancl. 1990. Community Decision Making in Providing Sewer Service to a Rural Area. The Environmental Professional. 12(2): 163-170.

Mancl, K. 1990. A Survey of Small Sewage Treatment Facilities in Ohio. The Ohio Journal of Science. 90(4): 112 - 117.

Mancl, K., W. Sharpe, and J. Makuch. 1989. Educating the Rural Public About Safe Drinking Water. Water Resources Bulletin. 25(1):155-158.

Mancl, K. 1989. Educating Rural Community Leaders in Wastewater Treatment Alternatives. Water Resources Bulletin. 25(5)985-989.

Mancl, K. 1989. National Educational Program in Wastewater Treatment for Small Rural Communities. Proceedings of the National Symposium on Water: Laws and Management. American Water Resources Association.

Gerber, D.B., K. Mancl, and G.C. Shurson. 1989. Gas Levels Survey of Ohio Swine Confinement Facilities. ASAE Paper No. 89-4526.

Mancl,K., S. Patterson. 1988. Management of On-site Sewage Systems at a Lake Development. The Environmental Professional. 10(4):317-325.

Mancl, K. and M. Duffalo. 1987. Circuit Riding for Managing Small Community Sewage Systems. Journal of Environmental Management. 11(2):203-208.

Mancl, K., W. Sharpe, and J. Makuch. 1987. A Groundwater Educational Program - Extension Safe Drinking Water Clinics. ASAE Paper No. 87-5020.

Mancl, K. 1987. Sanitary Surveys for Small Rural Communities. Proc. of the 5th National Symposium on Individual and Small Community Sewage Systems ASAE.

Mancl, K. S. Patterson. 1986. On-site Wastewater Management for a Recreational Lake Development. ASAE Paper No. 86-2136.

Mancl, K. 1986. Water Quality Problems Are Not Uncommon. Hoard's Dairyman. 131(15):702 and 738.

Mancl, K. 1984. Estimating Septic Tank Pumping Frequency. J. of the Environmental Engineering Division ASCE. 110(1):283-285.

Mancl, K. 1984. How to Keep Your Septic Tank Working. Pennsylvania Farmer. 210(1):48-49.

Mancl, K. 1984. Septage--An Overlooked Waste Disposal Problem. Water Pollution Control Association of Pennsylvania Magazine. 17(6):6-8.

Mancl, K. 1984. Sources of Information and Assistance in Water Quality. Forest Management and Water Quality, Proc. of the Penn State Forestry Issues Conference, University Park, PA.

Mancl, K. 1983. Is Your Water Safe to Drink? Pennsylvania Farmer. 209(4):24-25.

Mancl, K., C.E. Beer. 1982. High Density Use of Septic Systems, Avon Lake, Iowa. Proc. of the Iowa Acad. of Science. 89(1):1-6.

Mancl, K., C.E. Beer, S. Patterson. 1982. A Case Study of the Lake Panorama Management District. Proc. of the 3rd National Symposium on Individual and Community Sewage Treatment ASAE. pp.236-239.

Beer, C.E., K. Mancl. 1982. Completion Report - Development of a Countywide Model Management Organization for Wastewater. Iowa State Water Resources Institute. ISWRRI-106, ISD-ERI-Ames 83053.

Mancl, K. 1982. Public Management of On-site Wastewater Treatment Systems in Iowa. Ph.D. Dissertation. Iowa State University.

Mancl, K., C.E. Beer. 1980. On-site Wastewater Management Districts in Iowa. ASAE Paper No. 80-2102.

Extension Publications:

Mancl, K. and A. Bird. 2000. Safe Drinking Water: How Can We Provide it in Our Community? Extension Bulletin 882. The Ohio State University.

Mancl, K. and D. Rector. 1999 Sand Bioreactors for Wastewater Treatment in Ohio Communities. Extension Bulletin 876. The Ohio State University.

Mancl, K. and D. Rector. 1997. Reuse of Reclaimed Wastwater Through Irrigation for Ohio Communities. Extension Bulletin 860. The Ohio State University.

Mancl, K.M., J. Johnson, and M.A.Veenhuizen. 1995. Septage Management in Ohio. Extension Bulletin 854. The Ohio State University.

Wagenet, L., K. Mancl and M. Sailus. 1995. Home Water Treatment. NRAES-48, Northeast Regional Agricultural Engineering Service, Ithaca, NY.

Mancl, K. 1992. Mound Systems: Pressure Distribution of Wastewater. Extension Bulletin 829. The Ohio State University.

Veenhuizen, M.A., D. J. Eckert, K. Elder, J. Johnson, W.F. Lyon, K.M. Mancl, G. Schnitkey. 1992. Ohio Livestock Manure & Wastewater Management Guide. Extension Bulletin 604. The Ohio State University.

Mancl, K., M. Sailus, and L. Wagenet. 1991. Private Drinking Water Supplies ... Quality, Testing, and Options for Problem Waters. NRAES-47, Northeast Regional Agricultural Engineering Service, Ithaca, NY.

Widrig, D. and K. Mancl. 1991. Mound Systems for On-site Wastewater Treatment: Siting, Design, and Construction in Ohio. Extension Bulletin 813. The Ohio State University.

Mancl, K. 1989. Bacteria in Drinking Water. Extension Bulletin 795. Ohio State University.

Mancl, K. 1989. Bacteria in Drinking Water. Extension Slide-Tape Set. Ohio State University.

Mancl, K. 1988. Water Testing. Extension Slide-Tape Set. Ohio State University.

Mancl, K. 1988. Nitrates in Drinking Water. Extension Slide-Tape Set. Ohio State University.

Hanson, R. and K. Mancl. 1988. Modern Composting. Extension Bulletin 792. Ohio State University.

Mancl, K. 1988. Nitrates in Drinking Water. Extension Slide-Tape Set. Ohio State University.

Mancl, K. 1987. Nitrates in Drinking Water. Extension Bulletin 744. Ohio State University.

Ungvarsky, J. and K. Mancl. 1986. Septage Use and Disposal. Extension Circular SC 317. Penn State University.

Ungvarsky, J. and K. Mancl. 1986. Septage Management in Pennsylvania: Permits and Planning. Extension Circular SC 316. Penn State University.

Mancl, K. and R. Kipp. 1986. Wastewater Treatment Alternatives for Small Rural Communities. Extension Slide-Tape Set. Penn State University.

Young, K., K. Mancl, and J. Makuch. 1986. Nitrate and Your Water Supply. Extension Slide-Tape Set. Penn State University.

Mancl, K. and G. Silver. 1986. Nitrates and Families. Television Public Service Announcement. Extension Video Tape. Penn State University.

Mancl, K. and H. Carey. 1985. Septic Tank Pumping. Educational Exhibit. Penn State University.

Young, K. and K. Mancl. 1985. Nitrate: Its Effect on Families and Livestock. Extension Circular 308. Penn State University.

Mancl, K. and H. Carey. 1984. Water Testing--Is Your Water Fit to Drink? Educational Exhibit. Penn State University.

Glanville, T., K. Mancl. 1981. Wastewater Districts in Iowa. Extension Bulletin PM-1028. Iowa State University.

Penn State Agricultural Engineering Fact Sheets.
- SW-16 Removal of Nitrates
- SW-17 Iron Removal
- SW-18 Where to Have Your Water Tested

SW-19 Water Testing
SW-20 Water Softening
SW-22 Giardiasis
SW-40 Septic Tank Pumping
SW-41 Septic System Failure
SW-42 Percolation Tests
SW-43 Mound Systems for Wastewater Treatment
SW-44 Septic Tank-Soil Absorption Systems

Ohio State Agricultural Engineering Fact Sheets.

AEX-740 Septic Tank Maintenance
AEX-741Why Do Septic Systems Malfunction?
AEX-742 Soil Evaluation for Home Septic Systems
AEX-743 Septic Tank-Soil Absorption Systems
AEX-744 Septic Tank - Mound Systems
AEX-750 On-site Wastewater Management
AEX-768 Wastewater Treatment ... Principles and Regulations
AEX-314 Water Testing
AEX-315 Where to Have Your Water Tested
AEX-317 Emergency Disinfection of Water Supplies
AEX-318 Shock Chlorination of Wells and Springs
AEX-420 Water Use Planning Guide
AEX-421 Approaches to Solving Water Quality Problems
AEX- 422 Fire Protection in Rural Areas: Dry Hydrants for Ponds
AEX-423 Drinking Water Regulations
AEX-707 Land Application of Waste ... Spreading and Injection
AEX-708 Avoiding Stream Pollution from Animal Manure
AEX-709 Managing Livestock Waste Facilities... Controlling Crystal Buildup in Recycle Flush System.
AEX-710 Land Application of Livestock Waste ... Legislation, Regulations, Guidelines, and Standards

Management of Individual Mechanical Sewage Treatment Systems - How Much is Needed?

Karen Mancl and Michael Vollmer

Revised 7/2000

Abstract

Over 2600 discharging individual mechanical sewage treatment systems were studied to determine if mandatory maintenance contracts and semi-annual inspections with effluent sample collection is adequate to meet discharge standards. The discharge standards were set at BOD5 of 20 mg/l, total suspended solids of 20 mg/l and fecal coliform bacteria at 400 organisms per 100 mls. In 1997, 67% of the discharging individual mechanical sewage treatment systems in Will County, Illinois were in violation of at least one discharge standard. Overall cost of management, being shared by the homeowners and the county health department ranged from $350 to $725 per year.

Millions of homes in the US are constructed in rural areas beyond the reach of city sewer. Homes in rural areas have traditionally used septic systems to treat and dispose of wastewater. Beginning in the 1970's it was recognized that soil conditions in many rural areas are not suited to wastewater treatment, requiring other alternatives for onsite wastewater treatment and disposal.

One technology emerged to meet this need, known as home aerobic units or individual mechanical sewage treatment systems. These small versions of mechanical treatment plants are manufactured and sold by dozens of US companies.

Concerns surfaced beginning in the late 1970's as to how well these units performed and how much maintenance was necessary. One early study evaluated the use of 36 individual mechanical sewage treatment systems in Boyd County, Kentucky. A licensed sewage treatment plant operator was hired to monitor, service and test all equipment. In a report of the first 5 months of the project, nine of the electric pumps malfunctioned and had to be replaced. Waldorf concluded that engineers and contractors are not yet familiar with these systems, resulting in a wide variety of installation problems (1).

A survey of fifty-four household aerobic sewage treatment units was conducted in Preble County, Ohio in the 1970's (2). They found that 41% of the systems examined had black, odorous and/or turbid effluent upon visual inspection. Ten of the systems were sampled for chemical and biological analysis. Effluents from the systems had BOD5 ranging from 9 to 79.5 mg/l with an average of 30.9 mg/l. The suspended solids ranged from 5.5 to 164 mg/l with an average of 49.2 mg/l. Fecal coliform bacteria was present in all effluents ranging from 35 to 160 organisms/100 mls. Because ammonia is toxic to aquatic life, they also measured ammonia in the effluents which ranged from 7.5 to 94 mg/l with an average of 40.6 mg/l. They found on physical inspection of the systems which ranged in age from 1 to 8 years, that nearly one third had at least one mechanical component that was not functioning.

Hutzler and others (3) summarized many early studies of individual mechanical sewage treatment systems. The mean BOD5 and suspended solids findings for over 1000 samples are presented in Table 1. They went on to present maintenance costs for individual mechanical sewage treatment systems ranging from $65 to $160 per year.

Otis and Boyle (4) evaluated three individual mechanical sewage treatment system designs. They recommended regular maintenance with inspections at least every 2 months. They suggested sludge removal every 8 to 12 months.

Fancy (5) examined the service records for 22 home aerobic units. He found that the oldest units (5 to 8 years old) had the highest maintenance cost averaging $212 per year. The newer units (3 to 6 years old) had an average maintenance cost of $160.

A 1994 program in Hamilton County, Ohio took one step to providing oversight for management of mechanical home aeration systems (6) through an operation permit program. All new and existing systems were required to hold an operating permit where all household sewage disposal systems with electrical components would be subject to annual inspection. Effluent standards were set by the Hamilton County General Health District for the nearly 18,000 systems at BOD_5 at 20 mg/l, suspended solids at 40 mg/l and fecal coliform at 5000 CFU/100 ml.

Systems in Hamilton County receive only visual inspections following 10 criteria ranging from the condition of the lid, motor and filter to the visual condition of the effluent. Effluent samples are not collected during inspections. Permit fees with initial inspection are $30. If a follow-up inspection is necessary, it carries an additional $30 fee. Homeowners with maintenance contract with a registered and bonded company pay only $15 for reinspection. The Hamilton County program has resulted in reduced violations on visual inspections. When the program began, 33% of systems failed the first visual inspection. By 1996, only 6% failed the visual inspection. While individual system effluent was not sampled, the health district collected stream samples at 40 locations in the county beginning in 1997. Results showed high levels of fecal coliform bacteria averaging over 9000 organisms/100 ml, which is almost twice the county's fecal coliform discharge standard set at 5000 org/100ml. Also found were elevated BOD_5 averaging 5 mg/l in stream samples.

Other groups and agencies have set effluent standards for discharging wastewater treatment systems to protect the public health. For example, swimming beaches must be closed if fecal coliforms exceed 500 org/100 ml. The Great Lakes Water Quality Agreement of 1972 has set even more stringent discharge standards for fecal coliform at 200 org/100 ml.

The purpose of this study was to determine if mandatory maintenance contracts and scheduled semi-annual inspections with effluent sample collection is adequate for individual mechanical sewage treatment systems to meet discharge standards. The study discharge standards drew from the experience and recommendations of previous investigators and are specified in the Will County, Illinois sewage treatment and disposal ordinance (7) at BOD_5 of 20 mg/l, total suspended solids of 20 mg/l and fecal coliform bacteria at 400 organisms per 100 mls.

Method

Discharging individual mechanical sewage treatment systems in Will County, Illinois were the basis for this study. Located in northern Illinois, the county has broad expanses of level land, ideal for agricultural production. The soils throughout the county are mostly slowly permeable and poorly drained with shallow depths to groundwater making them poorly suited for soil absorption systems. Large areas of hydric soil are present in the county (8).

Will County lies just south of Chicago and is considered part of the metropolitan area.

The interstate highway system links the county with Chicago, making this rural area attractive to commuters to and from the suburban communities of Naperville and Bolingbrook. The City of Joliet is the county seat and is experiencing a revitalization which some may credit to the construction of two riverboat casinos in the city.

The rural areas of Will County are under the jurisdiction of the County Board, a 25-member elected body, and a County Executive. The 10-member County Board of Health manages the county health department and recommends the budget and necessary rule changes to the County Board.

The management program for individual mechanical sewage treatment system is found in the Will County sewage treatment and disposal ordinance adopted by the County Board in 1996 (7). The framework of the program is outlined in the ordinance.

1. The owner is required to obtain and maintain a service contract from a tested, licensed installation contractor to be in effect at all times.
(at least six installation contractors are licensed to work in the county.)
2. Copies of the service contract are to be supplied to the health authority.
3. Routine inspection with sampling tests at least every 6 months.
4. Provisions for emergency service within 24 hours of notification that the unit is not properly functioning.
5. Each person discharging effluent from an individual mechanical sewage treatment systems must have a valid permit to discharge (these, however, are not NPDES permits).
6. The permit application must be accompanied with an annual $100 fee.

Ten different brands of individual mechanical sewage treatment systems are currently in use in Will County (Table 2). A trash tank, a minimum treatment capacity, final settling chamber, sand filter and disinfection unit are required for all discharging systems. Chlorination is the disinfection approach used throughout the county. Under the code, the system must meet an effluent discharge requirement of 20 mg/l BOD_5, 20 mg/l suspended solids and 400 fecal coliform organisms per 100 ml. All systems must have a warning light or buzzer to warn of electrical or mechanical failure and each property owner must obtain and maintain a service contract.

An individual mechanical sewage treatment system can discharge in 1 of 3 places.

1. Body of water with 5 to 1 dilution. Two discharge points must be separated by 235 feet.
2. A lake or pond with 1/2 acre surface area per discharge.
3. To the ground surface on lots of 1 acre or larger with disinfection into an effluent receiving trench.

Semi-annual inspections of all discharging individual mechanical sewage treatment systems are conducted by 2, part-time samplers employed by the Will County Health Department. Each inspection involves examination of the condition of the physical components, observation of system operation and effluent sample collection. Each inspection takes about 15 to 20 minutes to complete the following tasks. (Pictures of an inspection are included in Figure 1.)

1. Locate home.
2. Take tools and sample bottles out of vehicle.
3. Knock on the door and speak with resident if they answer.

4. Look for evidence of surfacing sewage in yard.
5. Open pump tank, chlorine contact basin or sample collection port.
6. Check for chlorine.
7. Collect sample and fill sample bottles.
8. Label samples and place in cooler with ice packs.
9. Clean/disinfect tools and sampling containers and return to vehicle.
10. Enter observations on inspection form.
11. Leave hang-tag.

From 10 to 20 inspections are conducted early in the day. The samples are packed in ice and taken directly (within 4 hours) to the county health department laboratory for sample analysis. All analysis is conducted following Standard Methods for BOD5, total suspended solids and membrane filtration for fecal coliforms (9).

Results and Discussion

All 2643 discharging individual mechanical sewage treatment systems in Will County, Illinois were sampled at least twice in 1997. System performance was surprisingly poor, even with the special management program. Table 3 revealed that even with mandatory maintenance contracts, a high percentage of systems do not meet discharge standards.

Due to the large number of systems not meeting discharge standards and the variable nature of a sample collected once every 6 months, the county health department has created three categories for taking action to help manage its workload. (1)Systems meeting standards are in compliance. (2)Systems only slightly out of compliance in only one parameter in one sample are deemed satisfactory. (3)Systems with fecal coliforms over 1000 org/100 ml and systems with more than one parameter above the standard are deemed out-of-compliance. About 30% of the systems fall into the out-of-compliance category.

Property owners are notified by letter when their system is out-of-compliance. The letter indicates in what parameters their system does not meet standards. They are instructed to contact their Individual Mechanical Service Contract representative to begin taking corrective actions. If a repair is needed they must obtain a repair permit. Resampling is scheduled to make sure corrections are made.

The penalty provision Section 11 of the Will County Sewage Treatment and Disposal Ordinance (8) classifies a violation of the ordinance as a class A misdemeanor and each day the violation continues constitutes a separate violation. The State's Attorney of Will County brings actions against violators if the effluent consistently falls below standards and the property owners are unable or unwilling to correct their system after a three part enforcement protocol is followed. The first violation results in a letter, the second yields a warning, and the third a complaint. If improvement cannot be achieved through the investigation of the complaint, a court case is initiated. The time from the initiation of a complaint until a court case is filed ranges from one to more than six months depending on the quality of the effluent and the level of cooperation by the property owner.

Financial resources to support the management program are provided by the state and county budgets and permit fees. All homeowners with discharging systems must hold a permit to discharge. An annual fee of $100 covers most of the cost of sample analysis. Salaries and support for 2 part-time sample collectors and administrative staff, estimated from $50 to $60 per inspected dwelling per year, are covered by state and county funds appropriated to the health department. Additional homeowner costs included a service contractor ($200 to $400 per year) and pumping expenses ($150 to $175 in Will County).

Conclusions

Overall the management system was not sufficient to meet discharge standards as evidenced by the high numbers of violations. In 1997, 67% of the discharging individual mechanical sewage treatment systems in Will County were in violation of at least one discharge standard. Even with required maintenance contracts, systems were not meeting discharge standards. Overall cost of management, being shared by the homeowners and the county health department, is already quite high, and ranged from $350 to $725 per year.

The study in Will County indicated either the discharging individual mechanical sewage treatment systems need more maintenance than they currently receive to meet discharge limitations, or the systems are sized inadequately for the homes they are serving. However, it is difficult to speculate how much management would be necessary. Otis and Boyle in 1976 recommended regular maintenance with inspections at least every 2 months and sludge removal every 8 to 12 months. Results from Will County support Otis and Boyle's recommendation for more frequent maintenance and regulatory oversight if existing discharge standards are considered appropriate and kept in place. If more stringent controls are adopted, management costs could be well over $1000 per system annually.

An alternative would be to relax the discharge standards to a level that most systems are meeting and keep inspection costs to a minimum by limiting the inspection program to visual inspections as was done in Hamilton County, Ohio. However, the Hamilton County experience (6) suggests this option could lead to elevated fecal coliform and BOD levels in county streams, degrading surface water quality.

Acknowledgements
Karen Mancl is a Professor of Food, Agricultural and Biological Engineering at The Ohio State University. Michael Vollmer is Director of Environmental Health at the Will County Health Department. Research support provided by the Ohio State University Extension and Ohio Agricultural Research and Development Center. Sampling and analysis was supported by the Will County Health Department. Additional support was provided through a grant from the National Onsite Demonstration Program at West Virginia University.

References

1. Waldorf, L.E. (1977), "Boyd County Demonstration Project," *National Conference of Less Costly Wastewater Treatment Systems for Small Communities*, Washington D.C.:U.S. Environmental Protection Agency.

2. Brewer, W.S., J. Lucas, and G. Prascak (1978), "An Evaluation of the Performance of Household Aerobic Sewage Treatment Units," *Journal of Environmental Health*, 41(2): 82-85.

3. Hutzler, N.J., J. Fancy, and L.E. Waldorf (1978), "Performance of Aerobic Treatment Units," *Proceedings of the 2nd National Home Sewage Treatment Symposium*, St. Joseph, Michigan: American Society of Agricultural Engineers.

4. Otis, R.J. and W.C. Boyle (1976), "Performance of Single Household Treatment Units," *Journal of Environmental Engineering Division American Society of Civil Engineers*, 102(EE1):175-189.

5. Fancy, J. (1980), "Individual Aerobic Plant Operation and Maintenance," *Individual Onsite Wastewater Systems*, Ann Arbor, Michigan: Ann Arbor Science.

6. Ingram, T., T. Goodman, and T. Hull (1999), "On-site Wastewater Management," *Journal of Environmental Health*, 62(2):21-27.

7. Will County Health Department (1996), *Will County Sewage Treatment and Disposal Ordinance*, Joliet, Illinois: Will County Health Department.

8. U.S. Department of Agriculture - Natural Resource Conservation Service, Unpublished, *Soil Survey, Will County, Illinois*, New Lenox, Illinois: Will County Natural Resources Conservation Service

9. American Public Health Association, American Water Works Association and Water Environment Federation (1992), *Standard Methods for the Examination of Water and Wastewater, 18th ed.*, Washington D.C.: American Public Health Association.

Table 1. Individual mechanical sewage treatment system effluent quality compiled from six other studies by Hurtzler, Waldorf and Fancy 1978.

Number of samples	BOD_5 mean mg/l	BOD_5 range mg/l	Number of samples	Suspended Solids mean mg/l	Suspended Solids range mg/l
112	37	0-208	117	39	3-252
86	47	10-280	74	94	18-692
146	92	-	146	94	-
393	144	10-824	251	122	17-768
124	36	3-170	132	57	4-366
167	37	1-235	167	62	1-510

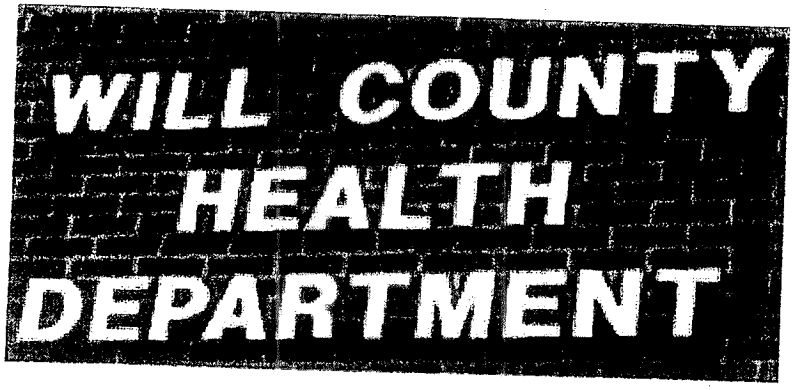
Table 2. Estimate of individual mechanical sewage treatment systems in use in Will County, Illinois.

System Type	Percent in use
Norwalk/Norweco	64%
Jet	22%
Clearstream	4%
Cavitette	3%
Others	4%
Unknown	3%

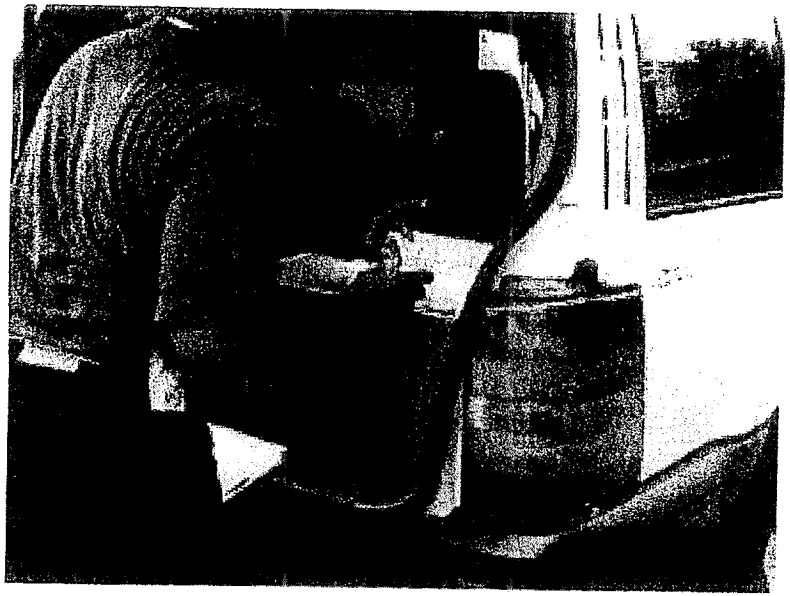
Table 3. Sampling results for 2643 discharging mechanical sewage treatment systems in Will County, Illinois.

	Fecal Coliform	Suspended Solids	BOD	Overall
Discharge standard	400 org/100 ml	20 mg/l	20 mg/l	1 or more standards
% over standard	45%	48%	13%	67%

Figure 1. Home aerobic system inspection and sample collection in Will County, Illinois.



1. Filling sample bottles from system accumulation tank or sampling port



2. Lable, refrigerate and transport to laboratory for immediate analysis

3. If resident is not home, leave red hang-tag with inspection notice.

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The T.J. Smull College of Engineering
Department of Civil Engineering

August 30, 2000

Comments
C/o Policy Unit
Office of the Mayor
City of Columbus
90 West Broad Street
Columbus, Ohio 43215

Re: Columbus Metropolitan Sewage Facilities Plan

Ladies and Gentlemen:

I wish to thank you for the opportunity to comment on the Columbus Metropolitan Facilities Plan (CMFP) at the August 24 public information meeting. I would also like to submit the following comments in writing regarding the CMFP. Further, I would propose that an actual study with evaluation of alternatives and engineering analysis be performed to formulate the final CMFP submission to Ohio Environmental Protection Agency to update the 208 Areawide Waste Treatment Plan. My comments, which include a preliminary outline of possible topics for such a study, are attached.

As the Designated Management Agency (DMA), the City of Columbus is not only responsible for identifying how wastewater treatment needs will be met in a manner to protect existing and future water quality, but also how those needs will be met in a manner that is most responsive to the desires of local officials and communities. Although, OEPA is working to complete the Blacklick Creek Section 208 Areawide Waste Treatment Management Plan by December 31, 2001, the City of Columbus does not have to complete the CMFP update in the same period. It is reasonable and prudent to take the time to complete a study and evaluation that addresses the engineering analysis outlined in this proposal along with addressing the desires of the local officials and communities in the planning area.

I am very interested in continuing to participate in the process of a properly designed analysis and evaluation for the planning area. I would genuinely appreciate the opportunity to prepare a detailed proposal to address these ideas in collaboration with other agencies such as those listed in these comments.

Columbus Metropolitan Facility Plan Comments

Background

The Columbus Metropolitan Facility Plan update (CMFP) proposes a planning area be administered around Columbus, Ohio for the next 20 years as an approach to protecting the environment. The CMFP proposes to use a common centralized sewerage collection system (the City of Columbus' system) along with the Jackson Pike and Southerly wastewater treatment plants for the collection, treatment, and "disposal" or reclamation of the used water within the planning area. The CMFP proponents have stated that this option for collection and treatment is the best available technology within the planning area for the next twenty years. The CMFP precludes the use of any "alternative" treatment systems within the planning area for the next twenty years. No systems that make use of spray irrigation or constructed wetlands to treat or dispose of effluent would be allowed.

Problems

1. The CMFP does not use analysis to arrive at the "best" solution based on scientific/technical, economic, and social/political considerations. This methodology is referred to as engineering analysis in these comments.
2. Although other public governing entities have been allowed to comment, the plan does not provide for analysis or evaluation of alternative growth scenarios or land use plans to arrive at the "best" scenario for all area stakeholders.
3. Although the City of Columbus has allowed public comment, there has been no definition of the baseline natural environmental conditions that exist or are desired to be maintained or developed over the next twenty years for surface water, ground water, agriculture, forests, parks, air quality, etc.
4. There has been no attempt to define, evaluate, or delineate types of alternative collection or waste treatment systems. Rather these systems have been subjectively and non-specifically defined as "bad" for the environment in this planning area.
5. Although the CMFP makes no economic or specific growth plan analyses (as stated in numbers 1 and 2 above), alternative wastewater systems are characterized as resulting in detrimental fiscal impacts to local governments and as depriving local governments of control over growth patterns. However, there are many published reports of alternative systems that have demonstrated positive fiscal impacts to local governments and allow for greater local government control of growth patterns.

Proposal

A study could be performed to analyze the CMFP for several different aspects. This study would help define the best available technology (ies) for protecting the environment in the planning area for the following twenty years after completion of the study. The study could be a partnership between a group of stakeholders such as the

following: Ohio Northern University (an independent undergraduate institution), The Ohio State University (a public multi-leveled degree research institution), The Ohio Environmental Protection Agency, The Ohio Department of Natural Resources, the United States Environmental Protection Agency, soil and water conservation districts, City of Columbus, surrounding communities and townships which are in the proposed planning area, United States Corps of Engineers, United States Geologic Survey.

Study Components

1. Centralized Sewerage Collection System(s)
   - Best environmental alternative? Best Available Technology?
   - Should there be only one "centralized" system in the planning area or multiple systems?
   - What are actual life-cycle, capital, and operation and maintenance costs for a centralized system?
   - What are the life-cycle costs for the optimum system for the planning area? Multiple centralized systems? Blended centralized and alternative systems?
   - What are the dynamics of Sewer System Overflow (SSO) in one centralized system versus multiple centralized or blended systems for the planning area? Impacts on homes, watersheds, etc?

2. Treatment Systems
   - Are the Southerly and Jackson Pike treatment plants the best available technology for the planning area for the next twenty years, or are they more representative of the technology and concepts that developed over the last twenty years?
   - Should some areas of the planning area be served by smaller centralized (alternative?) treatment plants?
   - Should properly designed and operating tertiary treatment plants always be discharging to the waters of the US or to the soils, also? What options are best for the environment in terms of lowest impact in different areas of the watershed?
   - What are the alternative treatment issues (level of treatment, operation and maintenance permitting, discharge to soil or surface water, winter operations (effluent storage)?
   - What is the best blend of centralized and alternative treatment plants?

3. Land Use/ Land Development/ Lifestyle/ Governance
   - City, County, and Township philosophies
   - Population, roadways, water and sewer, gas and electric, police and fire
   - What are the levels of government and degrees of self-determination that different areas want to function within for the next 20 years?
   - What are the desired densities of development and types of land use that different areas want to pursue over the next 20 years?

Columbus Metropolitan Facility Plan Comments (cont.)

4. Natural Environment
   What are current baseline conditions, designated uses, and desired outcomes over the next twenty years?

   - Lakes, streams
   - Hydric soils
   - Aquifers
   - Farm land
   - Woodlands
   - Riparian zones
   - Air Quality

Analysis

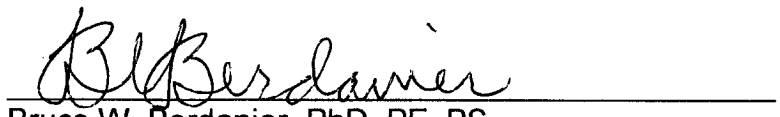
The proposed study could evaluate four parameters: collection systems, treatment systems, land use issues, and natural environment issues. Each parameter would be compared on the basis of environmental impacts, life-cycle costs, and social-political implications. Further each box in the matrix could be evaluated for multiple environmental management scenarios (i.e. (each cell could be evaluated for: 1.continuation of current plans, 2.CMFP proposed, 3.engineering analysis proposed).

	Environmental Impacts	Life Cycle Costs	Social-Political Implications
Collection Systems			
Waste Treatment			
Land Use Issues			
Natural Environment Issues			

Figure 1: Study Issues

Also, I will request that the Ohio Environmental Protection Agency (OEPA) provide in writing a statement to the effect that alternative waste treatment systems may be considered the best available treatment technology if used with proper evaluation and application. Mr. Doutt indicated at the public information meeting that he would like to see such a statement in writing from OEPA.

Sincerely,



Bruce W. Berdanier, PhD, PE, PS
Assistant Professor of Civil Engineering

Cc The Ohio Environmental Protection Agency