

**Testimony of Dr. Richard C. Warner**  
**In Support of HB 175**  
**Before the Ohio House Agriculture and Conservation Committee**  
**Pre-Hearing Submittal**  
**May 2, 2021**

Honorable Members of the Committee, Chairman Koehler, Vice Chair Creech, and Ranking Member Brent, Good morning.

My name is Richard Warner. I appreciate the opportunity to testify in support of HB 175.

I have dedicated much of my career to the development of environmental controls integrated with nature to enhance the protection of the environment.

As my attached resume states, the focus of my teaching, applied research, consulting, policy development and technology transfer efforts has encompassed measures that enhance the protection of the environment. (Exhibit 1). I am 1) an emeritus professor at the University of Kentucky in Biosystems and Agricultural Engineering, 2) principal of numerous U.S. and international companies that emphasize the holistic rehabilitation of land and water resources, sustainable energy and environment, 3) developer of software programs that are widely used by regulatory agencies, consultants and industry for the design and assessment of stormwater detention, water conveyance, erosion, and sediment control systems and 4) have been an advisor/consultant/project manager for 20+ major projects throughout South- Central- and North-America, Southeast Asia, Africa and the South Pacific with a project's total cost exceeding \$20 billion (USD).

Last year I was invited by the National Academy of Science, Engineering and Medicine to provide my recommendations on management strategies to reduce hydrologic and environmental risk associated with mining and reclamation through understanding and incorporating the interconnectedness of ecosystem components. As part of this forum, I detailed the efficacy of the weep berm technology which I developed, partially funded by Georgia DNR and U.S. EPA. I have been employing this technology since 2000 with applications from large- to small-scale land disturbance in mining, residential and commercial developments, and agriculture. More recently I completed a U.S. Office of Surface Mining Experimental Practice that generated an extensive data base codifying this preferred water and land enhancement technology that achieves protection of the environment both during active land disturbance and afterwards in lieu of replacing up-gradient ephemeral streams.

Results from this and other applied research concluded that this simple weep berm technology mimics the hydrologic balance of natural non-disturbed watersheds, enables zero sediment to enter streams and provides excellent water quality results with respect to agricultural runoff and metals.

Today my topic is ephemeral streams. I am here to offer my expert opinion that Ohio's environment will substantially benefit from the passage of HB 175.

Federal law under the Clean Water Act currently regulates impacts to two types of streams: perennial streams which flow continuously and intermittent streams which flow seasonally in direct response to high groundwater tables.

A third type of stream, called ephemeral streams are the subject of this Bill and not regulated by federal law. Ephemeral streams only flow when it rains. They are typically narrow from a few inches to a few feet wide and inherently unstable. A small erosion gully is today classified as an "ephemeral stream". I have attached illustrative photos of current day ephemeral streams, along with a comparison photo of a perennial stream. (Exhibit 2). Take a close look, particularly at photo 1 compared to photo 5. HB 175 would amend the definition of ephemeral streams to *ephemeral features* to make clear that the features like those shown in photos 1 through 4 are not subject to Ohio EPA regulation as "Waters of the State."

Although the federal government exempts ephemeral streams from regulation, I understand that States have discretion to impose regulations exceeding federal standards. But, by last count, 36 states currently do not regulate proposed dredging/filling of ephemeral streams. The results of this State-by-State survey was shared with Indiana's legislature on March 8<sup>th</sup> of this year in conjunction with that State's consideration of legislation on this same subject. Last week, on April 29<sup>th</sup> Indiana Governor Holcomb signed into law a Bill to prevent the Indiana Department of Environmental Management from regulating ephemeral streams and various other non-federally regulated waters.

Unfortunately, Ohio EPA in June of last year opted to join the minority of States deciding to regulate ephemeral streams with a General Permit program. I acknowledge that one purpose of this Bill is to bring Ohio in line with federal regulation and most other states. But that is not my purpose for being here. I am here to testify as to the environmental benefits of HB 175.

There is a preponderance of accepted opinion that we should always be guided by the geomorphic landform and streams that existed before we disturbed the land. The question then becomes - What is your perception of 'before'? It is important to understand that many ephemeral streams, as categorized today, are not natural to Ohio. Such streams were created due to a wide spectrum of developmental activities that increased stormwater flows and erosional processes. In Daniel Boone days, streams were a sequence of ponds created by the abundance of beavers. Beaver ponds stored stormwater, sediment, and nutrients. Such natural control systems slowly and passively recharge groundwater resources, provided baseflow and released water downstream. These ponds protected down-gradient streams from erosion and provided water resources for aquatic, terrestrial and avian wildlife that was documented by Ohio's early settlers. However, after beavers were trapped out of Ohio and as time marched on, erosional features developed across Ohio's landscape creating gullies that expanded into linear flow paths increasing runoff conveyance and associated flooding. As an alternative to reconstruction of ephemeral streams, HB 175, in conjunction with existing Ohio EPA provisions, will provide the opportunity to mimic the natural processes of beaver ponds, which in today's lingo would be best management practices (BMPs).

The scientific reality is that the functions of most ephemeral streams are *negative* due to their environmentally detrimental consequences to streams and water bodies farther downstream. Ephemeral streams are typically geomorphically unstable. As these gullies advance, pathways that move runoff quickly off the land extend upgradient which leads to a denser dendritic pattern, further increases in peak flows, erosion, sediment and nutrient supply, flooding, and adverse downstream channel impacts. Exhibit 3 to my written testimony itemizes the negative attributes of ephemeral streams.

The solution is not to replace and expand ephemeral stream pathways as Ohio EPA is now requiring in its Ephemeral Streams General Permit. Rather, today we benefit from professionally engineered stormwater best management practices (BMPs) to replace the unstable ephemeral stream channels and gullies encountered at development sites. Whether it be surface mining regulated under Ohio's Mining and Reclamation Act or development and construction activities regulated by Ohio EPA's Construction Activity General Permit, surface water runoff events are managed to reduce

flooding and erosion and control sediment. A broadly accepted premise is that land development increases peak flow and sediment load, much like the impacts of ephemeral streams. A wide spectrum of approved controls exists to specifically address the need to control stormwater. The preferred method is to use natural systems as much as possible. We have all heard of letting home downspouts discharge to our lawns and the use of rain barrels. Similarly, infiltration basins and grassed swales enable passive recharge of groundwater and reduce flooding potential. BMPs have design criteria that are well-researched, known and easily completed by engineering professionals. These features have been encouraged and approved regularly by the Ohio EPA for decades in their Construction Activity General Permit and *Rainwater and Land Development Manual*. Advanced control measures, such as weep berms, are constantly being added to the approved list.

In the absence of stormwater retention devices, an ephemeral stream channel functions more like a pipe, allowing inputs to be flushed quickly into valuable downstream intermittent and perennial streams. Stormwater BMPs properly address the primary watershed *need* to store stormwater and slowly release it to prevent downstream adverse impacts. BMPs are our modern-day beaver dams. The downstream consequences to larger streams of inappropriate policy decisions may take upwards of a half-century to recover. Alternatively, the use of Stormwater BMPs would effectively change my Exhibit 3 list of ephemeral stream *adverse consequences* immediately into a list of *environmental benefits* that produce the *exact opposite* outcomes.

I should add that this legislation would not alter existing pollution control regulations. Ohio EPA's existing NPDES program will continue to protect streams from pollution by regulating all point source discharges from development sites. Simply put, there is no environmental need to restore ephemeral stream channels to the condition found on development sites.

I also am aware of the tremendous burden of mitigation cost on Ohio businesses and individual landowners that will result without this legislation. Stream mitigation credits are purchased from a Stream Mitigation Bank by the foot. At the required mitigation ratio of 1.5 to 1, the expenditure for ephemeral stream mitigation currently ranges from \$350 to greater than \$650 per foot, depending on the location of the stream mitigation in Ohio. The required expenditure for ephemeral streams is nearly the same costs as for larger streams that may be 20-feet-wide and flow all year long.

Ephemeral streams are like the small branches of a tree. Hence, there is substantially more ephemeral stream length (feet) near the tops of watersheds than that of larger intermittent branches or the perennial larger streams in valley bottoms.

Consequently, ephemeral stream mitigation expenditures can quickly run into the millions of dollars and these costs are required to be paid *up-front* prior to development. These enormous costs have a high potential to be financially devastating to most projects.

In closing, the General Assembly should embrace this opportunity to join the majority of States not only in mirroring federal law, but also in preventing imprudent, unnecessary and costly regulation of ephemeral streams. I'm happy to answer any questions. Thank you.

*Exhibit 1 to HB 175 Testimony*

*R E S U M E*

Dr. Richard C. Warner

**RICHARD C. WARNER, Ph.D.**  
**2018 Update**  
**(Partial listings of articles and consultations)**

**Education**

- B.S. Water and Air Resources Engineering, University of Illinois-Chicago, 1970  
M.S. Water Resources Engineering, Clemson University, 1972  
Major: Water Resources Engineering, Minor: Operations Research  
Thesis: A Management Model for a Controlled Drainage and Subirrigation System  
Ph.D. Environmental Systems Engineering, Clemson University, 1981  
Major: Environmental Engineering and Water Resources Planning and Management  
Minors (1) Natural Resource and (2) Environment Economic  
Dissertation: Cost Effective Erosion and Sediment Control Systems

**Appointments and Experience**

- Emeritus Professor, Biosystems and Agricultural Engineering Department, University of Kentucky. November 2017 to present.
- Professor, Biosystems and Agricultural Engineering Department, University of Kentucky. November 2015 to November 2017.
- Extension Professor, Biosystems and Agricultural Engineering Department, University of Kentucky. July 2002- November 2015.
- Associate Extension Professor, Biosystems and Agricultural Engineering Department, University of Kentucky, July 1986-June 2002.
- Assistant Extension Professor, Agricultural Engineering Department, University of Kentucky, May 1981-July 1986.
- Hydrologist, United States Geological Survey, Columbia, South Carolina, 1979-1980.

**Publications**

***Journal Articles***

1. Patricio Pinto, R Souhail, C. Holder, R. Warner, J. Mckernan, S. Fulton and E. Somerville. 2018. Assessing the Impact of Removing Select Material from Coal Mine Overburden, Central Appalachia Region, USA. *Mine Water and the Environment* 37(1). March, 2018, Pages 31-41
2. [Mohammad Rezaee<sup>a</sup>](#), [Richard C. Warner<sup>b</sup>](#), [Rick Q. Honaker<sup>a</sup>](#). 2016. Development of an Electrical Conductivity Screening Test for Mine Waste Assessments, [Chemosphere Volume 160](#), October 2016, Pages 13–21
3. [Jennifer Thompson<sup>a</sup>](#), [Ahmed M.A. Sattar<sup>b</sup>](#), [Bahram Gharabaghi<sup>a</sup>](#), [Richard C. Warner<sup>c</sup>](#). 2016. Event-based Total Suspended Sediment Particle Size Distribution Model [Journal of Hydrology Volume 536](#), May 2016, Pages 236–246
4. [Villines, J.A.](#), C.T. Agouridis, R.C. Warner, and C.D. Barton. 2015. Using GIS to Delineate Headwater Stream Origins in the Appalachian Coalfields of Kentucky. *Journal of the American Water Resources Association* 51(6): 1667-1687. doi: 10.1111/1752-1688.12350 (*jif*: 1.782)

5. Sena, K., C. Barton, S. Hall, P. Angel, C. Agouridis, and R. Warner. 2015. Influence of Spoil Type on Afforestation Success and Natural Vegetative Recolonization on a Surface Coal Mine in Eastern Kentucky, USA. *Restoration Ecology* 23(2): 131-138. doi: 10.1111/rec.12164 (*jif*: 1.838)
6. Sena, K., C. Barton, P. Angel, C. Agouridis, and R. Warner. 2014. Influence of Spoil Type on Chemistry and Hydrology of Interflow on a Surface Coal Mine in the Eastern US Coalfield. *Water, Air and Soil Pollution* 225: 2171. doi: 10.1007/s11270-014-2171-y (*jif*: 1.685)
7. *da Rosa, M.*, C.T. Agouridis, and R.C. Warner. 2013. Weathered Spoil as a Low Permeable Barrier. *Journal of the American Society of Mining and Reclamation* 2(1): 49-67.
8. Warner, R.C., C.T. Agouridis, and R.L. Guffey. 2013. Designing Contour Weep Berms to Reduce Agricultural Nonpoint Source Pollution. *Applied Engineering in Agriculture* 29(4): 521-528. doi: 10.13031/aea.29.10044 (*jif*: 0.571)
9. Maupin, T.P., C.T. Agouridis, C.D. Barton, and R.C. Warner. 2013. Specific Conductivity Sensor Performance: I. Laboratory Evaluation. *International Journal of Mining, Reclamation and Environment*: 27(5): 329-344. doi:10.1080/17480930.2013.764701 (*jif*: 0.392)
10. Maupin, T.P., C.T. Agouridis, D.R. Edwards, C.D. Barton, R.C. Warner, and M.P. Sama. 2013. Specific Conductivity Sensor Performance: II. Field Evaluation. *International Journal of Mining, Reclamation and Environment*: 27(5): 345-365. doi: 10.1080/17480930.2013.764702 (*jif*: 0.392)
11. Agouridis, C.T., P.N. Angel, T.J. Taylor, C.D. Barton, R.C. Warner, and X. Yu, and C. Wood. 2012. Water Quality Characteristics of Discharge from Reforested Loose-Dumped Mine Spoil in Eastern Kentucky. *Journal of Environmental Quality* 41: 454-468. doi:10.2134/jeq2011.0158 (*jif*: 2.290)
12. Brinks, J.S., J.M. Lhotka, C.D. Barton, R.C. Warner, and C.T. Agouridis. 2011. Effects of Fertilization and Irrigation on American Sycamore and Black Locust Planted on a Reclaimed Surface Mine in Appalachia. *Forest Ecology and Management* 261: 640-648. doi.org/10.1016/j.foreco.2010.11.018 (*jif*: 1.992)
13. Barnett, J.R., R.C. Warner, C.T. Agouridis, and D.R. Edwards. 2010. Ability of a Weep Berm to Enhance Grass Filter Performance in a Simulated Grazed System: Preliminary Results. *Natural and Environmental Sciences* 1(1): 12-20.
14. Warner, R.C., C.T. Agouridis, P.B. Vingralek, and A.W. Fogle. 2010. Reclaimed Mineland Curve Number Response to Temporal Distribution of Rainfall. *Journal of the American Water Resources Association* 46(4): 724-732. doi: 10.1111/j.1752-1688.2010.00444.x (*jif*: 1.782)
15. Taylor, T.J., C.T. Agouridis, R.C. Warner, and C.D. Barton. 2009. Hydrologic Characteristics of Loose Dumped Spoil in the Cumberland Plateau of Eastern Kentucky. *Hydrological Processes* 23(23): 3372-3381. doi: 10.1002/hyp.7443 (*jif*: 2.068)
16. Taylor, T.J., C.T. Agouridis, R.C. Warner, and C.D. Barton. 2009. Runoff Curve Numbers for Loose-dumped Spoil in the Cumberland Plateau of Eastern Kentucky. *International Journal of Mining, Reclamation and Environment* 23(2): 103-120. doi: 10.1080/17480930802176389 (*jif*: 0.392)
17. Moberly, C., S.R. Workman, and R.C. Warner. 2001. Calibration and Evaluation of a Hydrologic Model for Loose-Dump Mine Spoil. *International Journal of Surface Mining, Reclamation and Environment*. Vol. 15(1):16.

### ***Edited Symposium Papers***

1. *da Rosa, M.*, C.T. Agouridis, and R.C. Warner. 2013. Weathered Spoil as a Low Permeable Barrier. *In*. Proceedings of 2013 National Meeting of the American Society of Mining and Reclamation, Laramie, WY, Reclamation across Industries. June 1-6, 2013. R.I. Barnhisel (Ed.)



Published by ASMR, 3134 Montavesta Rd., Lexington, KY 40502.

2. Monday, T. and Warner, R. Screening-Level Specific Conductivity Testing of Drill Core Strata. In: J.R. Craynon (ed.) Environmental Considerations in Energy Productions, April 14-18, 2013, Charleston, WV. pp. 471.
3. Unrine, J., Collin, B., and Warner, R. 2013. Selenium concentrations and solid-state chemical speciation in black shale associated with a West Virginia coal seam. In: J.R. Craynon (ed.), Environmental Considerations in Energy Productions, April 14-18, 2013, Charleston, WV. pp. 438-442.
4. Maupin, T.P., C.T. Agouridis, C.D. Barton, and R.C. Warner. 2012. Laboratory Evaluation of Conductivity Sensor Accuracy and Temporal Consistency. In: Proceedings of 2012 National Meeting of the American Society of Mining and Reclamation, Tupelo, MS, Sustainable Reclamation. June 8-15, 2012. R.I. Barnhisel (Ed.) Published by ASMR, 3134 Montavesta Rd., Lexington, KY 40502.
5. Mastin, C., C.D. Barton, C.T. Agouridis, and R.C. Warner. 2010. Use of Stream Restoration and Passive Treatment Technologies for Improving Water Quality in an Eastern Kentucky Valley Fill. In: Proceedings of 2010 National Meeting of the American Society of Mining and Reclamation, Billings, MT, Bridging Reclamation, Science and the Community. June 5-11, 2010. R.I. Barnhisel (Ed.) Published by ASMR, 3134 Montavesta Rd., Lexington, KY 40502.
6. Angel, P.N., C.D. Barton, R.C. Warner, C.T. Agouridis, T. Taylor, and S.L. Hall. 2008. Tree Growth, Natural Regeneration and Hydrologic Characteristics of Three Loose-Graded Surface Mine Spoils in Kentucky. In: Proceedings of 2008 National Meeting of the American Society of Mining and Reclamation, Richmond, VA, New Opportunities to Apply Our Science. June 14-19, 2008. R.I. Barnhisel (Ed.) Published by ASMR, 3134 Montavesta Rd., Lexington, KY 40502.
7. Angel, P.N., C.D. Barton, R.C. Warner, C. T. Agouridis, R.J. Sweigard, and D.H. Graves. 2007. Tree Growth and Natural Regeneration on Loose-Graded Brown and Gray Sandstone and Mixed Sandstone/Shale Surface Mine Spoils in Kentucky: Preliminary Findings. In: Proceedings of 2007 National Meeting of the American Society of Mining and Reclamation, Gillette WY, June 27, 2007. R.I. Barnhisel (Ed.) Published by ASMR, 3134 Montavesta Rd., Lexington, KY 40502. pp 29-42.
8. Angel, P.N., D.H. Graves, C.D. Barton, R.C. Warner, R.J. Sweigard, and C.T. Agouridis. 2006. Surface Mine Reforestation Research: Evaluation of Tree Response to Low Compaction Reclamation Techniques. In: Proceedings of the 2006 7th ICARD Annual Meeting, St. Louis, MO, March 26-30, 18p.

### ***Extension Publications***

1. Chattopadhyay, S., C. Agouridis, and R. Warner. 2016. Modeling Best Management Practices. University of Kentucky Cooperative Extension Service: AEN-132.
2. Mahoney, T., C.T. Agouridis, and R. Warner. 2016. Hydrologic Models. University of Kentucky Cooperative Extension Service: AEN-127.
3. Warner, R.C., C.T. Agouridis, and R.L. Guffey. 2012. Using Weep Berms to Improve Water Quality. University of Kentucky Cooperative Extension Service: AEN-114.

### ***Reviewed Technical Reports***

1. Agouridis, C.T., C.B. Barton, and R.C. Warner. 2014. UT to Laurel Fork: Guy Cove (Hollow Fill #9) Stream Restoration Monitoring Report. Monitoring Year 5: 2013.

2. Agouridis, C.T., C.B. Barton, and R.C. Warner. 2012. UT to Laurel Fork: Guy Cove (Hollow Fill #9) Stream Restoration Monitoring Report. Monitoring Year 4: 2012.
3. C.B. Barton, and R.C. Warner. 2011. UT to Laurel Fork: Guy Cove (Hollow Fill #9) Stream Restoration Monitoring Report. Monitoring Year 3: 2011.
4. **Agouridis, C.T.**, C.B. Barton, R.C. Warner, and C.B. Mastin. 2010. UT to Laurel Fork: Guy Cove (Hollow Fill #9) Stream Restoration Monitoring Report. Monitoring Year 2: 2010.
5. Brinks, J.S., J.M. Lhotka, C.D. Barton, R.C. Warner, and C.T. Agouridis. 2010. Demonstrating Techniques for Establishing Woody Biomass Plantations on Surface Mine Lands as Feedstocks for Energy Production. Final Report for Kentucky Governor's Office of Energy Policy, Award Number GOEP-Barton PO2 8850700011339.
6. Agouridis, C.T., C.B. Barton, R.C. Warner, and C.B. Mastin. 2009. UT to Laurel Fork: Guy Cove (Hollow Fill #9) Stream Restoration Monitoring Report. Monitoring Year 1: 2009.
7. Agouridis, C.T., C.D. Barton, and R.C. Warner. 2009. Recreating a Headwater Stream System on a Head-of-Hollow Fill: A Kentucky Case Study. IN K.C. Vories and A. Caswell, (eds.) Proceedings of Geomorphic Reclamation and Natural Stream Design: A Technical Interactive Forum. USDOI Office of Surface Mining and Coal Research Center, Southern Illinois University at Carbondale Illinois. (Invited)
8. Warner, R.C., C.T. Agouridis, and C.D. Barton. 2009. Modeling Hydrology and Sediment Loss on Head-of-Hollow Fills: Geomorphic Versus Traditional Approach. IN K.C. Vories and A. Caswell, (eds.) Proceedings of Geomorphic Reclamation and Natural Stream Design: A Technical Interactive Forum. USDOI Office of Surface Mining and Coal Research Center, Southern Illinois University at Carbondale Illinois. (Invited)
9. Angel, P.N., C.D. Barton, and C. T. Agouridis. 2008. Interagency Study Examines Impacts of Mine Spoil Types on Reforestation Efforts. U.S. EPA Technology News and Trends: 37:4-5. <http://www.clu-in.org/products/newsletters/tnandt/>
10. Graves, D.H., C.D. Barton, R.J. Sweigard, R.C. Warner, C.T. Agouridis, and T. Cushing. 2008. Post-Mining Reforestation Demonstration Project. Final Report for USDA-Forest Service, Award Number: 05-DG-11083150.
11. Agouridis, C.T., R.C. Warner, C.D. Barton, D.A. Bidelsbach, G.D. Jennings, R. Osborne, and J.W. Marchant. 2008. Design of a Headwater Stream System for a Head-of-Hollow Fill. Paper for the 2008 SME Annual Meeting & Exhibit, Salt Lake City, Utah, February 24-27.
12. Agouridis, C.T., R.C. Warner and C.D. Barton. 2007. Robinson Forest, Guy Cove, Hollow Fill #9 Stream Restoration Bid Documents, 67 p.
13. Agouridis, C.T., C.D. Barton, and R.C. Warner. 2007. Mitigation Plan for University of Kentucky Robinson Forest, Guy Cove (Hollow Fill #9): Restoration of Laurel Fork Tributary, 96 p.
14. Graves, D.H., C.D. Barton, R.J. Sweigard, R.C. Warner, and C.T. Agouridis. 2007. Carbon Sequestration on Surface Mine Lands: October 2003-September 2006. Final Report for Department of Energy, Award Number: DE-FC26-02NT41624.

#### ***Non-Reviewed Technical Reports***

1. Warner, R.C. and C.T. Agouridis. 2015. Feasibility Assessment of a Rain Garden Best Management Practice for Control of Stormwater Runoff, Taylor County, Kentucky. Report for the University of Kentucky, Taylor County Cooperative Extension Office, November 21.
2. Warner, R.C., C.T. Agouridis, and C.D. Barton. 2006. Mined Land Reclamation Research: Hydrology and Water Quality. Report for U.S. Fish and Wildlife Service and Office of Surface Mining Terrestrial Carbon Sequestration and Appalachian Regional Reforestation Initiative

Workshop, Hazard, KY, June 21.

3. Warner, R.C., C.T. Agouridis, and C.D. Barton. 2005. Mined Land Reclamation Research: Hydrology and Water Quality. Report for the Senator Mitch McConnell's Staff, Bent Mountain, KY, December 14.
4. Warner, R.C., C.T. Agouridis, A.W. Fogle, Tracy R. Goff, and Michael J. Parker. 2005. Development of Design Input Parameters Specific to Mining Operations and Reclamation Techniques. Report for the Senator Mitch McConnell's Staff, Bent Mountain, December 14.
5. Warner, R.C., C.T. Agouridis, and C.D. Barton. 2005. Mined Land Reclamation Research: Hydrology and Water Quality. Report for the Kentucky 404 Task Force, September 30.
6. Warner, R.C., C.T. Agouridis, and C.D. Barton. 2005. Mined Land Reclamation Research: Hydrology and Water Quality. Report for the U.S. Army Corps of Engineers - Huntington District, September 22.
7. Warner, R.C., C.T. Agouridis, and C.D. Barton. 2005. Mined Land Reclamation Research: Hydrology and Water Quality. Report for the Appalachian Regional Reforestation Initiative Members, August 10.
8. Warner, R.C., C.T. Agouridis, and C.D. Barton. 2005. Mined Land Reclamation Research: Hydrology and Water Quality. Report for the Tennessee Office of Surface Mining Inspectors, August 3-4.
9. Warner, R.C., C.T. Agouridis, and C.D. Barton. 2005. Mined Land Reclamation Research: Hydrology and Water Quality. Report for the Federal Office of Surface Mining Inspectors, July 12.
10. Warner, R.C., C.T. Agouridis, and C.D. Barton. 2005. Mined Land Reclamation Research: Hydrology and Water Quality. Report for the Kentucky Science Teachers Association, July 7.
11. Warner, R.C., C.T. Agouridis, and C.D. Barton. 2005. Carbon Sequestration on Surface Mined Lands: Mine Land Hydrology and Sedimentology. Report for the John Lytinski, Terrestrial Sequestration Program Director, National Energy Technology Laboratory, Department of Energy, June 29-30.
12. Dowdy, T., R.W. Warner, S.R. Workman, R.L. Fehr, and C.T. Agouridis. 2005. Integrating Mobile Technology into the GIS Classroom. Paper for the 2005 ESRI International Users Conference, Paper # EDUC1812, San Diego, California, July 25-29.
13. Agouridis, C.T., C.D. Barton and R.C. Warner. 2004. Preliminary Scope of Work and Cost Estimate for Stream Creation and Rehabilitation. Report for the Commissioner Susan Bush and Commissioner Lloyd Cress, Frankfort, Kentucky, November 10.
14. Agouridis, C.T., C.D. Barton and R.C. Warner. 2004. Preliminary Scope of Work and Cost Estimate for Stream Creation and Rehabilitation. Report for the Kentucky Stream Mitigation Review Team, Frankfort, Kentucky, October 26.
15. Warner, R.C., J.R. Barnett, and C.T. Agouridis. 2004. The Effectiveness of a Combination Weep Berm-Grass Filter Riparian Control System for Reducing Fecal Bacteria and Nutrients from Grazed Pastures. Paper for the 2004 ASAE Self-Sustaining Solutions for Streams, Wetlands, and Watersheds. St. Paul, Minnesota, September 12-15, 12p.
16. Warner, R.C., C.T. Agouridis, D.H. Graves and R.J. Sweigard. 2004. Creating Sustainable High-Value Forests. Paper for the 2004 ASAE International Meeting, Paper #042076, Ottawa, Canada, August 2-4, 10p.

#### A. Books and Chapters

- Mastin, C.B., J.D. Edwards, C.B. Barton, A.D. Karathanasis, C.T. Agouridis, and **R.C. Warner**. 2012. Development and Deployment of a Bioreactor for the Removal of Sulfate and Manganese from Circumneutral Coal Mine Drainage. Pp. 121-140. In: Bioreactors: Design, Properties and Applications. Eds. Antollo, P.G. and Z. Liu. Nova Science Publishers: Hauppauge, NY (Invited)
- **Warner, R.C.** and C.T. Agouridis. 2004. Stream Channel Construction. In Handbook of Western Reclamation Techniques. Section II: Hydrology. U.S. Department of Interior, Office of Surface Mining. 62 p.
- Kentucky Erosion Prevention and Sediment Control Field Guide. 2004. Technical Reviewer
- Barfield, B.J., **R.C. Warner**, and C.T. Haan. Applied Hydrology and Sedimentology for Disturbed Areas. Oklahoma Technical Press. 815 Stillwater. Stillwater, Oklahoma. 603 pps. 1981. 4 printings.
- **Warner, R.C.** Mining Environmental Handbook: Effects of Mining on the Environment and American Environmental Controls on Mining. J.J. Marcus editor. 785 pps. Chapter 6.3.2.1: Sediment Control Systems. pp 112-141. Imperial College Press. London, England. 1997.
- **Warner, R.C.** Handbook of Western Reclamation Techniques. Section II Hydrology F.K. Ferris editor. Dept of Interior, Office of Surface Mining, Denver, CO 1997.
  - Chapter B1: Sediment Control Basin Design and Construction
  - Chapter B2: Diversion Design and Construction
  - Chapter C5: Vegetative Filters
  - Chapter D2: Stream Channel Construction

## Applied Research Grants

- Use of GIS and WATER to Identify and Delineate Stream Types in Eastern Kentucky, Precision Resource Management, USDA-CSREES Special Grants, **\$48,200**, Co-Principal Investigator.
- Demonstrating Techniques for Establishing Woody Bioenergy Plantations on Reclaimed Surface Mined Lands, Kentucky Governor's Office of Energy Policy: Energy R&D Program, **\$174,166**, 11/2007-11/2009, Co-Principal Investigator.
- Guy Cove Stream Restoration II: Increase, Kentucky Department of Fish and Wildlife Resources, **\$516,824**, 6/2006-6/2013, Co-Principal Investigator.
- Guy Cove Stream Restoration II, Kentucky Department of Fish and Wildlife Resources, **\$1,069,776**, 6/2006-6/2013, Principal-Investigator.
- University of Kentucky Commonwealth Collaborative Award for Reforestation of Surface Mined Lands, University of Kentucky, **\$10,000**, 11/2005, Co-Investigator.
- Demonstration of a Performance-Based System of Storm Water and Erosion Controls on Small Residential/Commercial Sites in the Georgia Piedmont, **\$254,645** (\$52,259 UK), 4/2004-5/2006, EPA 319(h), Co-Principal Investigator

## Computer Programs Developed and Design Manuals

- R.C. Warner, T.W. Strum and S.F. Torrealba. 2007. Seep Berm Design Manual. U.S. Environmental Protection Agency, Atlanta, GA. Nov. 2007. 20pp.
- Kohley, T.W., R.C. Warner, M.E. Anderson and J.D. Hamerlinck. 2002. Research and Development of a GIS-Based Data Management and Model Integration Tool for Coal Mine Permitting and Reclamation in Wyoming. University of Wyoming Abandoned Coal mine Land Research program. 47 pps.

- Warner, R.C., D.J. Marshall and P.S. Schwab. SEDCAD – AutoCAD Interface (SCAC4): Design Manual and Users Guide. 90 pp. Civil Software Design. Ames, IA. 2001.
- Warner, R.C. and G.R. Foster. Guidelines for the Use of the Revised Universal Soil Loss Equation (RUSLE) Version 1.06 on Mined Lands, Construction Sites and Reclaimed Lands. T.T. Toy and G.R. Foster editors. Chapter 7: Applications of RUSLE, 44 pp. Off of Surface Mining. Denver, CO. 1998.
- Warner, R.C., P.J. Schwab and D.J. Marshall. SEDCAD 4 for Windows 95/98 & NT: Design Manual and User's Guide. pp 125 plus CD. Civil Software Design. Ames, IA. 1998.

## **Consultations**

Consulting activities predominantly addressed reducing business risk through the design and implementation of cost-effective environmental control systems.

- BHP Billiton – Ghana – Senior Advisor for review of mine and infrastructure surface water and sediment control construction and operation plans
- Xstrata Cooper – Philippines – Pre-feasibility design of a comprehensive surface water, erosion and sediment control for the mine and infrastructure
- Xstrata Nickel – Dominican Republic – Environmental assessment of the surface water data acquisition plan
- Xstrata Nickel – New Caledonia – Project management of: 1) storm water, erosion and sediment control system modeling, and 2) design and implementation of the surface water and sediment data acquisition system, and senior advisor for regulatory and permitting, revegetation research, and flocculation research
- Xstrata Nickel – Brazil – Design of surface water and sediment data acquisition system
- Rio Tinto – Chile – Senior Advisor – Conceptual design of sediment control system for mine, tailings and infrastructure
- Antimina Mine – Peru – Design and implementation of surface water, erosion and sediment control system
- Newmont – Peru – Water management and sediment control for 5-yr and life of mine pre-conceptual and conceptual plans
- BHP Billiton – Borneo, Indonesia – Storm water and sediment control systems for three coal mines
- National Academy of Sciences, Washington D.C., on small-scale sediment control systems.
- RRM Corporation and Delaware County Solid Waste Authority on a comprehensive hydrology, erosion, and sediment control plan for Colebrookdale Landfill.
- E.I. du Pont - Design, testing, and quality assessment/quality control of a \$100 million multiple soil layer cover system for closure of a low level nuclear waste site commingled with hazardous waste.
- Delaware County Solid Waste Authority – Storm water management, erosion, and sediment control permitting for \$80 million expansion of a solid waste landfill.
- Maxey Flats low level nuclear waste site through overview role as a member of the Governor's Maxey Flats Advisory Task Force.
- Oak Ridge Low Level Nuclear Waste Site - on closure techniques using a multiple layer cover system and a synthetic geonet drainage layer.

## **Companies (partial listing)**

Civil Software Design – Stormwater and Sediment Design Software. Lexington, KY. Approximately 7,000 users. U.S. Office of Surface Mining Permitting and Abandoned Mined Lands usage in 25 of 26 states, over 200 regulatory agencies use developed programs. Established 1982.

Surface Mining Institute – International Engineering Consultancy. Winchester, KY. Conducted engineering design and implementation for over 30 large international firms (predominantly mining) in 20 countries with a project total of over \$20 billion (USD). Conducted applied research for government and industry. Developed and advanced weep berm, screening-level geologic strata – water quality assessments, low permeable capping of problematic materials and natural stream design. Established 1980.

Rosebud – Fly ash monofill. West End, Ohio. Responsible for site selection, permitting, design, training, operation and monitoring of facility. Facilitated two expansions totaling 143 ac. Approximately 5,000,000 tons of fly ash deposited. Operated 2001 – 2017. Sold.

Civil Software Design International – Earthworks software products to advance productivity of designing hydrologic and environmental control systems. Santiago, Chile. Beta testing of software products to be released early 4<sup>th</sup> quarter 2019. Established 2013.

Solar Advantage – Design, installation and maintenance of solar systems for residential and commercial facilities. Castries, St. Lucia. Expanding to multi-Caribbean Island operations.

Wild Serenity Ltd. – Parent Company for investment operations. St. Lucia. Established 2015.

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## 2. PERSONAL INFORMATION

Date of Birth: September 22, 1947  
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University of Kentucky  
Lexington, Kentucky 40546-0276  
Email: Richard.Warner@uky.edu  
Home Address: 2073 Lakeside Drive  
Lexington, Kentucky 40502  
Phone/Fax: (859) 312-8956

## 3. EDUCATION

B.S. Water and Air Resources Engineering, University of Illinois-Chicago, 1970  
M.S. Water Resources Engineering, Clemson University, 1972  
Major: Water Resources Engineering, Minor: Operations Research  
Thesis: A Management Model for a Controlled Drainage and Subirrigation System  
Ph.D. Environmental Systems Engineering, Clemson University, 1981  
Major: Environmental Engineering and Water Resources Planning and Management  
Minors (1) Natural Resource and (2) Environment Economic  
Dissertation: Cost Effective Erosion and Sediment Control Systems

## 4. ACADEMIC AND MANAGEMENT POSITIONS

07/02 – Extension Professor, Biosystems and Agricultural Engineering Department, University of Kentucky. Responsible for extension, research, and teaching activities in the areas of: (1) stormwater management, erosion, and sediment control from disturbed areas, (2) waste management with an emphasis on the design, construction quality control, instrumentation, monitoring, and modeling of solid, hazardous, and low level nuclear waste landfills, (3) residential and commercial irrigation systems, farm irrigation and water supply; and (4) development and application of computer aided engineering and design programs.

07/86 – 06/02 Associate Extension Professor, Biosystems and Agricultural Engineering Department, University of Kentucky. Responsible for extension, research, and teaching activities in the areas of: (1) stormwater management, erosion, and sediment control from disturbed areas, (2) waste management with an emphasis on the design, construction quality control, instrumentation, monitoring, and modeling of solid, hazardous, and low level nuclear waste landfills, (3) residential and commercial irrigation systems, farm irrigation and water supply; and (4) development and application of computer aided engineering and design programs.

05/81 - 07/86: Assistant Extension Professor, Agricultural Engineering Department, University of Kentucky. Responsible for extension activities as well as research and teaching in the water and environmental resources area. Emphasis areas encompass: (1) stormwater management; erosion and sediment control, (2) landfill design, monitoring, and modeling; (3) irrigation; and (4) computer aided design.

10/80 - 05/81: Extension Specialist, Agricultural Engineering Department, University of Kentucky. Responsible for dissemination of applied technologies and methodologies concerning erosion and sediment control, and irrigation.

10/79 - 10/80: Hydrologist, United States Geological Survey, Columbia, South Carolina. Development of computer models to predict the hydrologic consequences and sediment impact of disturbed lands.

01/77 - 10/79: Doctoral research. Environmental Systems Engineering Department. Clemson University, Clemson, South Carolina. Developed a cost-effective erosion and sediment control system for disturbed lands. The

research effort encompassed hydrology and erosion modeling, sediment control, application of operations research techniques, and applied economics.

- 01/77 - 05/79: Teaching Assistant: Environmental Systems Engineering Department. Clemson University, Clemson, South Carolina. Responsible for lecturing, homework, and grading for 5 courses: (1) Water Resources Planning, (2) Environmental and Water Resources Modeling, (3) Water Resources Systems, (4) Applied Stream Survey Techniques, and (5) Water Resources Engineering.
- 08/76 - 01/77: Research Assistant: Environmental Systems Engineering Department. Clemson University, Clemson, South Carolina. Hydrology and nonpoint source pollution control research.
- 07/75 - 08/76: Research Assistant: Political Science Department, Clemson University, Clemson, South Carolina. Responsible for development of a public involvement workshop for water resources planners. Also, developed a computer retrieval system for assessment of special interest groups' power base.
- 06/74 - 05/75: Operations Officer: U.S. Naval Facility. Lewes, Delaware. Overall supervisory responsibility for all operational and administrative functions of the operations department and four divisions: research, analysis, communication/crypto, and electronics/computer. Fifty six employees.
- 10/73 - 06/74:\* Oceanographic Research Officer: Supervisory and technical research responsibility for the data acquisition, analysis and research divisions, and for three data gathering sections of the U.S. Naval Facility, Keflavik, Iceland. Thirty-seven employees.
- 03/73 - 06/74:\* Computer Systems Officer: Responsible for computer program development, data processing, and equipment operation and maintenance. Seven employees.
- 08/72 - 02/73: Special Intelligence/Oceanographic Watch Officer - Overall operational responsibility for a data acquisition and processing section. Fifteen employees.
- 01/74 - 06/74:\* Instructor - College Prep. Mathematics, Keflavik, Iceland.
- 02/73 - 06/74:\* Instructor - Oceanographic Analysis: Procedures and Techniques.
- 02/73 - 06/74:\* Classified Materials Control Officer: Responsible for classified equipment, documents, and messages.
- 05/72 - 08/72: Oceanographic Special Intelligence School
- 01/72 - 05/72: U.S. Navy Officers Candidate School, Newport, Rhode Island.
- 06/71 - 12/71: Research Assistant: Agricultural Engineering Department. Clemson University, Clemson, South Carolina. Drainage and subirrigation modeling.
- 08/70 - 06/71: Research Assistant: Civil Engineering Department. Clemson University. Clemson, South Carolina. Hydrology computer program development.

\*Concurrent responsibilities

## 5. PUBLICATIONS

### A. Refereed Journal Articles

- Taylor, T.J., C.T. Agouridis, R.C. Warner, and C.D. Barton. 2009. Runoff Curve Numbers for Loose-dumped Spoil in Eastern Kentucky. *International Journal of Mining, Reclamation and Environment* 23(2): 103-120.
- Agouridis, C.T., S.R. Workman, R.C. Warner, and G.D. Jennings. 2005. Livestock Grazing Management Impacts on Stream Water Quality: A Review. *Journal of the American Water Resources Association* 41(3): 591-606.
- Malone, R.W., L.Ma.D. Wauchope, L. Ahuja, K. Rojas. Q. Ma, R. Warner, and M. Byers. 2004. Modeling Hydrology, Metribuzin Degradation, and Metribuzin Transport in Macroporous Tilled and No-till Silt Loam Soil using RZWQM. *Pest Mgmt. Sci.* 60(3): 253-266.
- Moberly, C., S.R. Workman, and R.C. Warner. 2001. Calibration and Evaluation of a Hydrologic Model for Loose-Dump Mine Spoil. *International Journal of Surface Mining, Reclamation and Environment*. Vol. 15(1): 1-16.
- Meshkat, M., R.C. Warner, S.R. Workman. 2000. Evaporation Reduction Potential in an Undisturbed Soil Irrigated with Surface Drip and Sand Tube Irrigation. *Trans. of the ASAE*. Vol. 43(1): 79-86.
- Malone R.W., M.J. Shipitalo, L.W. Douglas, L.B. Owens, T. Nelsen, R.C. Warner, and M.E. Byers. 2000. Assessing Herbicide Movement using Soil Samples versus Percolate Samples. *Trans.of the ASAE*. Vol. 43(2):343-348.
- Antonious, George and R.C. Warner. 2001. Constructed Wetlands for Domestic Wastewater Treatment, Surveying and Performance in Kentucky. *Journal of Kentucky Academy of Science*. Vol. 61:1, pg. 23-29.
- Malone, R., R. Warner, and M. Byers. Runoff Losses of Surface-Applied Metribuzin as Influenced by Yard Waste Compost Amendments, No-Tillage, and Conventional-Tillage.

- Malone, R.W., R.C. Warner, S.R. Workman, and M.E. Byers. 1999. Modeling Surface and Subsurface Pesticide Transport Under Three Field Conditions Using PRZM-3 and GLEAMS. *Trans. of the ASAE*. Vol. 42(5):1275-1287.
- Meshkat, M., R.C. Warner, and L.R. Walton. 1999. Lysimeter Design, Construction, and Instrumentation for Assessing Evaporation from a Large Undisturbed Soil Monolith. *Applied Engineering in Agriculture*. Vol. 15(4): 303-308.
- Meshkat, M., R.C. Warner, and Stephen R. Workman. 1999. Modeling of Evaporation Reduction in Drip Irrigation System. *Journal of Irrigation and Drainage Engineering*. Nov-Dec. 1999. 315-319.
- Meshkat, M., R.C. Warner, S.R. Workman. 1998. Comparison of Water and Temperature Distribution Profiles Under Sand Tube Irrigation. *Trans. of the ASAE*. Vol. 41(6): 1657-1663.
- Bulletin of Environmental Contamination and Toxicology. 1996. vol 57.
- Malone, R., R. Warner, and M. Byers. Subsurface Losses of Surface-Applied Metribuzin as Influenced by Yard Waste Compost Amendments, No-Tillage, and Conventional-Tillage. *Bulletin of Environmental Contamination and Toxicology*. 1996. vol 57.
- Malone, R., R. Warner, M. Byers, D. Hilborn, and D. Gere. 1996. Extraction of Metribuzin from Soil Using Supercritical CO<sub>2</sub> (SFE). *Bulletin of Environmental Contamination and Toxicology*. vol 58.
- Malone, R., R. Warner, V. Evangelou and J. Wong. 1994. Transport of Benzene and Trichloroethylene through a Landfill Soil Liner Mixed with Coal Slurry. *Waste Management & Research*. vol 12.
- Griffin, M.L., B.J. Barfield, and R.C. Warner. 1985. Model Studies of the Hydraulic Efficiency of Sediment Ponds. *Trans. of the ASAE*. 28(3):779-804. May-June.
- Wilson, B.N., B.J. Barfield, I.D. Moore, and R.C. Warner. 1984. A Hydrology and Sedimentology Watershed Model. Part II: Sedimentology Component. *Trans. of the ASAE*. 27(5):1378-1384.

## **B. Submitted**

- Taylor, T.J., C.T. Agouridis, R.C. Warner, and C.D. Barton. In Review. Hydrologic Characteristics of Loose Dumped Spoil. *Hydrological Processes*.
- Taylor, T.J., C.T. Agouridis, R.C. Warner, and C.D. Barton. In Review. Water Quality Characteristics of Loose Dumped Spoil. *Ecological Engineering*.
- Malone, R.W., L. Ma, D. Wauchope, L. Ahuja, K. Rojas, Q. Ma, R. Warner and M. Byers. 2001. Modeling Hydrology, Metribuzin Transport in Macroporous Tilled and No-Tilled Silt Loam Using RZWQM.

## **C. Refereed Proceedings**

- Warner, R.C. and A Hootkany. 1998. Design, Construction, Monitoring and Performance of Animal Waste Lagoons. *Proceedings Western Section, American Society of Animal Science*. Vol. 49, pp1-7.
- Warner, R.C. Compacted Clay Liners for Landfills. *Proceedings of the Emerging Technologies for Hazardous Waste Management*. American Chemical Society, Industrial and Engineering Chemistry. Abstract and Paper. Atlanta, GA. Sept. 21-23, 1992.
- Baier, J. and R. Warner. 1990. A Simplified Computer Aided Trickle Irrigation Design and Parts Specification Model (STRIDES). *Proceedings of the 3rd National Irrigation Symposium*, Phoenix, AR. Oct. 28-Nov. 1, 1990.
- Warner, R.C. and N. Peters. Construction Quality Assurance for Hazardous Waste Land Disposal Facilities with Emphasis on Soil Barrier Layers and Final Multi-layer Cover Systems. *Proceedings of the National Conference on Hazardous Wastes and Hazardous Materials*. March 16-18. 1987.
- Peters, N., R.C. Warner, and A.L. Coates. Field Verification of the HELP Model for Multi-layer Hazardous Waste Landfill Covers. In *Hazardous Materials Control Research Institution, 7th National SUPERFUND Conference Proceedings*. December, 1986.
- Peters, N. and R.C. Warner. Applicability of the HELP Model in Multi-layer Cover Design: A Field Verification and Modeling Assessment. *The Twelfth Annual Research Symposium Land Disposal, Remedial Action, Incineration and Treatment of Hazardous Waste*. Cincinnati, Ohio. 4/21-23/86.
- Nebgen, P.J. and R.C. Warner. Applications of Computer Graphics in the Surface Mining Industry. *Proceedings. The Nineteenth International Symposium on Computer Applications in the Mineral Industries (APCOM)*. The Pennsylvania State University, University Park, Pennsylvania. April 14-18, 1986.
- Peters, N., R.C. Warner, and J.E. Wilson, and W. Grube. Field Verification of Landfill Cover System Construction to Provide Hydrologic Isolation. *Land Disposal of Hazardous Waste: Proceedings of the Eleventh Annual Research Symposium*. EPA/600/9-85/013, 1985.

- Nebgen, P.J. and R.C. Warner. 1985. Computer Aided Design of Hydrologic and Sediment Control Systems. Computer Aided Engineering Proceedings. 1985 Annual Conference. American Society for Engineering Education. Vol. 1. Georgia Institute of Technology. June 16-20, 1985.
- Meshkat, M. and R.C. Warner. A User-Friendly Interactive Trickle Irrigation Design Model. Third International Drip/Trickle Irrigation Congress. Fresno, California. November 17-21, 1985.
- Barfield, B.J., B.N. Wilson, and R.C. Warner. Simple Models to Evaluate Non-Point Sources and Controls. Proceedings of the Venice Conference on Agricultural Non-point Source Pollution (Developments in Environmental Modeling Series). International Society for Ecological Modeling. 1985.
- Warner, R. C., J. E. Wilson, N. Peters, H. J. Sterling, and W. E. Grube. Multiple Soil Layer Hazardous Waste Landfill Cover: Design, Construction, Instrumentation, and Monitoring. Land Disposal of Hazardous Waste: Proceedings of the Tenth Annual Research Symposium. EPA-600/9-84-007. 1984.
- Warner, R. C., B. N. Wilson, B. J. Barfield, and L. G. Wells. Evaluation of Alternative On-Site Sediment Controls Using the SEDIMOT II Model. Modeling and Simulation. University of Pittsburgh. Pittsburgh, Pennsylvania, April, 1982.
- Warner, R. C. and B. C. Dysart III. Erosion Modeling Approaches for Construction Sites. ASCE Symposium on Watershed Management. Boise, Idaho. July 21-23, 1980.

## **D. Books**

- Warner, R.C. and C.T. Agouridis. 2004. Stream Channel Construction. In Handbook of Western Reclamation Techniques. Section II: Hydrology. U.S. Department of Interior, Office of Surface Mining. 62 p.
- Kentucky Erosion Prevention and Sediment Control Field Guide. 2004. Technical Reviewer
- Barfield, B.J., R.C. Warner, and C.T. Haan. Applied Hydrology and Sedimentology for Disturbed Areas. Oklahoma Technical Press. 815 Stillwater. Stillwater, Oklahoma. 603 pps. 1981.

## **E. Chapters**

- Warner, R.C. Mining Environmental Handbook: Effects of Mining on the Environment and American Environmental Controls on Mining. J.J. Marcus editor. 785 pps. Chapter 6.3.2.1: Sediment Control Systems. pp 112-141. Imperial College Press. London, England. 1997.
- Warner, R.C. Handbook of Western Reclamation Techniques. Section II Hydrology F.K. Ferris editor. Dept of Interior, Office of Surface Mining, Denver, CO 1997.
- Chapter B1: Sediment Control Basin Design and Construction
- Chapter B2: Diversion Design and Construction
- Chapter C5: Vegetative Filters
- Chapter D2: Stream Channel Construction
- SME Mining Engineering Handbook, 2nd Edition. Chapter 12.1 Design and Management of Water and Sediment Control Systems. Society of Mining Engineers. Littleton, CO. 1992. (Requested to write this chapter for this two-volume handbook, The SME Engineering Handbook is revised every 20 years and is considered the bible for the mining industry).
- Nebgen, P.J. and R.C. Warner. Chapter 84. Applications of Computer Graphics in the Surface Mining Industry. In Applications of Computers and Operations Research in the Mineral Industry. Ed. R.V. Ramani Society of Mining Engineers, Inc. pps. 892-903. 1986.
- Wilson, B.N., B.J. Barfield, and R.C. Warner. 1986. Simple Models to Evaluate Nonpoint Pollution Sources and Controls. In Agricultural Nonpoint Source Pollution: Model Selection and Application. Ed. Aldo Giorgini and Franco Zingales. Elsevier. New York, NY. pps. 231-263.

## **F. Computer and Design Manuals**

- R.C. Warner, T.W. Strum and S.F. Torrealba. 2007. Seep Berm Design Manual. U.S. Environmental Protection Agency, Atlanta, GA. Nov. 2007. 20pp.
- Warner, R.C. and G.R. Foster. Applications of RUSLE, Chapter 7 in Revised USLE for Construction and Mining Version 1.06c.
- Kohley, T.W., R.C. Warner, M.E. Anderson and J.D. Hamerlinck. 2002. Research and Development of a GIS-Based Data Management and Model Integration Tool for Coal Mine Permitting and Reclamation in Wyoming. University of Wyoming Abandoned Coal mine Land Research program. 47 pps.
- Warner, R.C., D.J. Marshall and P.S. Schwab. SEDCAD – AutoCAD Interface (SCAC4): Design Manual and Users Guide. 90 pp. Civil Software Design. Ames, IA. 2001.

- Warner, R.C. and G.R. Foster. Guidelines for the Use of the Revised Universal Soil Loss Equation (RUSLE) Version 1.06 on Mined Lands, Construction Sites and Reclaimed Lands. T.T. Toy and G.R. Foster editors. Chapter 7: Applications of RUSLE, 44 pp. Off of Surface Mining. Denver, CO. 1998.
- Warner, R.C., P.J. Schwab and D.J. Marshall. SEDCAD 4 for Windows 95/98 & NT: Design Manual and User's Guide. pp 125 plus CD. Civil Software Design. Ames, IA. 1998.
- Warner, R.C. and P.J. Schwab. SEDCAD+ Version 3 Training Manual. 19 chapters, 310 pps. Civil Software Design, Ames, IA. 1992.
- Marshall, D.J., R.C. Warner and P.J. Schwab. AutoCAD®\_SEDCAD+TM Interface. Version 1.0 Civil Software Design, Ames, IA. 92 pp. 1992.
- Baier, J.W. and R.C. Warner. STRIDES (Simplified Trickle Irrigation Design and Specification Computer Model): Design and Users Manual. 52 pp. Agricultural Engineering Department, University of Kentucky. 1991.
- Schwab, P.J. and R.C. Warner. SEDCAD Version 2.0 (Sediment, Erosion, and Discharge by Computer Aided Design) Design Manual. 338 pp. Civil Software Design. Lexington, KY. 1987.
- Masoud, M. and R.C. Warner. Trickle Systems Design Model: Design and Users Manual. 41 pp. Agricultural Engineering Department, University of Kentucky. 1986.
- Warner, R. C., B. N. Wilson, B. J. Barfield, D. S. Logsdon and P. J. Nebgen. A Hydrology and Sedimentology Watershed Model. Part II: User's Manual. 215 pp. Department of Agricultural Engineering, University of Kentucky, Lexington, Kentucky. 1982.

## **G. Annotated Bibliography**

- Doekson, G.B. Jones, W. Park, M. Renkow, J. Schmidt, and R. Warner. Decision Aids for Municipal Solid Waste Management in Rural Areas: An Annotated Bibliography. Southern Rural Development Center. SRDC Publication No. 190. June 1995.

## **H. Rapporteur's Report**

- The Rene Dubos Center for Human Environments, Inc. 1986. Maintaining the Production, Environmental and Social Values Obtained from Agricultural Land in the U.S.A. The Environmental Regeneration Series. Praeger Publications, New York, NY. (Author of the Rapporteur's Report on Workshop 4-Managing Land Use.)

## **I. Extension Publications**

### **(1) Bulletins**

- Warner, R.C., S. Stombaugh, F. Collins-Camargo, M. Anderson, P. Howell, and J. Hagen. Dec. 2000. Practical Construction Techniques for Swine and Dairy Waste Lagoons. Joint publication with Natural Resources Conservation Service. 27 pps.
- Harker, C., W. Fountain, and R. Warner. Home Composting: A Guide to Managing Organic Yard Wastes. CES-UK HORT - 1991.
- Warner, R.C., R. Chamberlain, G. Logsdon, and J. White. 1992. Recycling Facilities in Kentucky: A Listing of Drop-Off and Buy-Back Recycling Facilities and Curbside Collection of Recyclables. Solid Waste Task Force Report, CES, University of Kentucky, Feb. 1992.
- Turner, L.W., R.C. Warner, and John P. Chastain. Micro-sprinkler and Fan Cooling for Dairy Cows: Practical Design Considerations. CES UK College of Agr. AEN-75. Jan. 92.
- Tobacco Bed Irrigation With Low-Volume, Low-Pressure Systems (70% completed)  
Reclamation News and Views Newsletter (Co-Editor)
- Vol. 1 No. 1 - What is the Reclamation News & Views Newsletter, V.P. Evangelou, R.C. Warner, T. Richards.
- Vol. 1 No. 3 - Porous Check Dam Design, R.C. Warner, and M.C. Hirschi.
- Vol. 1 No. 8 - Basic Water Chemistry on Settleable Solids in Coal Mine Sediment Ponds, V.P. Evangelou, and R.C. Warner.
- Vol. 2, No. 4 - How Neutralizing Agents Affect Water Quality, V.P. Evangelou and R.C. Warner.
- Vol. 3, No. 2 - Effects of Mulches on Infiltration, Runoff and Erosion on Reclaimed Minelands, S.D. Biggerstaff, I.D. Moore, and R.C. Warner.

### **(2) Other Newsletters**

Developing a Waste Stream Data Base. Community Development News. July 20, 1990.  
Trickle Irrigation for Christmas Trees - Forestry Newsletter

### (3) Agricultural Engineering Updates/Alerts

Using Topographic Maps in Extension

AEU-11 - A User-Oriented Introduction to the SEDIMOT II Program, B.N. Wilson, R.C. Warner, and B.J. Barfield.

AEU-19 - File Editing on the HP3000 for the SEDIMOT II Computer Model, D.S. Logsdon and R.C. Warner.

AEU-27 - Instructions for Updating the SEDIMOT II Computer Model, D.S. Logsdon and R.C. Warner.

AEU-30 - Certified Water Well Drillers

AEU-32 - Trickle Irrigation Installation for Horticulture Crops

AEU-36 Irrigation Companies

AE Alert - Some Guidance on Tobacco Irrigation Decisions

### (4) Newspapers and Magazines

UK Scientists Research Ways to Improve Water Quality. The Magazine, UK College of Agriculture. Spring 2006.

#### News releases:

Keep Animals Warm, Save Money with Newspapers

Is Your Drinking Water Safe?

Irrigation Efficiency

A Water Pump Without Power & Hydraulic Ram

Tensiometers: Soil Moisture Movement for Irrigation Management. February 30, 1989

Fact Sheet: Ag Engineering Course Gives Students Theory and Practice. May 5, 1989

Soil and Water Conservation Field Days: Half page in Louisville Courier Journal and half-page in Lexington Herald Leader

A Matrix of Suppliers and Areas of Emphasis

Pond and Lagoon Construction Advice.

Kentucky Farmer: Agricultural Engineering Briefs

Tips to Avoid Clogging in Trickle Irrigation Systems

Chemigations

Trickle Irrigation Yields Profits

Chemical Injection Through Irrigation Systems,

Results of Burley Irrigation Studies

Measuring Stream Flow

Irrigation Planning Checklist.

A Water Pump with Free Power.

Constructing a Safe Water Supply.

Irrigating Tobacco

Trickle Irrigation Yields Profits

Chemical Injection Through Irrigation Systems

### (5) PowerPoint Training Materials

Storm Water & Sediment Control: New Technologies & Design Considerations.

Head of Hollow Fill Design: A Systems Approach.

Design of Blueberry Automatic Irrigation Systems.

Storm Water & Sediment Control: New Technologies & Design Considerations.

Head of Hollow Fill Hydrology.

Automatic Irrigation System Design.

Automatic Monitoring Systems for Reclaimed Mined Lands and Permitting.

Sediment Storage Design Considerations for Temporary Structures.

Construction Techniques for Swine and Dairy Animal Waste Lagoons.

Design of Contour Furrows and Terraces in Mining.

Rick-based Sediment Regulations: Opportunities to Improvement Environmental Quality and Reduce Costs.

Environmental Impact and Cost of Mining: Regulatory Implications of Design Storm Selection.

Design of Erosion Prevention and Sediment Control Systems.

Drip Irrigation Design.

Using the Revised Universal Soil Loss Equation (RUSLE 1.06 computer model) for Mining and Reclamation.

Automatic Sampling Equipment for Rainfall, Runoff and Sediment.

Fundamentals of Geographic Information Systems Applied to Hydrology.

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- Hootkany, A., R. Warner, G. Felton, and J. Taraba. Laboratory Determination of Dairy Waste Lagoon Soil Liner Permeability as a Function of Clay Content, and Compactive Effort. 1994 American Society of Agricultural Engineers Meeting. Atlanta, Georgia. Paper No. 94-2531.
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## **M. Abstracts**

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- R. Warner, F. Camargo, and M. Anderson. Automatic Monitoring Systems for Reclamation Design, Surface Mining Reclamation Approaches to Bond Release: Cumulative Hydrologic Impact Assessment, Office of Surface Mining, Western Regional Coordinating center, Office of Technology Transfer, Billings, MT, Aug 27 - Sept 1, 2000.
- R. Warner, Sediment Storage Design Considerations for Temporary Structures. SEDCAD and RUSLE, Surface Mining Reclamation approaches to Bond Release: Cumulative Hydrologic Impact Assessment, Office of Surface Mining, Western Regional Coordinating center, Office of Technology Transfer, Billings, MT, Aug 27 - Sept 1, 2000.
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- Warner, R.C. and K. Dozier. Paint Recycling. Proceeding of the 4th Annual Kentucky Recycling Conference. Abstract. Lexington, KY. July 12-14, 1992.
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- Warner, R.C. and J.W. Baier. Landfill Regulations: RCRA Subtitle D Part 258. Proceedings of the Water Quality and Waste Management Symposium, Water Quality & Waste Management. Abstract. May 12-14, 1992.
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- Warner, R.C. Waste to Energy, Incinerations and Refuse Derived Fuel. Proceedings of the Solid Waste Management Symposium, Implementing an Extension Initiative. Abstract. May 8-10, 1991.
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- Agouridis, C.T., R.C. Warner, and C.D. Barton. 2008. Design of a Headwater Stream System for a Head-of-Hollow Fill. One-page informative document for UK Board of Trustees.
- Graves, D.H., C.D. Barton, C.T. Agouridis, R.J. Sweigard, and R.C. Warner. 2008. Reforestation of Coal-Mined Lands. Two-page informative document.
- C.T. Agouridis and R.C. Warner. 2006. Reforestation Project Designated a Commonwealth Collaborative. BAE Link.

(2) Other Publications

- Warner, R.C., C.T. Agouridis, C. Barton, D. Graves, and R. Sweigard. ASAE International Meeting. 2-4 Aug 04.
- Weber, D., T.W. Sturm, and R. Warner. Impact of Urbanization on Sediment Budget of Peachtree Creek. ASCE Water and Environmental Resources Congress. 27 Jun - 1 Jul 04.
- Creating Sustainable High-Value Forests. ASAE International Meeting. 2-4 Aug 04.
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## 6. TECHNOLOGY TRANSFER ACTIVITIES

### A. Policy Development and Regulatory Initiatives and Policy Development

1. Federal Program Proposed Rule – Revegetation Requirements of Loose-Dump Spoil.
2. Appalachian Reforestation Initiative for Mined Land Reclamation.
3. Negotiator for Head-of-Hollow Notice of Violation Program Implementation (KY Coal Industry versus KY Dept. of Surface Mining).
4. Acquisition of Representative Runoff Curve Numbers for Appalachian Mining Activities (numerous meetings with regulatory agencies, mining associations and engineering consultants).
5. Provided technique expertise in the development of storm water control regulations (new construction) for Jessamine Co. (incorporated into final regulatory program).

There are three primary technology transfer areas that are being emphasized: (1) stormwater, erosion, and sediment control systems; (2) landfill design, construction, instrumentation, monitoring, and modeling for permitting, operation, and closure of solid waste, hazardous, low level nuclear, and confined animal facilities; and (3) irrigation. All three activities include developing computer aided design (CAD); acquisition of field-scale verification data through demonstration studies; and

technology transfer via new and established short courses, development of user manuals, demonstration workshops, use of mass media, publications, books, field days, county agent training, news letters, and technical reports.

## **B. Technology Transfer Short Courses Developed**

Twenty-seven comprehensive short courses generic titles have been developed as a vehicle to convey recent research methodologies and techniques, in applied terms, to consulting engineers, industry, regulatory personnel, academia, contractors, inspectors, extension agents, and farmers. In excess of 6,500 persons have attended 201 1/2 to five day short courses, which have been modified for regional conditions and taught throughout the United States, and internationally.

## **C. Technology Transfer Short Courses**

Stormwater, Erosion and Sediment Control Short Courses

Fundamentals of Hydrology, Erosion and Sediment Control (The 'Red Book'),

SEDIMOT II (primarily applied to coal mining),

SEDCAD (wide spectrum of applications),

Sediment Basins,

Erosion and Sediment Control Systems (wide spectrum of applications),

Probably Hydrologic Consequence of Mining,

Hardware and Software for Computer Aided Drawing in Mining,

Reclamation Equipment in Surface Mining,

Permitting,

Abandoned Mined Lands,

Pollution Prevention Plans,

Urban Erosion and Sediment Control on Construction Sites,

AutoCAD Applications,

Hydrologic Applications Using Geographic Information Systems,

High Hazard Impoundments,

Analyzing Stormwater Conveyance Systems Using HEC-2,

Revised Universal Soil Loss Equation (RUSLE) for Mining and Construction Sites, and

Design of Highway Drainage and Sediment Control Systems.

### **Waste Management Short Courses**

Siting and Design of Solid Waste Landfills

Design, Construction and Monitoring of Multi-layer Soil Covers for Hazardous Waste Landfills

Solid Waste Management

Practical Construction Techniques for Swine and Dairy Waste Lagoons

### **Irrigation**

Basic Irrigation Design

Design of Trickle Irrigation Systems

Trickle Irrigation Installation for Horticulture Crops

Design of Agricultural Drainage Systems

## **D. Listing of Short Courses Taught**

2007

Hydrologic Modeling of Valley Fills. Nov. 16, 2006. Charleston, WV. (4 participants)

New Sediment Control Technologies for Illinois Coal Basin Region. Feb. 19-21. Evansville, IN. (12 participants)

Design of Stormwater and Sediment Control Systems for Mining in the High Elevations. Mar. 6-8, 2007. Steamboat, CO. (17 participants)

Surface Water, Erosion and Sediment Control for Infrastructure in Cold Climates, June 14-15, 2007. Juneau, AK. (6 participants)

Integration of Surface Water, Erosion and Sediment Control Systems with Mine and Infrastructure Planning. July 31, 2007. Santiago, Chile (16 participants)

- Design and Construction of Sediment Controls During Mine Exploration. August 6, 2007. Araguaia, Brazil (12 participants)
- Regulatory Implications and System Design Considerations: The Beneficial Impact of Data Analyses Associated with a Comprehensive Surface Water and Sediment Monitoring Program. Oct. 17-18. Noumea, New Caledonia. (13 participants) Taught with R. Merz and S. Torrealba.
- The Design and Performance of Weep Berms for Small Residential and Commercial Construction Sites. Oct. 29, 2007. Atlanta, GA. (145 participants)
- Hydrologic and Erosion Aspects of Geomorphic Land Form Design in the Southwestern U.S. Nov. 7-9, 2007. Gallup, NM. (11 participants)
- 2004-2006
- Stream Stability in Glacial Till Environments. 8-9 Sept 05, Healy, AK (6).
- Design of a Comprehensive Surface Water and Sediment Monitoring System. 24 May 05, Kone, New Caledonia.
- Utilization of Mine Soils for Low Permeable Leach Pad Liners. 17 Jan 06, Cajamarca, Peru (9).
- Evaluating Alternative TSS Regulatory Options. 3 Feb 06, Kone, New Caledonia (12).
- Designing a Surface Water and Sediment Control System for Mining in the African Safari: SEDCAD Applications. 13-17 Mar 06, Ghana, Africa (12).
- New Technologies for Storm Water and Sediment Control in Appalachian Coal Fields. 25 Apr 06, Frankfort, KY (65).
- Applicability of Surface Water and Sediment Monitoring Data in the Design of a Regulatory Program. 27 July 06, Noumea, New Caledonia (10).
- Cost-effective Design of Sediment Ponds. 2 Aug 06, Brisbane, Australia. (6).
- Design of Surface Water, Sediment and Metals Control Measures for a Leach Pad. 19-21 Sept 06, Lima, Peru. (8).
- 2003
- Advanced Erosion and Sediment Control Design: 19 Feb 03 Raleigh, NC (106).
- Advanced Erosion and Sediment Control Design: 19 Mar 03 Raleigh, NC (124).
- Surface Water and Sediment: International Policy Development: 18 Apr 03 Lima, Peru (38).
- Western Alkaline Mining Initiative: Formulation of Regulations: 11 Aug 03 Denver, CO (34); 12 Aug 03 Farmington, NM (47); 14 Aug 03 Casper, WY (31).
- Design of Sediment Control Systems for Arid and Semi-arid Areas: 12-14 Nov 03 Gallup, NM (14).
- International Technology Transfer: SEDCAD 4.0, RUSLE and New OSM Alkalinity Regulations: 2-6 Feb 04 Playa de Carmen, Mexico (10).
- Kentucky Erosion Prevention and Sediment Control: 5 Jan 04 Lexington, KY (32).
- Drip Irrigation: Installation and Maintenance: 18 Feb 04 Daviess County, KY (18).
- Design of Stormwater and Sediment Control Systems for Appalachian Mining: 12-14 May 04 Pikeville, KY (12).
- Sediment Control Systems for Hard Rock Mining in High Elevation Rain Forests: 16-17 Jul 04 Quito, Ecuador (9).
- 2002
- Drip Workshop: Step-by-Step Design and Operation of Irrigation Systems for Cantaloupe Production. Green River Co-Op. Nelson Co. 2/24/02. (18 students)
- Design of Erosion and Sediment Control Systems for Hard-rock Mining in High-Altitude Environments. Newmont Mining. Yanacocha Mine, PERU. 3/11 – 3/15/02. (32 students)
- Drip Irrigation: Design & Installation Techniques. Agent Training. Fayette County. 4/23/02. (36 participants)
- SEDCAD: Design of Cost effective Coal Mining Permits. Trapper Mine. Steamboat, CO. 7/24 – 7/26/02. (8 students)
- 2001
- Design of an Erosion Prevention and Sediment Control System: An Example at the Big Creek School Site. Fulton County Extension Service, Dunwoody, GA. 2/5/01; Gwinnett County, Norcross, GA. 2/6/01 (2 courses); Southern Polytechnic State University. Marietta, GA. 2/7/01 (2 courses); Coweta County Extension Service, Newman, GA. 2/8/01. (series of six 4-hour short courses taught to 228 participants)
- Project Design for Abandoned Mined Lands: Stormwater, Erosion and Sediment Control Systems. Harrisburg, PA. 3/13 – 3/15/01. (18 students)
- GIS Developments for Hydrologic Spatial Data. Office of Information Technology, Dept of Interior, Billings, MT. 7/16 – 7/18/01. (43 students)
- Best Management Practices for Sediment Control: An Assessment of Options. Minera Yanacocha. Cajamarca, PERU. 9/14/01. (23 students)
- Design of Stormwater and Sediment Controls for Urban Construction and Development Sites . Louisville Metropolitan Sewer District. 11/19 – 11/21/01. (8 students)
- Design of an Erosion Prevention and Sediment Control System: An Example at the Big Creek School Site. Fulton County Extension Service, Dunwoody, GA. 2/5

- Design of an Erosion Prevention and Sediment Control System: An Example at the Big Creek School Site. Gwinnett County, Norcross, GA. 2/6 (2 courses)
- Design of an Erosion Prevention and Sediment Control System: An Example at the Big Creek School Site. Southern Polytechnic State University. Marietta, GA. 2/7 (2 courses)
- Design of an Erosion Prevention and Sediment Control System: An Example at the Big Creek School Site. Coweta County Extension Service, Newnan, GA. 2/8
- Project Design for Abandoned Mined Lands: Stormwater, Erosion and Sediment Control Systems. Harrisburg, PA. 3/13-15
- GIS Developments for Hydrologic Spatial Data Office of Information Technology, Dept. of Interior, Billings, MT. 7/16-18
- Best Management Practices for Sediment Control: An Assessment of Options. Minera Yanacocha. Cajamarca, Peru. 9/14
- 2000
- The Potential for GIS in Eastern Coal Mining Permitting and Review, Surface Mining Reclamation and Enforcement, Lexington, KY. 3/13
- Geographic Information Systems and Electronic Permitting: Technical Review Development. . KY Department of Surface Mining Reclamation and Enforcement. Frankfort, KY. 4/10
- Computer Aided Engineering and Design of High Hazard Impoundments: Hydrologic and Hydraulic Design, Mine Safety and Health Administration 2000 Impoundment Engineers' Training Conference, national Mining Academy, Beckley, WV. 5/18
- New Developments in Computer Aided Design and Geographic Information Systems: Applications to Coal Mining, Office of Information Technology, Dept. of Interior, Billings, MT. 5/22
- Application of Computer Aided Design and Engineering Software to Urban Erosion and Sediment Control Systems, 13th Annual DeKalb County Soil and Water Conservation District's Erosion and Sediment Control Seminar, Conyers, GA. 5/19
- Computer Aided Design of Stormwater and Sediment Control Systems for Contour and Mountaintop Coal Mining, Office of Surface Mining, National Technology Transfer Short Course, Morgantown, WV. 7/11-13
- Hydrology Applications Using CAD and GIS, Western Regional Coordinating Center, Office of Surface Mining, Denver, CO. 7/25-27
- SEDCAD 4.0: Design of Stormwater, Erosion and Sediment Control Systems. Mid-Continent Coordinating Center. Alton, IL. 8/15-17
- Spatial Data for Hydrology Modeling Workshop Interactive Forum on Surface Mining Approaches to Bond Release, Cumulative Hydrologic Impact Assessment, Office of Technology Transfer, Western Regional Coordinating Center, Office of Surface Mining, Billings, MT. 8/28
- SEDCAD: Use in Expert Testimony. Univ. of KY. Lexington, KY. 10/2
- 1999
- Design of Stormwater Control Systems for Drastically Disturbed Lands. Gallup, NM. 1/18-20
- RUSLE 1.06: Reclamation Planning, Design and Permitting. Office of Technology Transfer. Office of Surface Mining. Laramie, WY. 4/12-13
- Permitting and Engineering of Sediment Control Systems During Active Mining and Reclamation. Office of Technology Transfer. Office of Surface Mining. Laramie, WY. 4/14-16
- Stormwater Management and Sediment Basin Design Using SEDCAD4. Ohio Department of Natural Resources. New Philadelphia, OH. 5/5-7
- Computer Aided Engineering and Design of Runoff and Sediment Control Systems. Office of Surface Mining. Mid-Continent Coordinating Center. Alton, IL. 5/25-27
- Application of RUSLE 1.06 to Arctic Environments. Alaska Division of Mines and Minerals. Anchorage, AK. 7/12-14
- RUSLE 1.06: Applications to Contour and Mountaintop Mining Methods in Eastern Kentucky. KY Department of Surface Mining Reclamation and Enforcement. Univ. of KY. Lexington, KY 7/19-20
- Design and Permitting Stormwater, Erosion and Sediment Control Systems. KY Department of Surface Mining Reclamation and Enforcement. Univ. of KY. Lexington, KY 7/21-23
- SEDCAD 4.0: Applications to Surface Mining and Reclamation in Arid and Semi-arid Lands. Office of Surface Mining. Gallup, NM 8/17-19.
- RUSLE 1.06: Applications to Mine Reclamation. Office of Technology Transfer. Office of Surface Mining. Flagstaff, AZ. 9/20-21
- Exploring AutoCAD and ArcView Capabilities to Increase Productivity in Coal Mining Permitting Review, Office of Surface Mining, Technology Information Processing System, Denver, CO,. 10/18-19

- Design of Highway Drainage Systems Using CAD/E Systems, Winchester, KY. 10/26-28
- Linking Geographical Information Systems with Hydrologic Systems: State of the Practice, Abandoned Coal Mine Land Research Initiatives Program, Laramie, WY. 11/17
- 1998
- Design of Highway Drainage and Sediment Control Systems. KY Department of Transportation. Frankfort, KY. 1/5-7
- Design of Sediment Control Systems for Reclamation in the Illinois Coal Basin Region. . Office of Surface Mining. Mid-Continent Coordinating Center. Alton, IL. 3/3-5
- Design of Highway Drainage and Sediment Control Systems. KY Department of Transportation. Frankfort, KY. 3/30-31, 4/1
- Design of Highway Drainage and Sediment Control Systems. KY Department of Transportation. Lexington, KY. 4/20-22
- SEDCAD4: Application to Alaska Coal Mine Permits. Alaska Division of Mines and Minerals. Fairbanks, AK. 6/29-30, 7/1
- Design of Highway Drainage and Sediment Control Systems. College of Engineering Continuing Education. Lexington, KY. 7/8-10
- Design of Highway Drainage and Sediment Control Systems. College of Engineering Continuing Education. Lexington, KY. 7/13-15
- Design of Highway Drainage and Sediment Control Systems. College of Engineering Continuing Education. Lexington, KY. 8/5-7
- Design and Evaluation of Alternative Sediment Control Systems in Western Mining. Office of Technology Transfer. Office of Surface Mining. Laramie, WY. 8/11-13
- SEDCAD, SEDCAD-AutoCAD Interface and ArcView Applications to Western Surface Mining. Technology Information Processing System. Denver, CO. 9/23-24
- SEDCAD: Applications to Eastern Kentucky Mining Operations. Univ. of KY. Lexington, KY. 10/19-21
- ArcView Applications in Hydrology. Office of Technology Transfer. Office of Surface Mining. Gillette, WY. 11/16-17
- RUSLE 1.06: Applications to Western Mining Planning and Design. Office of Technology Transfer. Office of Surface Mining. Gillette, WY. 11/19-20
- Design of Advanced Sedimentation Methods for Large Coal Mine Stormwater and Sediment Control Basins. Texas Utilities. TX. 12/14-16
- 1997
- Design of Multi-cell Sediment Basins for Coal Pile Runoff in High Rainfall Environments. Borneo, Indonesia. 3/17-21
- Design of Highway Drainage and Sediment Control Systems. KY Department of Transportation. Frankfort, KY. 10/29-30
- Stormwater Management and Sediment Control for Coal Mining in the Four Corners Region. Office of Technology Transfer. Office of Surface Mining. Farmington, NM. 11/13-15
- Design of Highway Drainage and Sediment Control Systems. KY Department of Transportation. Frankfort, KY. 12/2-4
- 1996
- Hydrologic Applications and Dam Design for Mining in High Rainfall Areas of Borneo. Borneo, Indonesia. 3/4-15
- HEC-2; A Surface Water Profile Model. Univ. of KY. Lexington, KY. (with Dr. Eigel) 4/17-18
- SEDCAD+ and SEDACAD Applications to Mining and Landfill Permitting. Lexington, KY. 5/21-23
- 1995
- SEDCAD+ and SEDACAD. Lexington, KY. 10/9-11
- Application of SEDCAD+ and SEDACAD to Appalachian Coal Mining Permits. Zanesville, OH. 6/13-15
- Computer Aided Engineering and Design of Sediment Control Systems in the Powder River Coal Basin. Gillette, WY. 6/2-3
- Stormwater and Sediment Control Engineering Techniques: Applications to Western Coal Mining Operations. Sheridan, WY. 5/30-31, 6/1
- SEDCAD+ and SEDACAD: Applications to Mining, Environmental Remediation, and Subdivisions and Commercial Development. Lexington, KY. 3/28-30
- Integrated Solid Waste Management Workshop. Lexington, KY. 3/31
- 1994
- Pollution Prevention Plans: A step-by-step design procedure. LFUCG. Lexington, KY 70 participants, 3/2
- Landfills and Their Impact on Groundwater Transfer Stations: Design and Cost. UK Lexington, KY 44 participants. 3/3
- Stormwater and Sediment Control Systems for Western Mining Operations. OSM-WSC. Laramie, WY. 18 participants. 3/9-11
- Cost Analysis of Municipal Solid Waste landfills. Bell Co., KY 3/13

Design and Evaluation of Mine Permits in Texas. TX Railroad Commission, Austin, TX 12 participants 5/18-20

SEDCAD and SEDACAD Applications to mining: Innovative Approaches to Cost Effective Sediment Basin Design with Flocculation and Passive Dewatering Systems. TX Railroad Commission. Austin, TX 10 participants. 5/23-25

Development of Pollution Prevention Plans for Stormwater and Sediment Control in Coastal Areas. SC Coastal Council. Charleston, SC. 22 participants. 6/27-29

Landfill Bonding: Evaluating Alternative Options. Cleveland, OH 13 participants 7/13

Impoundments: Elements of Design, Construction, Inspection & Rehabilitation. Muskogee, OK. 11/30-12/2 1993

Cost Effective Design for Coal Mining, Gallup, NM. 16 participants 1/6-8

SEDCAD and SEDACAD: Design Applications for Mining and Industrial Development, UK, Lex. KY. 12 participants. 2/24-26

Design of Erosion and Sediment Control Systems for Abandoned Mined Lands, PADER, Harrisburg, PA. 16 participants. 5/5-7

Paint Collection and Recycling. Louisville, KY 37 participants 7/12-13

Designing Pollution Prevention Plans for Commercial and Industrial Development, Land Resources Commission. Greenville, SC. 23 participants 7/27-29

Landfill Permitting Review. Div. Of Waste Management. Frankfort, KY. 9/2

Potential for a Regional Solid Waste Landfill: Site Assessment Techniques. Bell Co., KY. 6 participants 9/3

Design Methodology for Pollution Prevention Plans. LFUCG staff engineers. Lexington, KY 14 participants 9/29

Landfill Costs: A component Assessment Methodology. Fayette Co., KY 10/13

Local Options for Managing Solid Waste. UK Lexington, KY 10/13

Urban Woodwaste Management Alternatives. An Interagency Workshop. Lexington, KY 15 participants 10/26

Pollution Prevention Plans and KPDES Permits: Design Applications for Subdivision Developments. LFUCG. Lexington, KY. 8 engineering design firms that complete 90% of Fayette Co. developments for subdivisions and industrial parks. 11/9

Application of SEDCAD and SEDACAD to Nonpoint Source Pollution Control. UK, Lexington, KY 18 participants 11/15-17

SEDCAD Applications in the Design of Stormwater, Erosion and Sediment Control Systems for Solid Waste Facilities. Frankfort, KY 16 participants 11/29-30

Pollution Prevent Plans and KPDES Permits: Design and Review Methodologies. LFUCG. Lexington, KY. 17 city engineers and inspectors. 12/2

Siting, Design and Monitoring Solid Waste Facilities. UK Lexington, KY 8 participants 12/2-4

Design of Stormwater Management Facilities: Standardization for Cost Effective Design, Implementation and Inspection. Indiana Society of Mining and Reclamation. Vincennes, IN. 50 participants. 12/7

Geological Considerations in Landfill Siting and Design. American Institute of Prof. Geologist. UK Lexington, KY 16 participants 12/4

Landfill Costs: Estimating Costs for a Regional Landfill. Addington Environmental, Lexington, KY 12/10 1992

Landfill Siting and Design. UK Lexington, KY. 12 participants. 12/1-3

Applications of the SEDACAD Program to Dam Design Permits, UK, Lexington. KY 8 participants. 11/6 1991

An Applied Short Course on Design and Evaluation of Stormwater Management, Erosion, and Sediment Controls, Lexington, KY 4.24-26 1990

Application of SEDCAD+ Ver. 3.0 to Permit Review in Kentucky 2/13

Permit Review Procedures for Western U.S. Surface Mining Using SEDCAD+ Ver. 3.0./ Office of Surface Mining, Western Technical Center, Denver, CO. 5/10-13

Technology for Cost Effective Design of Sediment Basins and Diversions. 1990 National Symposium on Mining, Knoxville, TN. 5/14

Stormwater Management and Sediment Control for Technical Support Personnel. Prestonsburg Community College, Prestonsburg, KY. 6/27

SEDCAD+ Ver. 3.0: Increasing Profitability through Cost Effective Designs. Lexington, KY. 7/16-18

Conversion of Rainforest into Long Term Sustainable Food Production Agricultural Lands: Methods to Minimize Environmental Impacts, Syiah Kuala University, Banda Aceh, Indonesia 10/2-17

SEDCAD+ Ver. 3.1 - Computer Aided Engineering/Design of Storm Water, Erosion, and Sediment Control Structures for Solid Waste Facilities, Lexington, KY. 11/14-16



1989

SEDCAD+ Ver. 2.15 Applications Course for the Appalachian Coal Region. Lexington, KY. 6/20-22  
Solid Waste Management. Southeast Region Water Quality Work Shop. Birmingham, AL. 11/14

1988

Using SEDCAD+ in the Surface Mining Permitting Process. Office of Surface Mining, Knoxville, TN. 3/3-4  
Design of Storm Water Management, Erosion, and Sediment Control Structures through SEDCAD+. Lexington, KY. 3/24-25

Application of SEDCAD+ to Storm Water and Sediment Control on Solid Waste Landfills: An Overview. Pennsylvania Department of Natural Resources, Bureau of Solid Waste Management. Harrisburg, PA. 5/5  
SEDCAD+ - Computer Aided Engineering/Design of Storm Water, Erosion, and Sediment Control Structures. Lexington, KY. 6/8-10  
SEDCAD+ - Computer Aided Engineering/Design of Storm Water, Erosion, and Sediment Control Structures. Lexington, KY. 9/7-9  
SEDCAD+ Design Techniques Applied to Surface Mining in Ohio. Ohio Department of Natural Resources. Division of Permits, Columbus, OH. 9/19-21  
SEDCAD+ - Computer Aided Engineering/Design of Storm Water, Erosion, and Sediment Control Structures. Lexington, KY. 11/16-18  
Sediment, Erosion, Discharge by Computer Aided Design (SEDCAD) Mini-Course 2. National Symposium on Mining, Hydrology, Sedimentology, and Reclamation. University of Kentucky. Lexington, KY. 12/88.

1987

Application of SEDCAD+ to Reclamation, Enforcement, and Oversight Activities of OSM. Office of Surface Mining, Western Technical Center. Denver, Colorado. 2/18-20  
Design and Hydrologic Evaluation of Multiple Soil Layer Cover Systems for Remedial Action Superfund Sites. Office of Research and Development, Hazardous Waste Engineering Research Laboratory. U.S. Environmental Protection Agency. Cincinnati, Ohio. 3/5  
Construction Quality Assurance for Hazardous Waste Landfills with Emphasis on Cover Systems. Short Course Seminar 2B, 4th National RCRA Conference on Hazardous Wastes and Hazardous Materials. Hazardous Material Control Research Institute. Washington, D.C. 3/16  
Trickle Irrigation Installation for Horticulture Crops. Lexington, Kentucky. 3/24  
Trickle Irrigation Installation for Horticulture Crops. Princeton, Kentucky. 3/26  
Engineering Designs of Multiple Soil Layer Covers for Low Level Nuclear Waste Sites. E. I. du Pont. Savannah River Plant. Aiken, SC. 4/13  
SEDIMOT II: for the Stormwater and Sediment Control Methods Appalachian and Illinois Coal Basin. Lexington, KY. 4/15-17  
Sediment Control at Hydroelectric Construction Sites. Duke Power Co., Charlotte, NC. 6/8-9  
Application of Hydrologic and Sediment Control Methods to Coal Mining in Canada. Hilton, Alberta, Canada. 6/15-19  
An Overview of the SEDCAD+ Model with Emphasis on Regulatory Implications. KY Dept. of Natural Resources and Environmental Protection, Frankfort, KY. 8/27  
SEDIMOT II - Agricultural Data Center, Lexington, KY. 9/2-4  
Multiple Soil Layer Cover Design Procedures for Control of Infiltration and Radon Gas and Uranium Tailing Sites. State of Colorado, Dept. of Health and Safety. Denver, CO. 11/17  
An Overview of the SEDCAD+ Model: Sediment, Erosion, Discharge by Computer Aided Design. Mini-Course 1987 National Symposium on Mining, Hydrology, Sedimentology, and Reclamation. Springfield, IL. 12/10  
Sediment, Erosion, Discharge by Computer Aided Design (SEDCAD) Mini-Course 2. National Symposium on Mining, Hydrology, Sedimentology, and Reclamation. University of Kentucky. Lexington, KY. 12/87.

1986

Application of Storm Water Management and Sediment Control Techniques to the Four Corners Coal Mining Area. New Mexico Department of Mining and Minerals. Gallup, NM. 4/7-9  
Applied Hydrology and Sedimentology for Disturbed Areas. Lexington, Kentucky. 4/28-5/1  
SEDIMOT II: Model Applications with Sediment Basin Dewatering Methodology. Lexington, Kentucky. 5/14-16  
SEDIMOT II: Model Applications to Contour and Mountain Top Removal Mining Operations. Lexington, Kentucky. 7/30-8/1  
Applied Hydrology and Sedimentology for Disturbed Areas. Lexington, Kentucky. 8/5-8  
SEDIMOT II: Application to Area Mining Techniques. Lexington, Kentucky. 10/8-10  
Trickle Irrigation Workshop. University of Kentucky Research and Education Center. Princeton, Kentucky. 10/22

- SEDCAD - Sediment, Erosion, Discharge by Computer Aided Design. Mini-Course 2. 1986 National Symposium on Mining, Hydrology, Sedimentology, and Reclamation. University of Kentucky. Lexington, Kentucky. 12/8 1985
- Designing an Erosion and Sediment Control Program for an Initiated Captive Mine: Application of SEDIMOT II. The Dolet Mining Venture Corp., Mansfield, Louisiana. 1/17-18
- Applied Hydrology and Sedimentology for Disturbed Lands. Lexington, Kentucky. 2/5-8
- Trickle Irrigation Planning and Design Procedures. Wayne County, Kentucky. 2/19
- Lawn Service Short Course: Lawn Management and Renovation through Irrigation. Louisville, Kentucky. 2/18
- Kentucky Surface Mining Permit Regulatory Review Procedures. Surface Mining Commission. Dept. for Surface Mining Reclamation and Enforcement. Natural Resources and Environmental Protection Cabinet. Frankfort, Kentucky. 2/20, 3/27, 4/10, 4/17
- Irrigation Installation for Horticultural Crops. Lexington, Kentucky. 5/2-3
- SEDIMOT II: Applications to Contour and Mountaintop Removal Mining Methods. Agricultural Data Center. Lexington, Kentucky. 5/8-10
- SEDIMOT II: Area Mining in the Illinois Coal Basin Region of Western Kentucky. Agricultural Data Center, Lexington, Kentucky. 7/10-12
- Application of SEDIMOT II to Regulatory Permits in the Western United States. Office of Surface Mining. Western Technical Center. Denver, Colorado. 7/22-24
- Agricultural Extension Agent Training. Princeton, Glasgow, and Lexington, Kentucky. 9/17-19
- SEDIMOT II: Emphasis on Appalachian Mining Methods. Agricultural Data Center, Lexington, Kentucky. 10/9-11 1984
- Computer Aided Design Application of the SEDIMOT II Model to Large Western U.S. Area Mining Methods. Western Technical Center, Office of Surface Mining. Denver, Colorado. 2/6-7
- Hydrology and Sedimentology of Surface Mined Lands. University of Kentucky. Lexington, Kentucky. 2/21-24
- SEDIMOT II. Agricultural Data Center. University of Kentucky. Lexington, Kentucky. 3/13-15
- Computer Hardware and Software Considerations for Coal and Engineering Companies. Mine Management, Planning, and Evaluation Seminar Series. Institute for Mining and Minerals Research. University of Kentucky. Lexington, Kentucky. 4/9
- A Microcomputer-Aided Design Model for Evaluating Hydrology and Sediment Control Strategies on Surface Mined Land. Second Annual Symposium Application of Microcomputers in the Mining Industry. Pennsylvania State University. University Park, Pennsylvania. 04/17-18:
- Applied Hydrology and Sedimentology for Western Mining Operations. Salt Lake City, Utah. 5/15-18
- SEDIMOT II Applied to Lignite Mining Methods in the Southwest. Stillwater, OK 8/20-22.
- SEDIMOT II Applied to Contour and Mountaintop Removal Mining Methods. Agricultural Data Center. Lexington, Kentucky. 10/17-19
- Design, Construction and Monitoring of Landfill Covers for Hazardous Waste. Geotechnical Engineering for Waste Disposal Projects. College of Engineering. The University of Texas at Austin. Austin, Texas. 10/31
- Hydrology and Sedimentology Techniques for Surface Mining: Advances in Computer Aided Design. The Old Ben Coal Company. Lexington, Kentucky. 11/15
- Designing Cost Effective Sediment Basins. National Symposium on Surface Mining, Hydrology, Sedimentology, and Reclamation. Lexington, Kentucky. 12/03 1983
- Surface Mining Sediment Control Using the SEDIMOT II Model. Agricultural Data Center. Lexington, Kentucky. 1/05-07
- Permitting Aspects of the SEDIMOT II Program for Regulatory Enforcement. Agricultural Data Center. Lexington, Kentucky. 1/20-21
- Application of the SEDIMOT II Program to Coal Mining Operations: The Permitting Process. Office of Surface Mining. Eastern Technical Center, Pittsburgh, Pennsylvania. 1/26-28
- The SEDIMOT II Program for Regulatory Analysis of Western Surface Mining. Western Technical Center. Denver, Colorado. 2/9-11
- Designing Sediment Control Systems for Area Mining Using SEDIMOT II. Madisonville Community College. Madisonville, Kentucky. 2/16-17
- Regulatory Assessment of Sediment Control Designs Using the SEDIMOT II Model. Department of Natural Resources and Environmental Protection. Division of Surface Mining Permits. Frankfort, Kentucky. 2/24
- Sediment Basin Design for Contour and Mountaintop Removal Using SEDIMOT II. Hazard Community College. Hazard, Kentucky. 2/25

- Hydrologic and Sedimentologic Control of Surface Mined Lands: The SEDIMOT II Approach. Agricultural Data Center. Lexington, Kentucky. 3/01-3
- Hydrology and Sedimentology Assessment of Surface Mining in the Southern Appalachian Basin: The SEDIMOT II Method. University of Florida. Gainesville, Florida. 4/5-7
- Applied Hydrology and Sedimentology for Disturbed Areas. Fort Mitchell, Kentucky. 4/18-21
- SEDIMOT II in the Appalachian Basin: Application to Contour and Mountaintop Removal Methods. Agricultural Data Center. Lexington, KY. 5/2-4
- The 1983 Annual Meeting on Reclamation of Surface Mined Land. Prestonsburg, Kentucky, May 10; Calhoun, Kentucky, May 17; London, Kentucky, May 25.
- Applied Hydrology and Sedimentology for Disturbed Areas in the Lignite Coal Region. Houston, Texas. 6/6-8
- An Overview of Computer Aided Design Models Applicable to the Surface Mining Industry. Lexington, Kentucky. 6/10
- Area Mining Hydrology and Sediment Control Using SEDIMOT II. Madisonville Community College, Madisonville, Kentucky. 7/14-15
- SEDIMOT II: A Computer Aided Design Model to Evaluate Alternative Sediment Control Management Schemes. 1983 International Symposium on Urban Hydrology, Hydraulics and Sediment Control. Lexington, Kentucky. 7/25
- SEDIMOT II: Hydrology and Sediment Control Design for Western U.S. Coal Mining. Denver, Colorado. 8/1-3
- SEDIMOT II: Applications to the Appalachian and Illinois Coal Regions. Agricultural Data Center. Lexington, Kentucky. 8/22-24
- SEDIMOT II: Application for Contour and Mountaintop Removal Mining Methods. Agricultural Data Center. Lexington, Kentucky. 10/18-20
- Computer Aided Design Decision Criteria for Surface Mining: An Overview with Applications. National Symposium on Surface Mining, Hydrology, Sedimentology, and Reclamation. Lexington, Kentucky. 11/28
- SEDIMOT II: Hydrologic and Sediment Control Options for the Mining Industry. Agricultural Data Center. Lexington, Kentucky. 12/8
- 1982
- Hydrology and Sedimentology of Surface Mined Lands. Kentucky Center for Energy Research. Lexington, Kentucky. 2/8-11
- Drainage Systems Workshop. Kentucky Land Improvement Contractors Association. Green River Area Development District Building. Owensboro, Kentucky. 3/1
- Hydrology and Sedimentology of Surface Mined Lands. Denver, Colorado. 3/9-12
- Hydrology and Sedimentology of Surface Mined Lands. Fort Mitchell, Kentucky. 5/17-20
- Hydrology and Sedimentology of Surface Mined Lands. Sheridan, Wyoming. 10/12-15
- SEDIMOT II: A Hydrology and Sediment Control Program for Surface Mining. Agricultural Data Center. University of Kentucky. Lexington, Kentucky. 11/1-3
- SEDIMOT II: A Hydrology and Sediment Control Program for Surface Mining. Agricultural Data Center. University of Kentucky. Lexington, Kentucky. 11/8-10
- Small-scale Sediment Control Systems. National Symposium on Surface Mining, Hydrology, Sedimentology and Reclamation. Lexington, Kentucky. 12/6
- SEDIMOT II: An Overview of the Model. National Symposium on Surface Mining, Hydrology, Sedimentology and Reclamation. Lexington, Kentucky. 12/7
- SEDIMOT II: An Overview. Holiday Inn. Lexington, Kentucky. 12/13
- 1981
- Hydrology and Sedimentology of Western Surface Mines. Denver, Colorado 3/10-13
- Reclamation Equipment Needs of the Surface Mining Industry. John Deere Heavy Equipment Division. Georgetown, Kentucky. 3/26
- Hydrology, Erosion and Sediment Control of Disturbed Mined Lands. Denver, Colorado. 10/13-16
- Sediment Control Systems. National Symposium on Surface Mining, Hydrology, Sedimentology and Reclamation. Lexington, Kentucky. 12/7
- 1980
- Hydrology and Sedimentology of Surface Mined Lands. Southwest Virginia Community College, Lebanon, Virginia. 11/5-7
- Determining the Probable Hydrologic Consequences of Surface Coal Mining. National Symposium on Surface Mining, Hydrology, Sedimentology and Reclamation. Lexington, Kentucky. 12/1-2
- Agricultural Extension Agent Training. Princeton, Glasgow, and Lexington, Kentucky. 9/17-19
- SEDIMOT II: Emphasis on Appalachian Mining Methods. Agricultural Data Center, Lexington, Kentucky. 10/9-11

## E. Computer Programs Developed

Revised USLE for Construction and Mining Version 1.06c

Warner, R.C., D.J. Marshall, and P.S. Schwab. SEDCAD-AutoCAD Interface – The SEDCAD-AutoCAD interface enables the user to overlay a mine plan onto a contour map, locate, designate, link and route between individual sediment control structures, draw the overall watershed and subwatersheds, link and route subwatersheds. The user has a series of tools enabling the construction of efficient design drawings for the pond, embankment and spillways resulting in complete dam design drawings for use in permits.

Warner, R.C. and M.E. Anderson. 2002. SED-PrePro. A SEDCAD ArcView pre-processor utilizes overlays to develop topography, land use, soils and a land mining plan. Sediment control structures are located, designed, routed and linked and watersheds, and subwatersheds are automatically drawn and attributes such as area and Tc are automatically derived from the overlays. The stream network is automatically drawn. The Curve Number is automatically derived based entirely on the two overlays of land use and spoils spatially linked with subwatersheds.

SEDCAD-ArcView. 2001. This software package is similar to the SEDCAD-AutoCAD Interface program (described below) except that it takes advantage of the many attributes afforded through Geographic Information Systems (GIS). Thus overlays are developed for topography, land use, soils and a land disturbance plan, such as mining. Structures are located, designated, routed and linked as before except now watersheds, and subwatersheds are automatically drawn and attributes such as area and time of concentration are automatically derived from the overlays. Additionally, the stream network is automatically drawn and all structures linked. A nice feature is derivation of the Curve Number, which accounts for the rainfall-runoff modeling component, based entirely on the two overlays of land use and soils automatically spatially linked with subwatersheds. (Developed with Mike Anderson, Biosystems and Agricultural Engineering).

SEDCAD-AutoCAD Interface (version 4.0). 2001. The linkage of SEDCAD to AutoCAD was accomplished both as a preprocessor from AutoCAD to SEDCAD and as a post-processor drawing package that rapidly created permit design drawings for sediment ponds. The SEDCAD-AutoCAD interface enables the user to overlay a mine plan onto a contour map, locate, designate, link and route between individual structures, draw the overall watershed and subwatersheds, link and route subwatersheds. Derived data is seamlessly linked to SEDCAD. AutoCAD is used to draw the sediment basin and inputs regarding elevation-area are also linked to SEDCAD. After the system of structures is analyzed within SEDCAD outputs are transferred to AutoCAD where the user has a series of tools enabling the construction of efficient design drawings for the pond, embankment and spillways. The SEDCAD-AutoCAD interface results in development of complete dam design drawings for use in permit submittal and construction. The drawing package provides a plan view with section lines and spillways, profiles with embankment, basin and spillways, typical spillways with actual design sizing and dimensions, an elevation-area-capacity-discharge table and graph for the basin, and miscellaneous data and drawing elements. (Developed with Dennis Marshall Purdue University).

Stormwater, Erosion and Sediment Computer Aided Design (SEDCAD version 4 for Windows 95/98 and NT). 1998. This was a major restructuring and upgrade including conversion to a dynamic run capability that enables design on the fly, conversion to the Windows environment, restructuring of networking allowing on limitations on structure location and linkages. Increases in editing capabilities, the addition of some channel and dewatering spillways design capabilities, extensive online reference information and help, and extensive detailed on-line examples for all program structures were also upgrade features. (Developed with Pam Schwab, Civil Software Design and Dennis Marshall, Purdue University).

Revised Universal Soil Loss Equation (RUSLE) version 1.06 for Mining and Construction). 1998. The RUSLE program was modified to accommodate mining and construction applications. Additional algorithms were added for complex slope configurations, determination of sediment yield with respect to water quality, new diversion designs and grass strips. (Developed with the Office of Surface Mining sponsored RUSLE Task Working Group).

AutoCAD-SEDCAD Interface Version 1- Automatic Cross-Sections and Specifications. 1993. A new program that provides the ability to automatically calculate and draw cross-sections from plan view drawings and provides labels and specifications. Provides comprehensive design drawings. (Developed with Dennis Marshall, Purdue University).

SEDCAD Version 3.0 (Sediment, Erosion, Discharges by Computer Aided Design). 1992. Developed with - Ms. Pamela Schwab Status - Completed. Enhancements are continually being incorporated. Upgrade including new training manual, user-defined storm distributions, input breakpoint rainfall, file manager, and newer derived

methodologies. Model Description SEDCAD+ is a menu driven, user-friendly computer aided design program that aids in the engineering design of stormwater management and sediment control systems. It was specifically developed to assist in the design and selection of alternative stormwater, erosion, and sediment control options. The engineering work-station consists of an IBM PC-XT or compatible, a digitizer, and a plotter (optional). SEDCAD+ capabilities encompass: (1) hydrograph and sedimentgraph development on a subwatershed basis and routing of hydrographs and sedimentgraphs to and through sediment control structures; (2) evaluating sediment control structures with respect to sediment trap efficiency and outflow hydrograph and sedimentgraph; (3) earthfill embankment volume; (4) design of non-erodible, erodible, grass waterways, and rock riprap channels; (5) culvert design; (6) plunge pools; (7) earthwork; (8) principal and emergency spillways, (9) etc. (Developed with Pam Schwab, Civil Software Design).

Landfill Design and Evaluation Model. 1991. Model Description - A finite element model was development to assist in the design of landfills. Emphasis is focused on evaluating the hydrologic performance of alternative multi-layer cover designs and modeling moisture movement within the landfill to assist in predictions of leachate generation. Model capabilities include prediction of leachate for alternative cover designs, engineered internal drainage configurations, and liner systems. The model is also capable of predicting breakthrough times of leachate. Configuration of the model allows rapid determination of predicted hydrologic quantities for a complete range of design alternatives. (Developed with Mr. Nathaniel Peters, Ph.D. Student, Agricultural Engineering, UK).

STRIDES - Simplified Trickle Irrigation and Specification Model. 1991. The trickle irrigation design and components specification model was developed to accommodate users with limited experience in hydraulic analysis, design, system layout, and component specification. Interaction between the user and STRIDES model results in the development of a comprehensive design layout and parts specification based on user inputs of field(s) dimensions; elevation differences; row and plant spacing; preferred row direction; type of plant; plant water demand; irrigation frequency; type and location of a water source; type of pipe(s) for main, submain, and laterals; irrigation efficiency and; number of zones and general zone layout. (Developed with Mr. Jim Baier, MS Student, Agricultural Engineering, UK).

SEDCAD Version 2.0. (Sediment, Erosion, Discharges by Computer Aided Design). 1989. This was the first release of the SEDCAD program. The SEDIMOT II program, which was written in Fortran IV and ran on a mainframe computer was completely rewritten in Quick Basic, converted to a stand alone desk top computer, and expanded to incorporate basic channel design, additional sediment basin principal spillways, an emergency spillway and linked to a single brand of digitizer and plotter.

Trickle Design Model. 1986. The Trickle Irrigation Model allows an experienced irrigation designer or specifier to interactively design mains, submains, manifolds, and lateral lines based on specified uniformity of water distribution and zones. The model will calculate pipe size, flow rates and pressures for irregular size fields and uniform and undulating slopes. (Developed with - Mr. Masoud Meshkat, M.S. Student, Agricultural Engineering, UK).

SIMC I - A Supplemental Irrigation Model for Center Pivot and Traveling Gun Systems Applied to Corn. 1984. The SIMC I Model was designed to determine the economic feasibility of supplemental irrigation of corn. Economic feasibility is based on farm specific topographic and soil parameters, cost of either a center pivot or traveling gun irrigation system, pumping plant and water supply cost and a 30 year simulation of the incremental benefits of increased corn production due to supplement irrigation based on a simplified corn growth model. The benefit cost ratio, discounted present value, and yearly cash flow analysis are output parameters. Model calibration is based on at least a five-year historical record of precipitation and associated yield of corn. The SIMC I model was used to determine the economic feasibility of corn irrigation on 3 large acreage farms. (Developed with Mr. Gary Sands, MS Student, Agricultural Engineer, UK).

SEDIMOT II - A Hydrology and Sedimentology Watershed Model. The model segments a watershed into subwatersheds based on hydrologic and sedimentologic response, develops and routes hydrographs and sedimentgraphs and determines trap efficiency and outflow hydrographs and sedimentgraphs from sediment basins, rock check dams, and vegetative strips. Primarily responsible for conversion of a research computer program into a user-friendly interactive design model. A 215 page User's Manual was produced. Developed some model algorithms. (Developed with - Dr. Bruce Wilson, Dr. Billy Barfield, Dr. Ian Moore, Mr. David Logsdon, and Ms. Pamela Nebgen, faculty and graduate students Agricultural Engineering, UK).

## **F. Environmental Mediation**

OEPA/ODNR [Fly Ash Policy]. Jan. 25, 1996.

ODNR [Passive Dewatering System Policy and Proceedings]. Jan. 24, 1996.

Amberside vs. Apollo Coal [Stormwater and sediment impact]. March 8, 1995.  
 ODNR [Revised Pond Policy Regulations]. Feb. 16, 1995; Jan. 20, 1995.  
 KY DRP & NR Peak Sediment Concentration Regulation from Sediment Basins. Fall, 1996.

## **G. Extension Broadcast Media Communications**

### **Television – Extension Broadcast Media Communications**

New Technologies for Appalachian Surface Mining. Recorded May 8, 2007.  
 Appalachian Regional Reforestation Initiative. WYMT-TV November 3, 2006 Mountain News 6 and 11 PM.  
 Interview broadcast on evening news with Mountain News, Hazard, KY. 3 Nov 2006.  
 CNN Special Environmental Program – New Methods to Control Pollution from Golf Courses  
 NBC-Channel 18:  
 Six news broadcasts in the areas of: Pollution Control, Erosion.  
 Two segments of a special, entitled, “These Troubled Waters”.  
 Two news broadcasts: Clean Sites Inc. – A consortium of environmental groups and industry to resolve problems at Superfund hazardous waste sites.  
 ABC, CBS, NBC:  
 Soil and Water Conservation Field Day Highlights.

### **Cable TV and local broadcastings:**

Household Hazardous Waste  
 Drip Irrigation for Vegetable Gardening  
 TV program on Tensionmeters used to manage an irrigation system.  
 A cable TV video production on trickle irrigation with emphasis on the individual components.  
 A 15-minute program filmed by University of Kentucky Public Information for local and cable program distribution entitled: Trickle Irrigation: Components and Field Installation.

### **Websites:**

Reclamation of Surface Mine Lands. 2007. Developers: **Agouridis, C.T.**, T. Dowdy, and C.D. Barton. Available at:  
<http://www.bae.uky.edu/UKReclamation>  
 Irrigation Considerations for Tobacco (with Dr. Duncan). 2003.

### **Videos:**

Reclaiming the Future: Reforestation in Appalachia. 2007 (27 minutes). Producer: D.H. Graves. Contributor in script writing and participant in video on hydrology and sediment production.  
 Together We Can: The Importance of Partnerships. 2007. Producer: U.S. Department of Interior. Participant.  
 Reclaiming the Future: Reforestation in Appalachia. (27 minutes). Producer: D.H. Graves. Contributor in script writing and participant in video on hydrology and sediment production.  
 Managing Dairy Manure Storage Systems. 2004.  
 Warner, R.C. 2001. Design of an Erosion Prevention and Sediment Control System: An Illustration of a Paradigm Shift. 4-hour video. Chattahoochee-Flint Regional Development Center. Franklin, GA.

### **Radio:**

Trees to Electricity: Biomass Energy Jan 22, 2007.  
 Impact of Sediment on Fish in Streams May 7, 2007.  
 Pulse Irrigation: Potential Water Savings Benefits June 11, 2008.  
Radio Tapes: 7 (2004-2006).  
 Radio Tapes: 8, examples of various topics -  
 Trickle Irrigation of Blueberries: 15 Sep 03.  
 The Function of Trees in Stream Restoration: 8 Mar 04.  
 Protecting KY Streams through a Combination Weep Berm-Grass Filter: 7 Sep 04.

Sediment Impact on Fish and Aquatic Life: 5 Jul 03.  
 Ponds and lagoons; quality control through moisture application.  
 Lagoons that don't leak  
 Construction of dairy waste lagoons.  
 Low-pressure low-volume irrigation systems for greenhouses.  
 Trickle irrigation for residential and commercial areas (Farm and Home Show).  
 Basics of greenhouse irrigation.  
 Paint Collection and Recycling.  
 Compaction Fundamental for Agricultural Waste Lagoons.  
 Backflow Requirements for Irrigation Systems.  
 Grass Filters for Pollution Control from Farmland, Surface Mining and Construction Sites.  
 Construction Quality Control for Pond and Lagoon Construction.  
 The Landfill Capacity Crisis.  
 Landfill Liability.  
 Landfill Closure Options.  
 Recycling Old Newspaper for Animal Bedding.  
 Need for Regional Recycling.  
 Paint Collection and Recycling Day.  
 Recycling Old Newspapers for Animal Bedding.  
 Solid Waste Landfills.  
 Overview of Proposed Kentucky Landfill Regulations.  
 Selecting Plastic Pipe-PVC and PE.  
 Locating a Ground Water Source.  
 Scheduling Irrigation with Tensionmeters.  
 Water Hardness and Its Control.  
 Planning an Irrigation System.  
 Water Supply for Irrigation.  
 Is Your Drinking Water Safe?  
 Hazardous Waste Landfills.  
 Planning a Trickle Irrigation System.  
 Erosion Control for Farmland.  
 Removing Turbidity and Color from Drinking Water.  
 Nitrates in Drinking Water: Prevention Methods.  
 Information Needs for Fruit and Vegetable Irrigation Planning.  
 Residential Irrigation.  
 The Hydraulic Ram: Pumping Through Water Power.  
 Irrigation Components: Linking a City Water Supply to Your Irrigation System.  
 Filters for Farm Water Treatment.  
 Ponds for Water Supply.

## **H. Extension Field Days, Demonstrations, and Conferences (Principal Organizer, Coordinator)**

I have planned, organized, and coordinated fifteen major field days and conferences for purposes of demonstrating technology and methods of operation. These are: (1) Kentucky Recycling Conference: Practical Approaches to Recycling, Composting, and Solid Waste Management, (2) Optimum Resource Utilization for Horticultural Enterprises Workshop: Organic Solid Waste, (3) Paint Collection and Recycling Day\_\_A Household Paint Collection and Recycling Day, (4) Soil and Water Conservation Field Day, (5) Irrigation Field Day for Corn and Soybeans, (6&7) Trickle Irrigation Installation, and (8&9) Practical Construction Techniques for Swine and Dairy Waste Lagoons.

### **I. Conferences**

Kentucky Recycling Conference: Practical Approaches to Recycling, Composting, and Solid Waste Management. July 12-14, 1992 (Co-chairman) Organized 52 presentations, 17 exhibitors, proceedings (abstracts), facilities, funding (contributions), marketing and overall program.  
 Paint Collection and Recycling Day, (Co-Chairman with K. Dozier (LFUCG)), A Household Paint Collection and Recycling Day, was organized and conducted July 11, 1992.

Water Quality and Waste Management: Rules and Opportunities for Extension Initiative Programming. May 12-14, 1992. Atlanta, GA (report) Proceedings and Conference.

Solid Waste Management: Implementing an Extension Initiative - May 8-10, 1991. Atlanta, GA (committee member for SE Regional Solid Waste Extension Training) Proceedings and Conference.

Multi-Area Solid Waste Management Agent Training (Chairman); 2/13/91 Paintsville, 2/27/91 Lexington, 3/13 Hopkinsville and 3/27 Louisville.

Optimum Resource Utilization for Horticultural Enterprises Workshop: Organic Solid Waste, Oct. 21, 1991. (Co-Chairman with Dunwell and Brown).

## **J. Field Days**

Wells, Larry and Richard Warner. Demonstration of a Mechanical System for Reconstructing Soil without Vehicle Compaction. Center for Applied Research Nov. 2, 2007

Residential Irrigation Installation Methods. Jessamine, Co. Apr. 12, 2008

Practical Construction Techniques for Swine and Dairy Waste Lagoons

Short Course and Field Day (two times), Princeton and Lexington, KY, Dec. 2000

Proper site selection

Factors affecting permeability

Step-by-step construction procedures

Testing and discussion of leakage rates through soil liners

Demonstration of alternative construction equipment

Placement of lifts for proper construction

Soil preparation and moisture incorporation techniques

Compaction demonstration

Soil core extraction and testing methodologies

Taught to regulators, farmers, and equipment operators/contractors

Paint Collection and Recycling Day; Co-chairman with K. Dozier (LFUCG) A Household Paint Collection and Recycling

Day was organized and conducted July 11, 1992

Soil and Water Conservation Field Day

1st erosion control field day in Kentucky in greater than 25 years

All materials and labor donated to the Kentucky Baptist Home for Orphans

Planned, coordinated, designed, installed, and demonstrated:

no-tillage farming

Johnson Grass control

Parallel Tile Outlet Terraces (7,000 ft)

Tile Drainage (11,650 ft)

Sod Waterway (800 ft)

Sediment Control Basin

Diversion Ditch (500 ft)

Woodland Improvement

1,500 attendees

TV network news coverage

33 news releases

30+ radio station public service announcements

Irrigation Field Day for Corn and Soybeans

2nd irrigation field day in Kentucky

Demonstrated how to develop an irrigation plan for a specific farm

Toured and demonstrated center pivot and traveling gun operations

Introduced a computer model used to:

evaluate the economic feasibility of irrigation of corn

design a center pivot system

design a traveling gun system

150 attendees

Irrigation dealers exhibited

Radio tapes and news releases

Trickle Irrigation Installation Field Day and Short Courses (2 times)



1st trickle irrigation installation field day in Kentucky  
 Demonstrated all trickle irrigation components and discussed component selection  
 Installed a drip line irrigation system for vegetables  
 Installed an emitter-trickle system for blackberries  
 70 attendees at each field day  
 Radio tapes and news releases  
 4 irrigation dealers had displays  
 Irrigation literature displayed from over 150 companies  
 Supplies for all irrigation installations were donated

## **K. Professional Meetings Presentations**

### 2006-2008 Invited Presentations/Conferences: (# graduate student) 31 presentations- selected items listed

1. R.C. Warner, C.T. Agouridis and C.D. Barton. 2006. Starfire Mining Complex: Research Initiatives in Mine Land Reforestation. U.S. Office of Surface Mining Appalachian Regional Reforestation Initiative. Nov. 3, 2006. (Invited)
2. Warner, R.C. 2007. Water Sanitation, Sustainable Forestry and Biomass Production and Carbon Sequestration in Indonesia: Fulfilling the Potential. Indonesian University Consortium. March 19, 2007. Lexington, KY. (Invited)
3. Warner, R.C., KY Mine Reclamation Research: Transition to Rain Forest Environments. Brazilian State Department (Assistant State Secretary for the Environment). Lexington, KY. Apr. 20, 2007. (Invited)
4. Warner, R.C., C.T. Agouridis, and C.D. Barton. 2007. Mining and Mine Reforestation: Influences on Watershed Hydrology. Presentation for the 2007 ARRI Mined Land Reforestation Conference, Abingdon, VA, August 7-8. (Invited)
5. Taylor, T.J.#, R.C. Warner, C.T. Agouridis, C.D. Barton, D.H. Graves, and P.N. Angel#. 2007. Curve Numbers for Forested Watersheds and Loose-Dumped Mine Spoil. Presentation for the Society of American Foresters 2007 National Convention, Portland, OR, October 23-27.
6. Warner, R.C. 2007. Development and Design of Cost-Effective, Real-Time Implementable Sediment and Contaminant Release Controls for the Paducah Gasification Diffusion Plant. Oct. 30, 2007. Lexington, KY. (Invited)
7. Warner, R.C., C.T. Agouridis, J. Strang, and O. H. Hoffmann. 2008. Trickle Irrigation Design for Blueberries. Presentation for the 2008 Kentucky Fruit and Vegetable Conference and Trade Show, Lexington, KY, January 8. (Invited)
8. Warner, R.C., Research Update on Reforestation, Head-of-Hollow Fills and Innovations in Sediment Control Systems. 2008. Leading OSM with Integrity and Excellence: You are the Key Conference. March 6, 2008. San Antonio, TX. (Invited)
9. Warner, R.C., C.T. Agouridis, and C.D. Barton. 2008. Holistic Approach to Head of Hollow Fill Design. National Mining Association Clean Water Act Section 404 Permitting Policy Assessment. Lexington, KY. July 29, 2008. (Invited)
10. Warner, R.C., C.T. Agouridis, and C.D. Barton. 2008. Integrating Natural Systems into Sediment Controls. 2008. National Mining Association MinExpo International 2008, Las Vegas, NV. Sept. 22-24, 2008. (Invited)
11. Angel, P.N.#, C.D. Barton, R.C. Warner, C.T. Agouridis, and T.J. Taylor#. 2008. Forest Establishment and Water Quality Characteristics on a Loose-Graded Surface Mine in Eastern Kentucky. USEPA and National Groundwater Association Remediation of Abandoned Mine Lands Conference. Denver, CO. October 2-3, 2008. (Invited)
12. Warner, R.C., C.T. Agouridis, S.F. Torrealba#, and T. Dowdy. 2008. Cumulative Impact of Mining on Watersheds, Streams and Hydrology in the Middle Fork Kentucky River Watershed presented at the Kentucky Watersheds Assessment Project Cumulative Impact Assessment for 404 Permits: A Watershed Approach. Lexington, KY. Oct. 6, 2008. (Invited)

### 2004-2006 Invited Presentations: (14 -example titles).

1. Warner, R.C. 2005. Best Management Practices for Sediment Control. 101<sup>st</sup> Meeting of the Rocky Mountain Coal Mining Institute. June 27, 2005 (1 of 13 invited speakers)
2. Warner, R.C. and C.T. Agouridis. 2005. Coal Mining Research Needs in Hydrology and Sedimentology. Presentation to the Kentucky Coal Association. Lexington, KY. October 25, 2005.
3. Agouridis, C.T., R.C. Warner, C.D. Barton, D.A. Bidelsbach, G.D. Jennings, J.W. Marchant, and R. Osborne. 2006. Promoting a Paradigm Shift in Head-of-Hollow Fill Design through Public Education. Presentation for Stream Restoration in the Southeast: Accomplishments and Opportunities, Charlotte, NC, October 2-5.
4. Warner, R.C., C.T. Agouridis, and C.D. Barton. 2006. Mined Land Reclamation Research: Hydrology and Water Quality. Presentation for U.S. Fish and Wildlife Service and Office of Surface Mining Terrestrial Carbon Sequestration and Appalachian Regional Reforestation Initiative Workshop, Hazard, KY, June 21.

5. Taylor, T.J., C.T. Agouridis, R.C. Warner, C.D. Barton, D.H. Graves, and P.N. Angel. 2006. Hydrologic and Water Quality Characteristics of Loose-Dumped Mine Spoil. Presentation for the 2006 7<sup>th</sup> ICARD Annual Meeting, St. Louis, MO, March 26-30. *Presentation won the 2<sup>nd</sup> Place Student Award.*
6. Angel, P.N., D.H. Graves, C.D. Barton, R.C. Warner, R.J. Sweigard, and C.T. Agouridis. 2006. Surface Mine Reforestation Research: Evaluation of Tree Response to Low Compaction Reclamation Techniques. Presentation for the 2006 7<sup>th</sup> ICARD Annual Meeting, St. Louis, MO, March 26-30.
7. Warner, R.C. and C.T. Agouridis. 2006. Automatic Drip Irrigation Systems to Increase Productivity. Presentation for the 2006 Kentucky Fruit and Vegetable Conference, Jan. 10, 2006. (64 participants)

<2004

New Technology and the Basics of Installing an Irrigation System for Fruit Crops: 7 Jan 03.  
 World Bank Regulations Applied to Mining: 22 Jan 03.  
 Roles of the Independent Engineering Team (Export/Import Bank) in Environmental Impact Assessment: 9 Feb 03.  
 Application of Weep Berms for Metal Control at Hard Rock Mines: 11 Feb 03.  
 Regulatory Implications of Aquatic Impact Based Sediment Standards: 15 Apr 03.  
 Operating Procedures for Multi-linked, Integrated Surface Water Management Systems: 15 Jul 03.  
 Waste Management Options for Peru: 12 Jul 03.  
 Practical Construction Techniques for Swine and Dairy Waste Lagoons: 30 Oct 03.  
 Doppler Radar, GIS and Watershed Hydrology: 18 May 04.  
 The Potential Uses of GIS in Erosion Predictions: 20 May 04.  
 GIS in Water Resources Development: 25 May 04.  
 Increased Productivity through GIS in Water Resources: 27 May 04.  
 Potential Applications of GIS to Water Resource Development Projects: 28 May 04.  
 Carbon Sequestration and Mineland Reforestation: 3-6 May 04.  
 Irrigation Considerations for Tobacco (with Duncan). 7 Jan 03.  
 The Effectiveness of a Combination Weep Berm-Grass Filter Riparian Control System for Reducing Fecal Bacteria and Nutrients from Grazed Pastures. 12-15 Sep 04.  
 Mine Land Reclamation: Hydrology and Water Quality for KY OSM and TVA. 24 Sept 03.  
 Mine Land Hydrology and Water Quality at Starfire Mine. 28 Aug 03.  
 Potential for Robinson Forest Stream Restoration for KY DOW and KY F&W. 11 Mar 04.  
 Mine Land Hydrology and Water Quality at Starfire Mine for Washington Congressional Staff. 14-16 Apr 04.  
 Carbon Sequestration on Surface Mine Lands. 4-5 Aug 03.  
 4-H, Stream Classification: The First Step in Stream Restoration. 6 Jun 03.  
 Starfire Stormwater, Erosion and Sediment Control Experimental Practices Site Tour for OSM. 21 May 03.  
 Storage Basin Construction Issues. 30 Oct 03.  
 Carbon Sequestration on Surface Mine Lands. 2-5 Jun 03.  
 Warner, R., 2002. Using Turbidity as a Surrogate for Suspended Sediment Concentration to Measure the Performance of Sediment Controls at Construction and Mining Sites. Turbidity and Other Sediment Surrogates Workshop. Sponsored by the Subcommittee on Sedimentation USGS. Reno, Nevada. April 30-May 2, 2002.  
 R. Warner, R., New Developments in SEDCAD+ for GIS, Electronic Permitting Workshop, OSM Western Regional Coordinating Center, Office of Technology Transfer, Billings, MT, May 10-11, 2000.  
 Warner, R., F. Camargo, and M. Anderson, Automatic Monitoring Systems for Reclamation Design, Surface Mining Reclamation Approaches to Bond Release: Cumulative Hydrologic Impact Assessment, Office of Surface Mining, Western Regional Coordinating Center, Office of Technology Transfer, Billings, MT, Aug 27 - Sept 1, 2000.  
 Warner, R., Sediment Storage Design Considerations for Temporary Structures: SEDCAD and RUSLE, Surface Mining Reclamation approaches to Bond Release: Cumulative Hydrologic Impact Assessment, Office of Surface Mining, Western Regional Coordinating center, Office of Technology Transfer, Billings, MT, Aug 27 - Sept 1, 2000.  
 Warner, R. and A. Hootkany, The influence of Construction Equipment on the Saturated Hydraulic Conductivity of Compacted Soil Liners, 2000 Kentucky Nonpoint Source Conference, Kentucky Div. Water, Natural Resources and Environmental Protection Cabinet, Bowling Green, KY, May 23-25, 2000.  
 Warner, R. Application of RUSLE and SEDCAD+ for Design of Contour Furrows and Terraces to Minimize Sediment Yield. Approaching Bond Release: Revegetation, Reclamation Issues, and Surface Mining Applications in the Arid and Semi-Arid West, Office of Surface Mining, Western Regional Coordinating Center, Office of Technology Transfer, Flagstaff, AZ, Sept. 20-24, 1999.  
 Warner, R.C. New Erosion Modeling Tools: Potential use for Bond Release. OSM Interactive Forum on Approaching Bond Release: Applied Statistics for Reclamation and Surface Mining Applications in the Arid and Semi-arid West. Sept 2-4, 1998.

- Warner, R.C. Legislative Briefing Paper on Design, Construction and Monitoring of Soil Liners for Waste Lagoons. Mar. 1998.
- Warner, R.C. and A.N. Hootkany. Laboratory and Field Assessment of Agricultural Waste Storage Liner Hydraulic Performance Using Construction Quality Control Procedures. Fourth International Dairy Housing Conference. Jan. 28-30, 1998.
- Warner, R.C. and A.N. Hootkany. Subsurface Leaching Potential of Animal Waste Holding Ponds as a Function of Soil Moisture and Compaction: Emphasis of Contractor Constructed Permeabilities and Construction Guidance Document. KY Nonpoint Source Conference. Sept 29 Oct 1, 1998.
- Warner, R.C., P.J. Schwab, D.J. Marshall, and F. Collins-Camargo. Review of Electronic Permitting Using SEDCAD Version 4 for Windows 95. OSM Electronic Permitting Interactive Forum. June 30 - July 2, 1997.
- Warner, R.C., A. Hootkany, L. Jarrett, and M. Griffin. Subsurface Leaching Potential of Animal Waste Holding Ponds. KY Nonpoint Source Conference. Sept 16-17, 1997.
- Warner, R.C. Subsurface Leaching Potential of Animal Waste Holding Ponds as a Function of Soil Moisture and Compaction. Kentucky Nonpoint Source Conference. Lexington, KY. September 1996.
- Warner, R.C. Application of the SEDCAD Model. IT-in-NR Symposium on Information Technologies in Natural Resource Management. Louisville, KY. August 1996.
- Warner, R. Application of the SEDCAD Model. IT-in-NR Symposium on Information Technologies in Natural Resource Management. Louisville, KY. Aug. 1996.
- Warner, R. Irrigation Systems for Perennial Beds. Central Kentucky Ornamental & Turf Spring Outing. Lexington, KY. May 1996.
- Warner, R. Irrigation Systems for Perennial Beds. Central Kentucky Ornamental & Turf Spring Outing. Lexington, KY. May 1996.
- Byers, M., F. Young, R. Warner, C. Popplewell, W. Thom, G. Heady, W. Clark, T. Maxon, G. Crane, D. Nichols, M. Hooks, W. Combs, and C. Wells. Evaluation of Constructed Wetlands for Treatment of Wastewater from Single Family Dwellings, Onsite Constructed Wetlands Demonstration Project, and Developing Programs for Operation and Management of Onsite Constructed Wetlands. Kentucky Nonpoint Source Conference. Frankfort, KY. September 1995.
- Byers, M., F. Young, R. Warner, C. Popplewell, W. Thom, G. Heady, W. Clark, T. Maxon, G. Crane, D. Nichols, M. Hooks, W. Combs, and C. Wells. Evaluation of Constructed Wetlands Demonstration Project, and Developing Programs for Operation and Management of Onsite Constructed Wetlands. Kentucky Nonpoint Source Conference. Frankfort, KY. Sept. 1995.
- Warner, R., A. Hootkany, C. Blanton, J. Taraba, M. Byers, and G. Felton. Subsurface Leaching Potential of Animal Waste Holding Ponds: Laboratory and Preliminary Field Investigations. Kentucky Nonpoint Source Conference. Frankfort, KY. September 1995.
- Warner, R., A. Hootkany, C. Blanton, J. Taraba, M. Byers, and G. Felton. Subsurface Leaching Potential of Animal Waste Holding Ponds: Laboratory and Preliminary Field Investigations. Kentucky Nonpoint Source Conference. Frankfort, KY. Sept. 1995.
- Warner, R., Moderator. Infrastructure Needs and Economics. Successful Water Quality and Waste Management Programming. New Orleans, LA. June 1995.
- Warner, R. Demonstrate and Discuss Management Irrigation. Sports Turf Management Seminar. Lexington, KY. June 1995.
- Warner, R. Moderator. Infrastructure Needs and Economics. Successful Water Quality & Waste Management Programming. New Orleans, LA. June 1995.
- Warner, R. Demonstrate and Discuss Irrigation. Sports Turf Management Seminar. Lexington, KY. June 1995.
- Warner, R. Interactive Forum on Modeling Sediment Yield and Runoff on Mined Lands (Pre and post-Mining) in the Semi-arid West. Bozeman, MT. Jan. 24-26, 1995. Presenter and Interactive Discussion Leader for 24 topics: (1) Runoff in the gauged Watersheds under Changing Conditions. (2) Estimating Runoff for Un-gauged Watersheds. (3) Estimating Sediment Yield Un-gauged Watersheds. (4) Runoff in the Gauged Watersheds under Changing Conditions. (5) Estimating Sediment Yield. (6) Estimating Length of Time Needed for Sediment Yield to Be Equal or Less Than That of Pre-disturbance. (7) Design of Stable Surface Structure Impoundments for Retention of 10-year, 24-hour Storm Events. (8) Capacity of Impoundments to Store Sediment. (9) Differences in Temporary and Permanent Impoundment Designs. (10) Meeting Water Quality Discharge Standards. (11) Emergency Spillway Design. (12) When, If Ever, Should PMP/PMF Be Considered in Design of Large Impoundments on Surface Mines. (13) Economic Aspects of Designs Passing PMP/PMF Events. (14) Modeling Watershed Hydrology and Sedimentology (with J. Galetovic and B. Carlson): a. TR-55, b. STORM, c. RUSLE (USLE, MUSLE), d. SEDCAD+, e. SURVCADD and f. SEDCAD Interface. (15) Design of Efficient Monitoring Systems. (16) Measuring Sediment Yield and Water Discharge Volume. (17) Flocculation Treatment Sizing. (18) Cleanout. (19) Disposal Issues. (20) Passive De-watering. (21) Use of Wetlands for

- Additional Water Quality Enhancement. (22) Other Alternate Sediment Control Measures (with T. Munson). (23) When is the Parameters Used in Modeling Invalidated by Field Modifications (with J. Noonan). (24) Summary - Comfortable Ranges of Modeling Parameters.
- Warner, R. Kentucky Woodwaste to Energy: Policy Issues. Woodwaste Air Pollution and Solid Waste Roundtable. Div. of Energy. Louisville, KY. Mar 17, 1995.
- Warner, R. Interactive Forum on Modeling Sediment Yield and Runoff on Mined Lands (Pre- and Post-Mining) in the Semi-arid West. Bozeman, MT. Jan. 24-26, 1995.
- Warner, R. SEDCAD and SEDACAD: Practical Design Tools for Teaching and Consultants. 1994 ASAE International Winter Meeting. Atlanta, GA. December 1994.
- Warner, R. Permeability of Soil Liners in Waste Lagoons. ASAE International Winter Meeting. Atlanta, GA. December 1994.
- Warner, R. SEDCAD and SEDACAD: Practical Design Tools for Teaching and Consultants. 1994 ASAE Winter Meeting. Atlanta, GA. Dec. 1994.
- Warner, R. Permeability of Soil Liners in Waste Lagoons. ASAE International Winter Meeting. Atlanta, GA. Dec. 1994.
- Warner, R.C. and J.W. Baier. Computer Aided Design and Parts Specification of a Trickle Irrigation System for Fruit and Vegetable Plantings. Proceedings 1991. Kentucky State Horticultural Society and Kentucky Vegetable Grower's Association. Abstract. Nov. 21-22, 1991.
- Warner, R.C. Modeling Best Management Practices Using SEDCAD+. Computer Model Expo. Living With The Land. Soil and Water Conservation Society Annual Meeting. Lexington, KY. Aug. 4-7, 1991.
- Turner, L.W., R.C. Warner, J.P. Chastain, and H.F. Elder. Forced Evaporative Cooling of Dairy Cows: On-Farm Demonstration Results. ASAE Paper No. 91-4023. Jun 23-26, 1991.
- Turner, L.W., R.C. Warner, J.P. Chastain, and H. F. Elder. Forced Evaporation Cooling of Dairy Cows: On-Farm Demonstration Results. American Society of Agricultural Engineers, Paper No. 91-4023. Albuquerque, NM. June 23-26, 1991.
- Warner, R.C. Successful Trickle Irrigation Systems for Residential Horticulture. Housing Showcase for the 90's. Paintsville, KY. May 11, 1991.
- Warner, R.C. Landfill Siting and Compensation: Interacting Facets Among Consultants, Reviewers, and the Public. The Economics of Solid Waste Management in the 90's. SRIEG-10. April 18, 1991.
- Warner, R.C. Trickle Irrigation Systems in Fruit Production. UK College of Agriculture Field Day. Princeton, KY. July 19, 1990.
- Warner, R.C. Kentucky Solid Waste Management Program. Southeast Regional Solid Waste Management Task Force. Atlanta, GA. July 12, 1990.
- Warner, R.C. Solid Waste Landfills: Impact of Regulations at the County Level. RJR Reynold's Leadership Training Workshop. Lexington, KY. July 12, 1990.
- Warner, R.C. Solid Waste Landfills in Kentucky: Regulation, Design, Construction, and Monitoring. Waste Recycling Seminar; Trim the Trash. Fleming County, KY. (Also videotaped for future training programs). June 30, 1990.
- Warner, R.C. Teaching Trickle Irrigation. Vocational Agricultural Teachers Workshop. Lexington, KY. June 21, 1990.
- Warner, R.C. Erosion and Sediment Control Facilities: Design and Operation. Solid Waste Advisory Board. Oley, PA. April 21, 1990.
- Warner, R.C. Plant Bed Irrigation Systems: Mini-Sprinklers, Drip Tape and Porous Pipe. Tobacco Plant Bed Field Day. April 19, 1990.
- Warner, R.C. Requested by Ohio Dept. of Natural Resources to be discussion leader/facilitator at a two-day workshop to explore alternative design method and procedures for surface mining permitting. April 5-6, 1990.
- Warner, R.C. Ponds: Construction and Sealing. Pumps for Agriculture. Western Kentucky Aquaculture Conference. Princeton, KY. March 29, 1990.
- Warner, R.C. Trickle Irrigation for Christmas Tree Growers. Christmas Tree Growers Assoc. Annual Meeting. Lexington, KY. March 10, 1990.
- Warner, R.C. Tobacco Bed Trickle and Low Volume Mini-Sprinkler Irrigation Systems. Burley Tobacco Growers. Wayne County, KY. February 5, 1990.
- Warner, R.C. Water Use in Kentucky. ASAE State Section Meeting. Frankfort, KY. November 9, 1989.
- Warner, R.C. Irrigation Equipment for New Watering Trays for Greenhouses: Design and Operation. 1989 Greenhouse Production Short Course at Kentuckian Greenhouse Assoc. Annual Meeting and 1989 Greenhouse Production Short Course. Louisville, KY. November 4, 1989.
- Warner, R.C. QA/QC Construction and Testing for Solid, Hazardous and Low Level Nuclear Waste Sites. Environmental Systems Seminar Series. October 19, 1989.

- Warner, R.C. Mine Permitting and Abandoned Mine Lands. Ohio Department of Natural Resources. Zanesville, OH. October 12, 1989.
- Warner, R.C. Alternative Designs of Sediment Basins: Environmental and Economic Considerations. ASAE Summer Meeting. June 26, 1989.
- Warner, R.C., P. Schwab. Alternative Designs of Sediment Basins: Environmental and Economic Considerations. American Society of Agricultural Engineers, Paper No. 89-2020. Quebec, PQ, Canada. June 25-28, 1989.
- Schwab, P. and R. Warner. Stormwater Management, Erosion, and Sediment Control by Computer Aided Design (SEDCAD): Landfill Application. American Society of Agricultural Engineers, Paper No. 89-2017. Quebec, PQ, Canada. June 25-28, 1989.
- Warner, R.C. Stormwater Management, Erosion, and Sediment Control by Computer Aided Design (SEDCAD+): Landfill Application. ASAE Summer Meeting. June 26, 1989.
- Warner, R.C. Overview of Landfill Design and Construction Research. Overview of Proposed KY Solid Waste Regulations. ASAE State Section Meeting. Greenbo Lake State Park, KY. May 5, 1989.
- Warner, R.C. Soil Layer Covers, U.S. EPA 15th Annual Research Symposium on Remedial Action, Treatment, and Disposal of Hazardous Waste. Cincinnati, OH. April 10, 1989.
- Warner, R.C. and P.J. Schwab. SEDCAD+ Application to Piedmont Watersheds. The South Carolina Land Resources Commission and the South Carolina Chapter of Soil and Water Conservation Society Stormwater Symposium 189. Greenville, SC. April 4, 1989.
- Warner, R.C. Irrigation Systems for Horticultural Landscapes. State Meeting for Ornamental and Vegetable Growers. 1989 Home and Garden Expo. Owensboro, KY. March 18, 1989.
- Warner, R.C. Trickle Irrigate to Increase Profits. National Sweet Sorghum meeting. Nashville, TN. March 10-11, 1989.
- Warner, R.C. Trickle Irrigation Equipment and Cost for Fruit and Vegetable Production. 1989 Young Farm Family Management School. Montgomery County, KY. February 16, 1989.
- Warner, R.C. Testimony before Maxey Flats Commission hearing on Closure Options and Subsidence Concerns for Low Level Nuclear Site Remediation and Closure. February 10, 1989.
- Warner, R.C. Trickle Irrigation Systems and Design Concerns. 133rd Annual Meeting of the Kentucky State Horticultural Society and the 18th Annual Meeting of the Kentucky Vegetable Growers Association. Owensboro, KY. Nov. 30, 1988.
- Warner, R.C. Impact of Biotechnology. Agricultural Engineering Seminar Series. Sept. 30, 1988.
- Dysart II, B.C., R.M. El-Farhan, M.A. Lancaster, and R.C. Warner. Improving the Cost-Effectiveness and Performance of Erosion Control Systems. National Conference of Erosion and Sediment Control Program Administrations. Charleston, SC.
- Warner, R.C. Multiple Layer Cover Systems for Hazardous Waste Landfills. Water Resources Monthly Seminar Series. Lexington, KY. April 6, 1988.
- Warner, R.C. Case Studies and Practical Aspects of Drip-Trickle Irrigation. American Society of Agricultural Engineers. Southeast Region. New Orleans, LA. Feb. 1, 1988.
- Warner, R.C. Storm Water, Erosion and Sediment Control by Computer-Aided Design. Environmental Systems Engineering Seminar Series. Clemson University. Clemson, SC. Jan. 21, 1988.
- Warner, R.C., and P.J. Schwab. SEDCAD Mini-course. 1987. National Symposium on Mining, Hydrology, Sedimentology, and Reclamation. Springfield, IL. Dec. 10, 1987.
- Warner, R.C. and B.J. Barfield. 1987. Status of SEDIMOT II. Water Resources Monthly Seminar Series. Lexington, KY. June 3, 1987.
- Warner, R.C., Profits, Costs and Components of Trickle and Sprinkler Irrigation Systems. 131st Annual Winter Meeting - Kentucky State Horticultural Society and 16th Annual Meeting- Kentucky Vegetable Growers Association. Louisville, KY. Dec. 9, 1986.
- Warner, R.C. and P.J. Schwab. SEDCAD Mini-course. 1986. National Symposium on Mining, Hydrology, Sedimentology, and Reclamation. University of Kentucky. Lexington, KY. Dec. 8, 1986.
- Warner, R.C., J.D. Eigel, P.J. Nebgen, and R.M. Bodner. Planning and Implementation of Remedial Landfill Reclamation. 1986 Summer Meeting. American Society of Agricultural Engineers. Paper No. 86-2145. San Luis Obispo, CA. June/July, 1986.
- Warner, R.C., B.C. Dysart, III, W. Thiess, and R. Gilbert. Field and Model Evaluation of Nonpoint Source Sediment Impacts. 1985 Winter Meeting. American Society of Agricultural Engineers. Paper No. 88-2518. Chicago, Illinois. December, 1985.
- Warner, R.C., B.N. Wilson, and B.J. Barfield. Development and Implementation of the Interactive Version of SEDIMOT II. 1985 Winter Meeting. American Society of Agricultural Engineers. Paper No. 85-2541. Chicago, Illinois. December, 1985.

- Peters, N., R.C. Warner, J.E. Wilson, and D.S. Logsdon. Construction, Monitoring, and Evaluation of a Field-Scale Multilayer Hazardous Waste Landfill Cover. U.S. E.P.A. On-site Workshop on Field Permeability Measurement. Harrisburg, PA. December, 1985
- Meshkat, M. and R.C. Warner. Interactive Computer Trickle Irrigation Design Systems. 1985 Summer Meeting. American Society of Agricultural Engineers. Paper No. 85-. East Lansing, Michigan. June, 1985.
- Sands, G.R., I.D. Moore, and R.C. Warner. A Computer Model for Irrigation Planning and Management. 1984 Winter Meeting American Society of Agricultural Engineers. Paper No. 84-2605. New Orleans, Louisiana. December 11-14, 1984.
- Warner, R.C. Sediment II Model Overview for Industry. 1983 Annual Meeting of the Interstate Mining Compact Commission. Little Rock, AR. April 1, 1983.
- Warner, R.C. and M.C. Hirschi. Modeling Check Dam-Trap Efficiency. American Society of Agricultural Engineers. National Annual Summer Conference, Bozeman, Montana, ASAE Paper No. 83-2082, 1983.
- Xue, K., J.T. Ligon, and R.C. Warner. Predicting Water Table Level for a Controlled and Reversible Drainage System. American Society of Agricultural Engineers, Annual National Winter Conference. Chicago, Illinois. ASAE Paper No. 83-2689, 1983.
- Warner, R.C. and B.C. Dysart, III. Modeling the Effectiveness of a System of Diversions. American Society of Agricultural Engineers. National Annual Summer Conference. Bozeman, Montana, ASAE Paper No. 83-2093, 1983.
- Warner, R.C., B.C. Dysart, III, R.C. Gilbert, and W.G. Thiess. Field and Model Evaluation of Agricultural Best Management Practices. American Geophysical Union Annual Meeting, Philadelphia, Pennsylvania, 1982.
- Sands, G.R., I.D. Moore, and R.C. Warner. Evaluating the Feasibility of Irrigation in Humid Regions. American Society of Agricultural Engineers, National Annual Summer Conference, Madison, Wisconsin, ASAE Paper No. 82-2081, 1982.
- Latham, W.R., III and R.C. Warner. Parallels Between Regional Input-Output Analysis and a Model of Fluid Dynamics. North American Regional Science Association Meeting, Pittsburgh, Pennsylvania. 1982.
- Sterling, J.H. and R.C. Warner. Design and Construction of a Landfill Cover. Kentucky Symposium on Hazardous Waste Management Policy and Methods. Louisville, Kentucky. 1982.
- Griffin, M.L., B.J. Barfield, and R.C. Warner. Model Studies of the Hydraulic Efficiency of Sediment Ponds. American Society of Agricultural Engineers, National Summer Conference. Bozeman, Montana. ASAE Paper No. 83-2084. 1981.
- Warner, R.C., I.D. Moore, B.J. Barfield, and B.C. Dysart, III. Applied Comparative Analysis of Erosion Models. American Society of Agricultural Engineers, Annual Winter Conference. Chicago, Illinois. ASAE Paper No. 81-2526. December, 1981.
- Warner, R.C., L.G. Wells, B.J. Barfield, I.D. Moore, and B.N. Wilson. Evaluating Alternative Surface Mining Methods Using a Distributed Parameter Approach. Paper No. SER-81-016 presented at the Southeast Region Meeting of the ASAE. Atlanta, Georgia. February 1981.
- Warner, R.C., J.T. Ligon, and J.R. Lambert. A Controlled Drainage and Subirrigation Management Model. Southeastern Regional Conference of the American Society of Agricultural Engineers. April 1972.
- Warner, R.C., J.T. Ligon, and J.R. Lambert. A Management Model for a Controlled Drainage and Subirrigation System. Paper presented at the Annual Winter Meeting of the American Society of Agricultural Engineers. Chicago, Illinois. December 1972.

## **L. Demonstration Projects and Agent Training (partial listing)**

- Demonstration Site for Residential Irrigation: 26 Apr 03.
- Reclamation Techniques: International Exchange (Peru): 28-30 May 03.
- Construction of Low Permeability Soil Liners for Fly Ash Facilities: 9 Jun 03.
- Potential for Head-of-Hollow Fill Stream Restoration: 16 Jun 04.
- 1994
- 1/5-7 Nursery Irrigation Design: Developing a Research and Demonstration Facility. UK
- 1/30 Geotextiles for Greenhouse Passive Irrigation Systems. UK
- 4/30 Trickle Irrigation for Small Vegetable Producers. Anderson, Co.
- 5/8 Trickle Irrigation for Residential Areas: Component Identification and Installation Procedures. Fayette Co.
- 7/11 Tobacco Irrigation: Meeting Water Requirements with Limited Water Supplies. Harrison Co. approx. 220 participants
- 8/24 The Design and Installation of Trickle Irrigation Systems for Residential and Commercial Developments: Training for Irrigation Contractors and Landscape Installation Firms. Fayette Co.
- 9/2 Trickle Irrigation for the Production of Woody Ornamentals. Franklin Co.
- 1993

1/22 Low Pressure Low Volume Mini-sprinkler Irrigation System for Greenhouses. Multi-area training on bedding plant production. Boone Co., KY approx. 110 participants  
 5/3 Irrigation Design for Greenhouses and Nurseries: Design and Specification. Boone Co. 5 participants  
 6/18 Irrigation for Annuals. Fayette Co., KY  
 6/21 Irrigation Design for an Arboretum. Fayette Co., UK.  
 6/30 Irrigation of Retail Greenhouses: A Hands-On Demonstration. Elizabeth town, KY  
 8/3 Trickle Irrigation for a Wholesale Nursery. Morehead, KY  
 9/1 The Design of Low Water Demand Irrigation and Fertigation Systems for Wholesale Containerized Nursery Areas. Louisville, KY

1991

10/17 Designing Residential and Commercial Irrigation Systems by Computer Aided Design. Lexington, KY.  
 5/12-14 Water Quality and Waste Management: Rules and Opportunities for Extension Initiative Programming. Atlanta, GA. (report) Proceedings and Conference.  
 5/8-10 Solid Waste Management: Implementing an Extension Initiative, Atlanta, GA. (Committee Member for SE Regional Solid Waste Extension Training) Proceeding and Conference.  
 4/11 Design and Demonstration of Fertigation and Chemigation Systems for Drip Irrigation of Horticultural Crops, Princeton, KY  
 Hands-on design and field demonstration of all fertigation system components. Feb-Mar: Multi-Area Solid Waste Management Agent Training (Chairman): Developed, organized, and coordinated 10 speakers - Prepared 120 page training package.

3/27 Louisville  
 3/13 Hopkinsville  
 2/27 Lexington  
 2/13 Paintsville

1990

4/19 Plant Bed Irrigation Systems: (Mini-Sprinklers, (2) Trip Tape, (3) Porous Pipe. Tobacco Plant Bed Field Day.  
 1989

2/26-3/1 APCON'89, 21 International Symposium on the Application of Computers and Operations Research in the Mineral Industry. Demonstration of SEDCAD+ ver. 2.15 Model.

4/12 Trickle Irrigation for Home Landscapes and Gardens. Fayette County Home and Garden Show.  
 4/18 Irrigation Systems for the Home Landscape and the Field. Pennyrille Agent Professional Improvement Training, Crittenden County.  
 4/19 Tobacco Bed Irrigation Field Day. Robertson County Arranged for 9 irrigation dealers, and provided hands-on demonstration of 3 alternative low cost irrigation systems.  
 4/20 Lexington Senior Citizens Center - Demonstration of trickle irrigation for home gardeners. Installed system for senior citizens center, which is wheel chair accessible.  
 5/13 Drip Irrigation for Vegetable Gardening. Irrigation Alternatives for the Home Landscape. Fayette County Extension Field Days/Demonstration.  
 6/5 RJR Reynold's Tobacco Irrigation Class for Extension Agents.  
 7/14 Tour 4: Demonstration of Drip Irrigation for Home and Farm. Horticultural Crops for Profit. Horticultural Field Day Demonstration, Lexington, KY.  
 7/20 Tobacco Bed Irrigation Systems: Low Volume Mini-Sprinklers, Dripline, and Leaky Pipe. Tobacco Field Day, Jessamine, County.  
 7/20 Irrigation Systems, Types, Features and Costs. Tobacco Field Day. Spindletop Farm, Lexington, KY.  
 Fall '89 Design, installation, and testing of an irrigation system for UK president's residence. Obtained donation of \$12,000 worth of irrigation supplies and time, equipment, and personnel from three irrigation manufacturers and two irrigation contractors.  
 Fall '89 North farm irrigation system - expand design to incorporate trickle irrigation of all fruit and all horticultural plant materials.

1988

5/13 Waddle Farm Trickle Irrigation Field Day. Design system and provided for tour of demonstration farm used in trickle irrigation of tomatoes, cabbage, strawberries, and brambles.  
 6/7 Landscape & Turf Industry Field Day. North Farm. Demonstrated the use of irrigation traveling guns and drip irrigation.

- 7/14 UK Research and Education Center Field Day. Princeton, KY. Trickle irrigation for grapes, apples, and strawberries. Presented 12 times.
- 10/20 1988 Kentucky Turfgrass Conference and Field Day. Demonstrated trickle irrigation for ornamentals.
- 1987
- 7/23 Horticulture Fruit and Vegetable Field Day. South Farm. Fayette Co. Trickle Irrigation Components and Operation.
- 10/15 Boyle County Conservation Field Day. Boyle Co. Filtering Systems for Trickle Irrigation Farm Pond Water.

## **M. Forums**

- 1994
- 5/10-11 Office of Surface Mining Western Support Center - Assessment of Current Regulations and Strategies for Advancing Fluvial System Based Regulations. Salt Lake, UT.
- Pollution Prevention Plan LFUCG
- Solid Waste Permits, Div. Of Solid Waste Management LFUCG
- 1992
- A total of 34 presentations were conducted:
- Six Solid Waste Forums (Livingston, Taylor, Fayette, Marshall, Montgomery and Daviess Counties)
- State Extension Council
- 1 U.S. Congressional Legislative Assistants Briefing
- Agent training, Conferences, and Workshops

## **N. Irrigation Demonstration Projects**

- 15th Annual Associated Landscape Contractors of America Student Field Day. Developed and coordinated two sections: (1) Irrigation Design and (2) Irrigation Assembly. Mar. 22-24, 1991
- Designed a comprehensive research irrigation system for the Horticultural Dept.'s north farm. The system will provide interchangeable facilities for trickle, sprinkler, and traveling gun systems. Computer managed research operations are designed for the system but additional funding is required for total implementation. The impacts of such a comprehensive research facility should provide more publishable research and especially it should result in a better linkage among various crop, management, variables, etc., and water application. It is anticipated that such a facility can substantially encourage and enhance the irrigation aspects of the research. The facility will be used as an irrigation demonstration for an irrigation course and later for subsequent demonstration field days.
- Trickle irrigation of peppers (Horticulture Department)
- Trickle irrigation of tomatoes (Horticulture Department)
- Trickle and sprinkler irrigation of tobacco.
- Trickle irrigation of blackberries (Horticulture Department)
- Controlled drainage and subirrigation of corn (Soil Conservation Service) Frost protection of strawberries (Horticulture Department)
- Design low volume irrigation system for cooling dairy cows. Combined this with L. Turner grant work. Installed system in Boyd County.
- Gypsum block calibration and installation procedures for horticultural experiment in Princeton (with Horticulture).
- Design measures and sprinkler head specification with J. Walker on his low volume sprinklers for frost protection.
- Develop tobacco bed irrigation systems for field day, brochure, and hands-on demonstrations.
- Designed and introduced trickle irrigation, low volume mini-sprinklers, and porous pipe systems.
- Trickle irrigation design on research plot (with Entomology).

## **O. Irrigation and Water Supply Designs**

### Custom Engineering Designs of Irrigation Systems:

1. Drip irrigation design for a home garden – demonstration site – Scott Co. 20 Jun 05.
2. Overhead Micro-irrigation for Nursery Production – demonstration site – Jessamine Co. 15 Aug 06.
3. Paducah Master Gardener's Drip Irrigation Demonstration Site. Design, acquisition of material and installation by Residential and Commercial Irrigation Class.

### Other

- 155 completed designs for Kentucky producers



Irrigation designs for producers in fruit, vegetables, nurseries, and greenhouse, tobacco beds, horse farms, pastures, residential, commercial, etc.

## **P. Technical Consultations**

Technical Consultations: 32 conducted (2006-2008), examples of various topics

1. Design of a Gravity-flow Domestic Water Supply System – 25 Feb 05.
2. Owens Nursery – Design water supply and irrigation for 5 green house, pot-in-pot and new retail garden center. Somerset, KY.
3. Residential Irrigation Demonstration, Fayette Co. Dec. 15, 2006.
4. Irrigation/fertigation design to enhance growth of trees on mined lands for biomass production. Jan. 6, 2007.
5. Assessment of sediment impact on homeowner's stream due to up-gradient construction. Oldham Co. April- May, 2007.
6. In-situ stream flow controls to reduce CO<sub>2</sub> release from drained peat lands in Indonesia. Mar. 13, 2007.
7. SEDCAD Design Considerations of Infrequent Storm Events for the Protection of Large Dams. U.S. Mine Safety and Health Administration. Mar. 20, 2007.
8. Critical Assessment and Alternative Options for World Bank TSS Mining Regulations. Denver, CO. May 28-29, 2008.
9. Residential Micro-Irrigation for Landscapes – Installation Procedures. Site Visits. Aug 2008.

Technical Consultations: 28 conducted (2004-2006), examples of various topics

10. Design of a Gravity-flow Domestic Water Supply System. 25 Feb 05.
11. Evaluation of a Potential Site for Stream Remediation. 15 Mar 05.
12. Protecting the Water Resources of the Ohio River – Sediment Control for a Quarry. 6 & 11 Apr 05.
13. Conceptual Design Alternative for Protecting Mill Creek from Leachate Generation Emanating from an Old Municipal Landfill. 18 Apr 05.
14. Use of Leaky Clay Pots for the Removal of Bacteria and Viruses: Potential Use in Cambodia. 17 Jun 05.
15. Real-time Stream Remediation for Contaminant Removal at the Paducah Gasification Diffusion Plant. 17 & 26 Aug 05.
16. Runoff Control and Coal Particle Sedimentation from a Coal Preparation Storage Area. 30 Aug 05.
17. Technology Transfer Opportunities for the Office of Surface Mining Western Regional Office. 6 Oct 05.
18. Trouble-shooting (and resolving problems) Horticultural Drip Irrigation System Used for Experiments. Oct 06.
19. Engineering Performance Assessment of a Perforated & Slotted Riser for Controlled Release of Swine Waste. Oct 06.

### Other

Highway Erosion Sediment Control Systems: 25 Apr 03.

Experimental Practice Permitting for Reforestation of Mined Lands: 22 Apr 03.

Potential for NRCS Technical Service Provider Interface with BAE: 24 Apr 03.

Cumulative Hydrologic Impact Assessment Techniques: 11 Jun 03.

First Flush of Metals from Highways: 20 Aug 03.

American Electric Power: Head-of-Hollow Fill Modeling: 1 Oct 03.

Investigation of AutoCAD Capabilities for Sediment Pond Design: 23 Oct 03.

Municipal Solid Waste Landfill Remediation Alternatives: 30 Jan 04.

Potential for Carbon Sequestration in Illinois Coal Region through Reclamation: 26 Jul 04.

Removal of 60 acres of Radioactive Scrap Materials at Paducah Gaseous Diffusion Plant Superfund Site: 11 Dec 02.

Potential for Carbon Sequestration in Illinois Coal Region through Reclamation 19 Dec 03.

Drip irrigation design for 75 acres of tomatoes and 65 acres of green peppers: Owensboro, KY 26-27 Mar 04.

Drip irrigation design for 45 acres green peppers: Liberty, KY 30 Mar 04.

Trickle irrigation design for 4 acres of blueberries: Hazard, KY 15 Sep 03.

Leaky ponds

Slope stability of a slurry pond

Constructed wetlands

Stormwater and sediment control methods (highways, mining, subdivision, commercial property) Drip irrigation for nurseries, reclamation of mined lands

Landfill and mining low permeability soil covers

Impact of off-site sediment

Pot and pot irrigation and drainage designs.

Pine Mountain Environmental Camp 6 presentation on stream monitoring (5/9-10/1999)  
 4-H Environment Program 4 presentations of lake monitoring methods  
 US Congressional Legislative Assistant's Briefing  
 Potential for Water Contamination and Remediation Alternatives for Fly Ash Facility. July 20, 1995. Remediation of  
 Acid Mine Drainage by Application of Fluidize Bed Combustion Fly Ash. July 13, 1995.  
 NPDES Computerized Monitoring System for Sampling of Leachate. June 6, 1995.  
 Leachate Control for a municipal solid waste landfill. Apr. 13, 1995.  
 Stormwater Control Using Passive Dewatering Systems. Apr. 3, 1995.  
 Siting Construction Quality Control and Monitoring on Fly Ash Monofill. March 17, 1995.  
 Design and irrigation system for a 8.6 ac greenhouse. Country Corner. Springfield, Ky. Summer, 1996.  
 Fly ash disposal for beneficial use in eastern Ky mountain top area. Sept. 22, 1995.  
 Fly ash disposal options. KY Power Dale Site. Dec. 8, 1995.  
 Hazardous Waste Risk Assessment for Environmental Bonding. Dec. 14, 1995.  
 Water Supply and Irrigation System Design for a 100,000 tree horticultural operation in Fleming Co. Summer, 1996.  
 Methane Gas Recovery from a municipal landfill for energy utilization. Aug. 1, 1996.  
 15th Annual Associated Landscape Contractors of America Student Field Day. Developed and coordinated two sections:  
 (1) Irrigation Design and (2) Irrigation Assembly. Mar. 22-24, 1991. (My irrigation students finished 2nd in Residential  
 Irrigation Design and 6th in Irrigation Assembly out of 26 competing schools)  
 Advised County Judge Executive and helped establish 109 Board for Solid Waste Management, Montgomery County,  
 KY.  
 Design stormwater basin for Garrett County School District  
 Woodhills Development, Lexington, KY, investigate erosion/sediment control problem do to upstream subdivision  
 construction.  
 Assist with development of the Green River Water Quality Project. Casey, Russell, Adair, Taylor, and Lincoln Counties.  
 Assist graduate student from Clemson University of verification study of SEDCAD+ applied to a high head pump storage  
 hydroelectric project in the Piedmont.  
 Worked with Kentucky Irrigation Association on Contractor Certification Exam.

## 7. APPLIED RESEARCH PROJECTS

### **Projects Current: Extramural: (\$1,867,494)**

1. Sither, A., R.C. Warner, and C.T. Agouridis. Kentucky Water Resources Institute, Kentucky River Authority Watershed Grant, **\$2,950**, 12/2007-12/2008, Co-PI
2. Barton, C.D., J.M. Lhotka, R.C. Warner, C.T. Agouridis, D.H. Graves, and S. Fei. Demonstrating Techniques for Establishing Woody Bioenergy Plantations on Reclaimed Surface Mined Lands, Kentucky Governor's Office of Energy Policy: Energy R&D Program, **\$174,166**, 11/2007-11/2009, Co-PI
3. Agouridis, C.T., R.C. Warner, and C.D. Barton. Guy Cove Stream Restoration II: Increase, Kentucky Department of Fish and Wildlife Resources, **\$516,824**, 6/2006-6/2013, Co-PI
4. Sither, A., R.C. Warner, and C.T. Agouridis. Kentucky Water Resources Institute, Kentucky River Authority Watershed Grant, **\$2,500**, 1/2007-12/2008, Co-Investigator
5. Agouridis, C.T., R.C. Warner, and C.D. Barton. Guy Cove Stream Restoration II, Kentucky Department of Fish and Wildlife Resources, **\$1,069,776**, 6/2006-6/2013, Co-PI
6. Graves, D.H., C.D. Barton, R.C. Warner, C.T. Agouridis, R. J. Sweigard, and D. S. Maehr. University of Kentucky Commonwealth Collaborative Award for Reforestation of Surface Mined Lands, University of Kentucky, **\$10,000**, 11/2005-6/2007, Co-PI
7. Warner, R.C., C.T. Agouridis, D.H. Graves, C.D. Barton, T.W. Sturm, and T.J. Taylor. Investigations of Alternatives for Restoring Headwater Streams via Sediment Pond Removal in the Appalachian Coal Belt Region, U.S. Office of Surface Mining. **\$44,278**, 10/2005-9/2008, PI
8. Coolong, T., R. Warner, J. Wilhoit, and J. Strang. Increasing Irrigation Water Use Efficiency in Vegetables and Small Fruits Using Automated Pulsed or Microdrip-Irrigation Systems. Specialty Crop Initiative. **\$32,000**. 6/07-7/09. Co-PI
9. Warner, R.C. Field Determination of the Performance of a Novel On-site Wastewater Treatment System. Zoeller Company, **\$15,000**. 11/08-12/09 PI

### **Projects Completed: (\$430,205)**

### **Submitted Grants: (\$780,894)**

**Projects Current: Extramural: (\$2,720,316)**

1. Warner, R.C. and C.T. Agouridis. Demonstration of a Performance-Based System of Storm Water and Erosion Controls on Small Residential/Commercial Sites in the Georgia Piedmont, Georgia EPD/USEPA Region IV. **\$52,259**, 2004-2007. PI (R 20%, AR 80%). Regionally competitive.
2. Graves, D.H., R.C. Warner, and R.J. Sweigard. Post Mining Reforestation Demonstration Project IV. U.S. Forest Service. **\$978,000**, 2004-2007. Co-PI (R 30%, AR 70%). Nationally competitive.
3. Graves, D.H., R.C. Warner, and R.J. Sweigard. Post Mining Reforestation Demonstration Project V. U.S. Forest Service. **\$500,000**, 2005-2008. Co-PI (R 30%, AR 70%). Nationally competitive.
4. Warner, R.C., C.T. Agouridis, D.H. Graves, C.D. Barton, T.W. Sturm, and T.J. Taylor. Investigations of Alternatives for Restoring Headwater Streams via Sediment Pond Removal in the Appalachian Coal Belt Region, U.S. Office of Surface Mining. **\$44,278**, 10/2005-9/2007, PI (R 30%, AR 70%). Nationally competitive.
5. Agouridis, C.T., R.C. Warner, and C.D. Barton. Guy Cove Stream Restoration II, Kentucky Department of Fish and Wildlife Resources. **\$1,069,776**, 6/2006-6/2008, Co-PI.
6. Warner, R.C. Assessment of Surface Water and Sediment Control Facilities for Outfalls 008, 011 and 015 at the Paducah Gasification Diffusion Plant. U.S. Dept. of Energy. **\$66,003**, 2006-2007, PI (R 20%, AR 80%). Regionally competitive.

Other: Graves, D.H., C.D. Barton, R.C. Warner, C.T. Agouridis, R.J. Sweigard, J.W. Stringer, and J.M. Ringe. University of Kentucky Commonwealth Collaborative Award for Reforestation of Surface Mined Lands, University of Kentucky. **\$10,000**, 11/2005-6/2007, Co-Investigator.

**Projects Completed (2005-2006 - \$2,212,065)**

1. HP Technology for Teaching Grant Initiative – 2004-2005. Higher Education Edition, **\$70,000**. HP. PI (R 100%).
2. Post Mining Reforestation Demonstration Project III. **\$978,000**, 2003-2006. USFS. Co-PI (R 30%, AR 70%).
3. Carbon Sequestration on Reclaimed Mined Lands. **\$1,000,000**, 2003-2006. DOE. Co-PI (R 30%, AR 70%).
4. Dairy Waste Utilization Management Tool Development and Demonstration. **\$76,285**, 2003-2005. KY EPA 319(h)/USEPA Region IV. Co-PI (AR 100%).
5. Agouridis, C.T., R.C. Warner, and C.D. Barton. Guy Cove Stream Restoration, Kentucky Department of Fish and Wildlife Resources. **\$175,560**, 8/2005-6/2006, Co-PI (\$87,780 of grant was included in Guy Cove Stream Restoration II).

**Proposal Submitted: (\$2,807,976) Note: all external funding sources.**

1. Warner, R.C. Field Determination of the Performance of a Novel On-site Wastewater Treatment System. **\$9,000**. Zoeller Company, PI. (pending)
2. Warner, R.C., T. Dowdy, and C.T. Agouridis, HP Technology for Teaching Grant Initiative (2005-2006), **\$124,000**, Hewlett Packard Co., PI. (not funded)

**Other**

Demonstration of a Performance-Based System of Storm Water and Erosion Controls on Small Residential/Commercial Sites in the Georgia Piedmont, Georgia EPD, \$52,259, 2004-2006. Co-PI (R 20%, AR 80%).

HP Technology for Teaching Grant Initiative - 2004 Higher Education Edition, \$70,000. HP. Co-PI (R 100%).

Post Mining Reforestation Demonstration Project III. \$978,000, 2003-2006. USFS. Co-PI (R 30%, AR 70%).

Post Mining Reforestation Demonstration Project IV. \$978,000, 2004-2007. USFS. Co-PI (R 30%, AR 70%).

Post Mining Reforestation Demonstration Project V. \$500,000, 2005-2008. USFS. Co-PI (R 30%, AR 70%).

Carbon Sequestration on Reclaimed Mined Lands. \$1,000,000, 2003-2006. DOE. Co-PI (R 30%, AR 70%).

SediGraph Automatic Particle Size Analyzer. UK Major Research Equipment Fund. \$47,878. Dec 2002. PI.

Carbon Sequestration on Surface Mine Lands. U.S. Department of Energy. 2002-2005. \$1,000,000. (Co-PI with Forestry-Graves (PI) and Mining Engineering). Nationally competitive. [R-30%, AR-70%].

Post-Mining Reforestation Demonstration Projects- Phase II. U.S. Forest Service. 2002-2005. \$985,000. (Co-PI with Forestry-Graves (PI) and Mining Engineering). Nationally competitive. [R-25%, AR-75%].

Dairy Waste Utilization Management Tool Development and Demonstration. U.S. EPA and KY Natural Resources Environmental Protection Cabinet. 2002-2004. \$76,285. (Co-PI with Bicudo (PI) and Edwards). Regionally competitive. [R-10%, AR-90%].

SediGraph Automatic Particle Size Analyzer. UK Major Research Equipment Fund. \$42,878. 2002. PI.

Post-Mining Reforestation Demonstration Projects. U.S. Forest Service. \$985,000. 2001. (Co-PI with Forestry and Mining Engineering)

Evaluating the Performance of External Sand Filters. Robinson Forest Trust, \$10,000. 2001. PI.

Laboratory and Mine Site Assessment of Sediment Basin Performance Using a Floating Siphon and External Sand Filter. Robinson Forest Trust, \$10,000. 2001.

Comparison of Runoff from Compacted Versus Loose Dumped Mine Spoil. Robinson Forest Trust, \$10,000. 2001. PI.

Water Balance Assessment of Loose Dumped Spoil. Robinson Forest Trust, \$10,000. 2001. PI.

Retention and Removal of Sediment, Radioactive Waste and Heavy Metals at the Paducah Gaseous Diffusion Plant. Department of Energy. \$8,000. 2001. PI.

Equine Waste BMP Demonstration Project (319H cooperator with USDA/NRCS and the Thoroughbred RC&D). \$8,000. 2001. PI.

Short Course Generated Funding. 1981-2000.

Reducing Sediment Effluent Concentration by a Perforated Riser and Internal Sand Filter – Field Verification. Robinson Forest Trust. \$10,000. 2000.

Stormwater and Sediment Yield from Compacted and Uncompacted Mine Spoil, Robinson Forest Trust. \$10,000. 2000.

Infiltration Potential of Loosely Placed Mine Spoil. Robinson Forest Trust. \$10,000. 2000. Subsurface Leaching Potential of Animal Waste Holding Ponds. USEPA/NREPC. 2000. \$243,860. PI.

Computer Modeling Assessment and Site Demonstration of Alternative Sediment Control Systems. Chattahoochee-Flint Regional Development Center. \$200,000. Co-PI. 1999. (Conducted during Sabbatical 1999-2000).

Infiltration Potential of Loosely Placed Mine Spoil. Robinson Forest Trust. \$10,000. 1999.

Stormwater and Sediment Yield from Compacted and Uncompacted Mine Spoil, Robinson Forest Trust. \$10,000. 1999.

Enhanced Performance of Sediment Basins through Slow Sand Filter Passive Dewatering Systems. Robinson Forest Trust. \$16,250. 1999.

Increasing Effectiveness of Residential Wetland through Pulsed Vertical Flow Fixed Film Reactors. Zoeller Company, Inc. \$16,000. 1999. PI.

Sediment Pond Design Evaluation Passive Dewatering Systems, U.S. Office of Surface Mining/NREPC. \$99,956. 1998. PI.

Reducing Sediment Effluent Concentration by a Perforated Riser or Internal Sand Filter: Field Verification. Robinson Forest Trust, \$10,000. 1999. PI.

Infiltration Potential of Loosely Placed Mine Spoil, Robinson Forest Trust, \$10,000. 1999. PI.

Enhanced Sediment Control by Passive Dewatering Basins. Robinson Forest Trust. \$34,560. 1998.

Surface Runoff and Erosion Rate Determination from Compacted and Uncompacted Appalachian Mine Spoil. Robinson Forest Trust. \$17,920. 1998.

Sediment Pond Design Evaluation – Passive Dewatering Systems. U.S. Department of the Interior, Office of Surface Mining, Natural Resources and Environmental Protection Cabinet. \$111,866.

Increasing High Value Tree Survivability on Uncompacted Mined Spoil through Drip Irrigation, Robinson Forest Trust (Robinson Forest Trust), \$7,800. 1997. PI.

Surface Runoff and Erosion Rate Determination from Compacted and Uncompacted Appalachian Mine Spoil, Robinson Forest Trust, \$17,920, 1997. PI.

Enhanced Performance of Sediment Basins through Slow Sand Filter Passive Dewatering Systems, Robinson Forest Trust, 1997. \$16,250. PI.

Maximization of Landfill Gas Production, TVA/NREPC, 1997, \$1,800, PI Sediment.

Determination of the Hydrologic and Sedimentologic Response of Loose Mined Spoil Planted with Hardwoods. Robinson Forest Trust. \$420,000. (with Forestry, Mining and L. Wells)

Evaluation of Passive Dewatering Systems for Sediment Basins. Robinson Forest Trust. \$60,000. 1996.

Field Determination of Infiltration. Robinson Forest Trust. \$32,640. 1996.

Surface Runoff and Erosion of Compacted and Uncompacted Appalachian Mine Spoil. Robinson Forest Trust. 32,780. 1996.

Maximization of Landfill Gas Production - KY Environmental Cabinet, Div. of Energy, \$36,120. PI.

R. Sweigard, D. Graves, J. Ringe, and R. Warner, Stabilization of Embankments on AML Slopes using Soil Bioengineering Techniques: A Field Evaluation of Cost-Effectiveness, US Dept of Interior, \$198,771, 1996-8, Co-investigator.

Subsurface Leaching Potential of Animal Waste Holding Ponds as a Function of Soil Moisture and Compaction. USEPA/NREPC. \$453,860. 1996-2000. PI.

Transport and Fate of Metribuzin on Horticultural Fields Amended with Composted Yard Waste. KSU \$6,225. PI (1996)

Assessment of Current Decision Making Aids for Waste Management Facilities. Southern Regional Development Corp. \$16,000 Co-PI with the Univ. of TN and OK State. (completed 1996)

Development of Hydrologic Parameters for Surface Mining in the Appalachian Coal Region. Cypress Minerals. \$56,000. Co-PI with KGS. (1995-6)

Major Equipment Grant - Supercritical Fluid Extractor UK Equipment Enhancement Grant. \$55,938. PI. (completed 1995)

Potential Utilization of Clay Deposits Extracted During Mining for Fly Ash Monofills. Industrial Mining, Ohio. \$1500. PI

Determination of the Hydrologic Response of Reclaimed Mined Lands. Cypress Minerals, Denver, Co. \$50,000. (with J. Dinger)

Assessment of Current Decision Making Aids for Waste Management Facilities. Southern Region Development Corp. \$16,000 Co. PI with the Univ. of TN and OK State.

Design of an Infiltration Basin for Aquifer Recharge During Surface Mining, Star Fire Project, Cyprus Minerals & Cyprus Coal Co., \$148,000 [Co-P.I. with Dr. Dinger, KY Geol. Survey].

Development of Landfill, Recycling, Composting and Waste-to-Energy Legislature Options for the Kentucky Legislature Special Session on Solid Waste Management, Governor's Office, \$150,000 (\$5,000 RCW).

On-site Investigation of Soil Additives to Reduce the Saturated Hydraulic Conductivity of Landfill Soils Used for Landfill Covers and Liners. Delaware County Solid Waste Authority, \$11,000.

Swirl Concentrator: A Combination Sediment Separator and Junction Box for Fish Hatchery Operations. Rainbow Glen Trout Company Incorporated. Winchester, Kentucky. 1990. \$5,000.

Field Investigation of Soil Additives to Reduce the Hydraulic Conductivity of Low Clay Content Landfill Cover Soils for Solid and Hazardous Waste Landfills, Soil Science, Inc. \$11,000. Hydraulic Mechanisms of Multiple Soil Landfill Surface Cover Systems, US EPA sponsored project, funded at \$58,651.

The Swirl Concentrator as a Primary Sediment Separator for Water Treatment in Developing Countries. U.S. Agency for International Development. Grant to the Office of International Programs for Agriculture, University of Kentucky.

Design and Demonstration of Fertilization and Chemigation Systems for Drip Irrigation of Horticulture Crops. Program Enhancement Grant, \$4,985.

SEDIMOT III Workshop. \$10,000. Office of Surface Mining sponsored. (B.J. Barfield, Agr. Engr., and L. Sendlein, IMMR).

Moisture Absorption, Holding and Transmission Characteristics of Rebuilt Prime Farmland Soils. \$20,640. USDA sponsored. (Dr. Felton, Agr. Engr.)

Evaluating the Feasibility of Tobacco Irrigation in Kentucky \$8,600. RJ Reynolds sponsored. (G. Duncan, Agr. Engr.)

Development of a Generic Technology Center for Reclamation and Sedimentology. \$25,000.

Transport and Fate of Metribuzin on Horticultural Fields Amended with Composted Yard Waste, KSU, \$6,225.

Designs, Construction, and Instrumentation of a Multiple Layered Hazardous Waste Cover System. \$251,760.

Monitoring and Modeling of Multiple Soil Layer Landfill Covers. \$367,937.

Development of a User-Oriented Short Course of Surface Mining Computer Programs Applicable to the Coal Mining Industry. \$5,000.

Development of an interactive trickle irrigation system for fruits and vegetables. No extramural funding.

Utilization of Commercially Composted Waste to Reduce the Transport of Herbicides to Surface and Groundwater (with M. Byers - KSU, completed 1996).

Proposals Submitted (Note, all external funding sources)

Carbon Sequestration Phase I Regional Carbon Sequestration Partnerships Department of Energy Carbon: \$1,200,000, 2003. Co-PI.

Guy Cove Stream Restoration Project at the University of Kentucky Robinson Forest. \$1,220,000, 2004. Co-PI.

Camden Creek Restoration Project at UK's ARC. \$350,000, 2004. Co-PI.

Demonstration of a Riparian Corridor Weep-Berm Control System for Reducing NPS in N. KY. \$172,336, 2004. Co-PI.

Assessment of the Occurrence of Time of Diurnal Maximum/Minimum Stream Parameter Values as an Indicator of Stream Recovery Dynamics. \$100,000, 2004. Co-PI.

Investigation of Sediment Pond Removal Alternatives for Restoring Headwater Streams in the Appalachian Coal Belt Region. \$44,278, 2004. Co-PI.

## 8. ACADEMIC TEACHING AND ADVISING

### A. Teaching

## Course Listings

Year	Course# - Hrs.	Description	# Students	Evaluation Course/Tech	Dept. Ave)	Dept Range	Agr Col	Unit
Sp 07	AEN 462 - 3	Residential and Commercial Irrigation	8	4.0/4.0				
Sp 06	AEN 462 - 3	Residential and Commercial Irrigation	10	3.9/4.0				
Fall 06	BAE 599 - 3	Advanced Residential and Commercial Irrigation	1	NA				
Sp 05	AEN 462 - 3	Residential and Commercial Irrigation	11	3.9/4.0				
Sp 05	BAE 599 – 7 lectures	Intro. Stream Restoration						
Fall 05	BAE 750 - 3	Assessing Engineering Char. Of Modeling Clay	1	NA				
Fall 05	BAE 750 - 3	VOC characteristics in Wood Processing	1	3.9/4.0				
Sp04	BAE 599	GIS for Water Resources <sup>1</sup>	6	4.0/4.0				
Sp04	BAE 599	Stream Restoration <sup>2</sup>	5	3.5/4.0				
SP03	AEN 462	Res. & Com. Irrigation	13	4.0/4.0				
Sp02	BAE 599	Golf Course Irrigation	8	4.0/4.0				
Sp02	PLS 597	Landscape Irrigation	24	3.4/4.0				
Sp02	BAE 750	Stream Restoration	6	NR				
F02	FOR460G	Forest Watershed Mgmt	14	NR				
Su01	AEN750 – 3	Stream Restoration	2					
S99	PLS597 – 3	Advanced. Residential Irrigation	6	No evaluation received since less than 10 students				
F98	AEN599 - 3	Landfill Design	7	3.9/3.9	3.3		3.3/3.4	3.2/3.3
S98	AEN462 - 3	Residential & Commercial Irrigation. Design	24	3.9/3.8	3.3	2.4-4.0	3.3/3.4	3.2/3.3
F98	AEN750 - 3	Advanced Landfill Design	6	None available				

S97	AEN537 - 3	Irrigation. & Drainage Engineering	21	3.3/3.3	3.3	2-3.8	3.3/3.4	3.2/3.3
F97	AEN667 - 3	Stormwater Modeling	6	3.7/4.0	3.3	2.4-3.7	3.4/3.5	3.2/3.3
F96	AEN536/ CE546 -3	Fluvial Hydraulics.	6	3.5/3.7	3.3	2.0/3.8	3.3/3.4	3.2/3.3
F96	AEN599 - 3	Computer. Aided Irrigation Design	12	None available				
S96	AEN599 - 3	Residential & Commercial Irrigation. Design	32	3.6/3.7				
S96	AEN 599 - 3	Landfill Design	11	3.6/3.3				
F96	AEN 462 – 3	Computer. Aided Irrigation Design	12	12				
F96	AEN536/CE546 -3	Fluvial Hydraulics	7	Taught ½ of course - Student Advising				
S95	AEN536/ CE546 -3	Fluvial Hydraulics	10	3.4/3.1	Taught ½ of course			
F95	AEN599 - 3	Solid Waste Facility Design	16	3.4/3.4	Taught ½ of course			
F95	AEN537 - 3	Irrigation. & Drainage Engineering	6					
94	AEN536/ CE546 - 3	Fluvial Hydraulics	11	3.3/3.2				
S94	AEN599 -3	Solid Waste Facility Design	11	3.45				
S94	AEN599 - 3	Residential & Commercial Irrigation. Design	14	3.65				
Su94	AEN750 - 3	Site Assessment for Solid & Hazardous Waste						
S94	HOR582	Advanced Greenhouse Irrigation	½ course w/Buxtom					
S94	AEN343 - 3	Fluid Mechanics	1 week					
S93	AEN59 - 3	Landfill Design	12	3.7				
F93	AEN537 – 3	Irrigation. & Drainage Engineering						
S93	HOR352	Nursery Production	2 weeks					
S93	MNG 463 - 3	Surface Mining Operations	2 weeks					

S93	AEN437 - 3	Soil & Water Conservation	1 lecture					
1992	AEN599 - 3	Solid Waste Landfill						
S92	AEN599 - 3	Municipal. Solid Waste Management						
S92	AEN750 - 3	Surface Irrigation for Develop. Countries.	1					
F92	AEN537 - 3	Irrigation. & Drainage Engineering	2					
F92	AEN750 - 3	Adv. Trickle Irrigation	1					
S91	AEN599 - 3	Residential & Commercial Irrigation. Design	7	4.76/5				
F91	AEN599 - 3	Solid Waste Landfill Design						
F91	AEN599 - 3	Residential & Commercial Irrigation Installation		4.85/5.00				
F90	AEN599 - 3	Residential & Commercial Irrigation. Design	10					
1990	EXP396	Ground Water Monitoring		4.85/5.00				
	AEN599 -3	Residential & Commercial Irrigation. Design		4.73/5.00				
1989	AEN450 - 3	Residential & Commercial Irrigation. Design						
	AEN537 - 3	Irrigation. & Drainage Engineering						
	AEN102	Ag Eng Prob.						
1988	AEN537 - 3	Irrigation. & Drainage Engineering						
	AEN750 - 2	Spec Problem Sediment Flume						
	AEN75 - 2	Spec. Problem Channel Side Slope Stability						
1985	AEN537 - 3	Irrigation. & Drainage Engineering						
	AEN430 - 3	Farm Water Management						
	HORT450 - 3	Landscape Installation						



	AEN750 - 3	Adv. Sediment Basin Design						
1984	AEN537 - 3	Irrigation. & Drainage Engineering						
	AEN750 - 3	Applied Oper. Research. & Simulation						
	GEN300C - 3	Landscape Archit Instal & Maint.						
1983	AEN750 - 3	Applied Oper Research & Simulation						
	AEN430 - 3	Farm Water Management						
	AEN750 - 3	Grnd. Water Proce & Coal Region						
	AEN750 - 3	Math. Model of Irrigation System						

<sup>1</sup>Co-instructor with Ms. Dowdy; <sup>2</sup>Co Instructor with Dr. Agouridis

## B. Course Descriptions

### AEN 599: Solid Waste Landfill Design

This is an introductory course for seniors, graduate students, consultants and regulatory personnel. Design and construction methods were emphasized encompassing regulations, siting, geohydrologic regime, capacity, cover systems, liners, leachate production and control, drainage systems, methane gas production and control, stormwater and sediment control structures, and groundwater monitoring and modeling.

AEN 450: Installation of Residential and Commercial Irrigation Systems. A senior level course for Landscape Architecture, Horticulture and Agronomy students. The course emphasizes installation of equipment selection and usage, selection installation, and maintenance of pipe, irrigation heads and nozzles, valves, wiring, controllers, back flow preventors, etc. Cost estimation and system management.

### EXP 396: Groundwater Monitoring at Solid Waste Landfills

An upper class level course encompassing geological considerations, siting, type and location of monitoring wells, well construction, sampling procedures, regulations, and groundwater modeling.

### AEN 450: Design of Residential and Commercial Irrigation Systems

A senior level design course for Landscape Architects, Horticulture and Agronomy students. Major topics covered are basic hydraulics, piping and pipe networks, sprinkler types, selection and layout zoning, water-supply, pumps, controllers, wire sizing, plant water requirements, xeriscapes, and designs. Designs progressed from a simple residential landscape, to complicated residential landscapes, commercial developments, athletic fields, and golf courses.

AEN 537: Irrigation and Drainage Engineering. AEN 537 is an advanced course in engineering design of irrigation and drainage systems. Designs performed encompass: (a) all types of sprinkler irrigation, (b) trickle irrigation, (c) residential/ commercial turf irrigation, (d) irrigation scheduling, (e) trickle irrigation, (f) land application of waste, (g) water supply and delivery systems, (h) surface and subsurface drainage, (i) subirrigation, and (j) water supply.

AEN 430: Farm Water Management. This course focuses on water as a resource. All systems using water on the farm are designed. It is an applied course covering the following major topics: (a) water supply, (b) water treatment, (c) wastewater treatment, (d) irrigation, (e) drainage, (f) diversion/waterway design, (g) pumps and piping, and (h) ponds.

AEN 750: Special Problems in Agricultural Engineering. Six courses have been taught under the special problem topic: (a) applied operations research and simulation, (b) ground water processes in the Appalachian Coal Region, (c) mathematical model of irrigation systems, (d) advanced sediment basin design, (e) design and construction of a sediment flume, and research, and (f) development of a conceptual model for predicting sideslope stability of channel walls. The operations research course is an advanced applied course covering: (a) linear programming, (b) integer programming, (c) single and multivariable optimization, (d) quadratic programming, (e) geometric programming, and (f) discrete deterministic dynamic programming. The ground water course focuses on fracture flow analysis and water quantity and quality impacts of underground coal mining.

GEN 300C: Landscape Architecture Installation and Maintenance. This was a multiple instructor course in which I was responsible for a four week sequence in turf and woody ornamental irrigation for residential and commercial sites.

HORT 450: Basic hydraulics, pipe networking, sprinkler head selection and spacing, and system layout, as applied to residential and commercial irrigation, was taught in HORT 450 over a four week period.

### C. Graduate Student Advising

Name	Year	Degree	Thesis Title	Role
Torrealba, Sebastian	2010	Ph.D.	A Continuous Mathematical Model of the One-Dimensional Sedimentation Process of Flocculated Sediment Particles	Major Advisor
Hootkany, Ali	2007	Ph .D.	Design and Performance of Waste Lagoons.	Major Advisor
Stiglbauer, Paul	2008	Ph.D.	Fines Reduction at Oriented Strandboard Flakers.	Major Advisor; co-advisor with Dr. Conners
Taylor, Timothy	2008	M.S.	Hydrologic Evaluation of Loose-Dumped Spoil for Use in Headwater Stream Restoration on Head-of-Hollow Fills	Major Advisor; co-advisor with Dr. C.T. Agouridis
Peake, Matthew	2009	M.S.		Major Advisor
Patrick Angel,	2008	Ph.D.	Plant and Soil Science	Committee Member
Maxwell, Jason	2008	M.S		Committee Member
Bodapati, Kiran	2008	M.S.		Committee Member
Nunez, Andres	2008	Ph.D.	Plant and Soil Science	Outside Examiner
Belcher, Brian		Ph.D.	Civil Engineering	Committee Member
Barnett, John	05/04	M.S.	The Effectiveness of a Combination Weep Berm-Grass Filter Control System for Reducing Fecal Coliforms and Nutrients from Runoff and Subsurface Flow.	Major Advisor
Torrealba, Sebastian	08/04	M.S.	Development and Testing of a Methodology to Assess the Potential Field Performance of Flocculants.	Major Advisor
Byrd, Eric	05/02	M.S.	Evaluation of Surface Runoff and Infiltration on Non-Compacted Mine Spoils.	Committee Member
Collins-Camargo, Francis	2000	M.S.	Evaluation of Enhanced Water Quality Through passive Dewatering Systems Utilizing Sand Filters: A Field and Large Scale Laboratory Study	Major Advisor
Dawalt, Eric	2000	M.S.	Evaluation of Sediment Basin Effectiveness Using A Laboratory Scale Basin and Field Basins	Major Advisor
Hallany, Jihad	2000	M.S.	Evaluation of passive Dewatering System for Small Storms Using a Laboratory Sediment Basin	Major Advisor
Weber, Diana	2000	M.S.	Relative Contribution of Sediment from Upland and Channel Erosion	Co-Advisor Civil Engr. @

				GA Tech
Gholamimerhrabadi, Adolfazl	2000	Ph.D.	An Assessment of Factors Affecting the Competency of Agricultural Mechanization Programs and Teachers in the Islamic Republic of Iran	Co-Director, Ag Voc. Education
Moberly, Charlotte	1998	M.S.	Parameterization of a Hydrologic Model for Simulating Water Transport and Storage in Mine Spoil	Co-Advisor
Baier, James W.	1997	Ph.D.	Development and Evaluation of a Model for an Active Gas Collection System at Municipal Landfills.	Major Advisor
Malone, Robert	1996	Ph.D.	Evaluating the Effectiveness of BMP for Horticultural Crops.	Major Advisor
Popplewell, Cynthiana	1996	M.S.-CE	The Use of Constructed Wetlands to Treat Domestic Wastewater	Co-Advisor
Blanton, Christine	1995	M.S.	Hydraulic Conductivity of Earthen Liners in Agricultural Waste Containment Facilities: Evaluation of Field Construction Techniques	Major Advisor
Hootkany, Ali	1994	M.S.	Hydraulic Conductivity Behavior of Soil Liners in Agricultural Waste Containment Facilities	Major Advisor
Meshkat, Masoud	1994	Ph.D.	Development and Evaluation of the Tubular Sand Method to increase Drip Irrigation Efficiency	Major Advisor
Ampfer, Christopher	1992	M.S.	Effects of Clay Content, Clay Type, Soil Texture, and a Soil Additive, on the Hydraulic Conductivity of Compacted Soils Used for Landfill Covers and Liners.	Major Advisor
Malone, Robert	1992	M.S.	Transport of Benzene and Trichloroethylene Through a Landfill Soil Liner Mixed With Lignin Treated Coal Fines.	Major Advisor
Peters, Nathaniel,II.	1992	Ph.D.	Ph.D. 1992. Construction, Instrumentation, Monitoring and Modeling of Multi-Layer Soil Landfill Covers.	Major Advisor
Purnamo, Rahmad		M.S.	Investigation of Surface Irrigation Methods for Indonesian Agriculture.	Major Advisor
Taylor, Page	1992	M.S. Geology	Page Taylor - M.S. (Geology) - Verification of the SEDCAD+ Model and Development of Hydrologic Parameters for Surface Mining in the Appalachian Coal Region.	Co-Advisor
Baier, James W.	1991	M.S.	James W. Baier. M.S. 1991. A Simplified Trickle Irrigation Design and Specifications Model (STRIDES).	Major Advisor
Hafizi, Mahammad	1991	Ph.D.	Computer and Centrifuge Modeling and Testing of the Failure Mechanisms of a Compacted Clay Cap Subjected to an Underlying Cavity	Major Advisor
Mujiharjo, Sigit	1991	M.S.	Evaluation of a Swirl Concentrator as a Sediment Separator for Primary Water Treatment.	Major Advisor
Harned, James	1988	M.S.	Evaluation of the Hydraulic Mechanisms of a Hazardous Waste Landfill Cover Under Stable and Subsidence Conditions)	Major Advisor
Humel, Steve	1988	M.S.	Special Problems (1) Conceptual Modeling of Sidewall Failure in Gullies and Natural Channels; (2) Design and Construction of a Channel Erosion Flume)	Major Advisor

Coates, Anna	1987	M.S.	Hydrologic Performance of Multilayer Landfill Covers: A Field Verification and Modeling Assessment of HELP and SOILINER)	Major Advisor
Schwab, Pamela	1987	M.S.	Sediment, Erosion, Discharge by Computer Aided Design (SEDCAD)	Major Advisor
Meshkat, Masoud	1986	M.S.	Interactive Hydraulic Design Model of a Trickle/Drip Irrigation System)	Major Advisor
Sands, Gary	1984	M.S	A Computer Model for Analysis of Irrigation Planning and Management Alternatives for Humid Regions)	Major Advisor

## Committee Member For

Eric Byrd, M.S. Forestry - 2001  
 B. Shergill, Ph.D. Civil Engineering - outside examiner  
 C. Cosmos, M.S. Agricultural Engineering - 1998 (Univ of IL)  
 D. Wang, Ph.D. Civil Engineering - 1999  
 Dadung Li, Ph.D. Civil Engineering - 1999  
 Kenneth Liberty, Ph.D. Agricultural Engineering - 2001  
 Teng Tech Lim, M.S. Agricultural Engineering - 1997  
 Charles Martin, M.S. Civil Engineering - 1996  
 Carl Peterson, M.S. Geology - 1999  
 Ananto Seta, Ph.D. Civil Engineering - 1998  
 Robert Michael Williams, Ph.D. Agricultural Engineering - 2000  
 Jiang Yaping, Ph.D. Agricultural Engineering  
 Terry K. Hutchens, M.S. Agronomy  
 Jeffrey McBurnie, Ph.D. Agricultural Engineering  
 Stephen Noe, M.S. Agricultural Engineering  
 Charles Aldred, M.S. Forestry - 1991  
 Daniel Storm, Ph.D. Agricultural Engineering - 1991  
 Charles Arnold, Ph.D. Agricultural Engineering - 1990  
 Susan Lewis, M.S. Agricultural Engineering - 1990  
 Noel Herrera, M.S. Agricultural Engineering - 1989  
 Ronald Bingner, M.S. Agricultural Engineering - 1989  
 Herujoho Hadisuparto, Ph.D. Forestry - 1989  
 Daryl Greer, M.S. Civil Engineering - 1986  
 Michael Hirschi, Ph.D. Agricultural Engineering - 1985  
 Michael Ronayne, M.S. Civil Engineering - 1985  
 Ray Albright, M.S. Forestry - 1985  
 Bruce Wilson, Ph.D. Agricultural Engineering - 1984  
 Sherman Biggerstaff, M.S. Agricultural Engineering - 1984  
 Mitchell Griffin, M.S. Agricultural Engineering - 1984

## 9. HONORS AND AWARDS

### A. Honor Societies

Alpha Epsilon (Agricultural Engineering)  
 Epsilon Sigma Phi (Extension)  
 Gamma Sigma Delta (Agriculture)  
 Chi Epsilon (Civil Engineering)  
 Omega Rho (Operations Research)  
 Sigma Xi (Research)

### B. Awards

United States Department of Interior's 2007 Cooperative Conservation Award to ARRI Core and Academic Teams (member of the Academic Team).  
 Wethington Award 2006 and 2007.  
 Wethington Award 2005 and 2006.  
 American Society of Mining and Reclamation 2<sup>nd</sup> place poster award at the 2006 7<sup>th</sup> ICARD Annual Meeting, Hydrologic and Water Quality Characteristics of Loose-Dumped Mine Spoil.  
 University of Kentucky Commonwealth Collaborative selected project, Reforestation of Surface Mined Lands, 2006.  
 1992  
 The 1992 Environmental Commission Annual Environmental Award for Household Paint Collection and Recycling. 1990-89  
 College of Engineering Outstanding Teacher, Dept. of Agricultural Engineering.

1988

Outstanding Technical Paper Award at the 1988 National Surface Mining Symposium for the paper entitled: SEDIMOT Pond Design and Performance Analysis.

1987

Appointment to the Governor's Advisory Task Force on the Superfund Closure of Maxey Flats, a low level nuclear waste site.

1985

Association of Kentucky Extension Specialist Outstanding New Specialist Award.

1984

Association of Kentucky Extension Specialist Outstanding Project Award for SEDIMOT II: A Computer Aided Design Sediment Control Model.

1983-84

College of Engineering Outstanding Teacher, Department of Agricultural Engineering.

1983

Outstanding Technical Paper at the 1983 National Symposium on Surface Mining, Hydrology, Sedimentology, and Reclamation for the paper entitled: Potential Use of the Swirl Concentrator for Sediment Control on Surface Mined Lands.

1979-80

U.S. Geological Survey Fellowship for the Doctoral Thesis Support Program.

## 10. PROFESSIONAL SOCIETIES AND ACTIVITIES

### A. Reviewer Panels for Grants and Journals

#### Review Panels and Services (2006-2008):

1. Academic member of the Appalachian Regional Reforestation Initiative
2. Agricultural Research Service North Appalachian Experimental Watershed
3. USDA Evans-Allen Supported Proposal Review
4. USDA Small Innovation Research Program
5. Outside reviewed of International Surface Mining Journal, American Society of Agricultural and Biological Engineers, American Society of Civil Engineers and American Society of Mining and Reclamation

#### Review Panels and Services (2004-2006):

1. Academic member of the Appalachian Regional Reforestation Initiative
2. Agricultural Research Service North Appalachian Experimental Watershed
3. USDA Evans-Allen Supported Proposal Review
4. USDA Small Innovation research Program
5. Outside reviewed of international surface Mining Journal, American Society of Agricultural and Biological Engineers and American Society of Civil Engineers

#### Other

USDA CSREES Watershed Processes and Water Resources

Agricultural Research Service North Appalachian Experimental Watershed

USDA Evans-Allen Supported Proposal Review

USDA Small Innovation Research Program

Outside reviewed of International Surface Mining Journal, American Society of Agricultural Engineers and American Society of Civil Engineers

American Society of Agronomy

International Journal of Surface Mining

American Society of Agricultural Engineers

American Society of Civil Engineers

Environmental Institute Proposal to Establish a University-Wide Environmental Institute

National Association of State University and Land-Grant Colleges

USDA Water Resources Management and Technology

USDA's National Research Initiative Competitive Grants Program

USDA/CSRS Evans-Allen Capacity Grants

USDA-ARS  
 International Surface Mining Journal  
 Dept. of the Interior, Office of Surface Mining  
 USDA Water Resources Assessment and Protection Program  
 US Environmental Protection Agency  
 Outside reviewed of promotion packages for USDA Agricultural Research Service.  
 Reviewed two textbooks, for publishers, in the hydrology and stream transport areas.  
 CSRS-USDA FY 1992 Water Quality Program Grants Reviewer  
 Invited Reviewer for USDA-CSRS Water Quality Grants and Evans-Allen Grants

## **B. Committees, Task Forces, Boards**

Committees (2006-2008): 6 total – selected committees listed

1. College Advisory Committee on Appointment, Promotion and Tenure. 2007 and 2008. 17 evaluations completed (2007).
2. BAE Promotion and Tenure Chair 2007-2008: Successfully completed 2 Assoc. to Professor Promotion Packages. (Colliver, Purschwitz, Workman)
3. ASABE Evaluator for Blue Ribbon Awards – Manuals and Workbooks. June, 2007

Committees (2004-2006):

1. Promotion and Tenure Chair 2004-2006: BAE. (Stombaugh, Crofcheck, Nokes)
2. Alumni Development Committee: BAE 2005-2006.
3. Extension Planning Committee: BAE 2005-2006.

Other

Solid Waste Collection and Waste Reduction Tiger Team: UK  
 Promotion and Tenure Chair 2004: BAE.  
 Kentucky Research Consortium for Energy and Environment 2004: UK.  
 Research Committee: BAE 2003.  
 Extension Planning Committee: BAE 2003.  
 Alumni Development Committee: BAE 2003.  
 Committee on Research and Policy of the Kentucky Water Resources Institute: 2003 – 2004.  
 Solid Waste Advisory Board, LFUCG; Urban Nonpoint Source Pollution Water Quality Task Force, LFUCG;  
 Pollution Prevention Plan Advisory Board, LFUCG; and Comm. For the Handbook of Western Reclamation  
 Techniques.  
 Planning Comm. Office of Surface Mining Technology Transfer Forums  
 Technical Comm. - Electronic Permitting KYNREPC  
 KY Task Force on Developing Technical Guidelines for Surface Mining Regulations  
 Experimental Practices in Surface Mining - KYNREPC.  
 Bitterroot Forest Environmental Impact Development Committee. (USDA-Forest Service) 1993  
 Stormwater Regulations and Urban Water Quality Task Force - LFUCG 1993-94  
 Natural Resources Curriculum Committee. 1993-94  
 SREIG Regional Solid Waste Committee. 1993-94  
 Kentucky Robinson Forest Project Committee.  
 LFUCG Solid Waste Planning Committee.  
 Environmental Certificate Program Committee.  
 KY Onsite Wastewater Assoc. 1995 Conference Committee.  
 SWCS Conference Planning Comm. for the Information Technology and Natural Resources Management  
 Conference  
 LFUCG Solid Waste Advisory Board - Solid Waste Management Plan (1993-94)  
 Southern Extension and Research Activity (SERA) Task Force on Solid Waste Management (Committee Member,  
 Conference Organizer) 1990 - present  
 Environmental Commission for Lexington - Fayette County Task Force on Our State of the Environment 1993:  
 Lexington and Fayette County, Kentucky. Project. (Member and resource person)  
 Governor's Task Force on Kentucky Solid Waste Management: Needs and Options  
 Solid Waste Education Task Force of the Kentucky Environmental Council  
 Board of Directors - Kentucky Recycling Association  
 Solid Waste Task Force, College of Agriculture, Chairperson  
 Southern Region Extension Waste Management Task Force



Household Hazardous Waste Task Force  
 Governor's Commission on the Maxey Flats Advisory Task Force  
 National Academy of Sciences, Board on Mineral and Energy Resources of the Commission on Physical Sciences, Mathematics and Resources (appointed as a consultant-1984).  
 American Society of Agricultural Engineers  
 SW-264, Reclamation of Disturbed Lands Committee (ASAE): 1984 - present.- Secretary, 1985; Vice Chairman, 1986; Acting-Chairman, 1987; Chairman, 1988; Program Chairman for 1986 Summer Meeting.  
 SW-224, Pollution by Sediment Committee (ASAE): 1982 - present.  
 Kentucky Section; First Vice Chairman, 1985; Publicity Chairman, 1984; Vice-Chairman, 1988; Chairman, 1989.  
 SW-164 Regional Committee on Application of Water Quality Models for Agricultural and Forested Watersheds  
 SW-174 Regional Committee on Effects, Mechanism and Control of Erosion and Sediment from Agricultural and Forest Lands  
 SW-211 Regional Committee on Hydrological Water Quality Modeling of Sediment and Chemical Movement.  
 Organizing committee for a workshop through the Rene Dubos Center for Human Environments Inc. on Managing Land Use - Maintaining Agricultural Productivity in the United States. Held April 1986. - Rapporteur.  
 Member of the development committee for the U.S.A. - Italy Joint Workshop on Agricultural Nonpoint Source Pollution.  
 SCS/Department of Natural Resources and Environmental Protection Joint Committee on Regulations for Prime Farmland (Chairman of Soil Compaction Committee).  
 Mining and Reclamation Council of America, National Research Priorities Committee.  
 Educational Advisor Kentucky Land Improvement Contractors Assoc.: 1981 - 84.  
 Surface Mining Symposium on Hydrology, Sedimentology and Reclamation Executive Program Advisory Committee (1982 -1991). Detail of committee involvement includes;  
 Hydrology Abstract and Technical Article Review Committee. Chairman (1982-1990).  
 Sedimentology Abstract and Technical Article Review Committee. Chairman (1982- 1990).  
 Mining Technology Abstract and Technical Review Committee. (Member 1983, Chairman 1984 - 1986).  
 Mini course committee (member).  
 Student activities committee (member).  
 Mini course awards committee (member).

### **C. Departmental, College and University**

BAE Awards Committee. 1995  
 BAE Selection Committee for Groundwater/Water  
 Agricultural Engineering Graduate Committee 1993-94  
 College of Agriculture Solid Waste National Initiative Comm. Chairman 1993-94  
 College Solid Waste Task Force - Chairperson (1990-91)  
 College Groundwater Resource and Education Program Committee Member (1989-90)  
 College Vegetable Producers Task Force (1989-90)  
 Kentucky Water Resources Research Institute Strategic Planning Commission (1988-90)  
 Research Committee - Chairperson (1983-89)  
 Graduate Committee Member (1989-91)  
 Interagency/Intercollege Task Force on Prime Farmland Regulatory and Research Needs - Chairperson of Compaction Subcommittee (1986-88)  
 Water Conservation Ad Hoc Committee - Chairperson (1987-89)  
 Surface Mining Symposium on Hydrology, Sedimentology and Reclamation - Executive Committee Member (1986-90)  
 Groundwater Interagency Committee - Member (1987-88)  
 AKES Awards Committee (1989)  
 Department Office Procedures Committee (1989)

### **D. Professional Society Membership**

American Society of Agricultural and Biological Engineering (ASABE)  
 American Society of Agricultural Engineering (ASAE) (1971 - 1972, 1981- Present, Computer Conference Organizer)

American Society of Agricultural Engineering, Kentucky Section (1981 - present)  
 Soil Conservation Society of America (SCSA) (1978 - 1980, 1991)  
 Soil Conservation Society of America (SCSA) (1978 - 1980, 1991)  
 American Society of Civil Engineering (ASCE) (1975 - 1980)  
 American Geophysical Union (AGU) (1978 - 1980)  
 Water Pollution Control Federation (WPCF) (1975 - 1981)  
 Water Pollution Control Association of South Carolina (1975 -1981)  
 Kentucky Land Improvement Contractors Association (1982 - 1984)

## 11. CONSULTING ACTIVITIES

Newmont Mining – Water management and sediment control 5-yr and life of mine pre-conceptual and conceptual design.

Harvard Waste Facility – Bioengineering stream restoration of Mills Creek.

BHP Mining – Stormwater and sediment control systems for three coal mines in Borneo, Indonesia.

National Academy of Sciences, Washington D.C., on small-scale sediment control systems.

RRM Corporation and Delaware County Solid Waste Authority on a comprehensive hydrology, erosion, and sediment control plan for Colebrookdale Landfill.

E.I. du Pont - Design, testing, and quality assessment/quality control of a \$100 million multiple soil layer cover system for closure of a low level nuclear waste site commingled with hazardous waste.

Delaware County Solid Waste Authority - Stormwater management, erosion, and sediment control permitting for \$80 million expansion of a solid waste landfill.

RMC Corp. - on the closure of Solid Waste Landfills.

Harvard Refuse - on the closure of a solid waste landfill with emphasis on a methane gas barrier.

Martin and Martin, Inc. - on the assessment of leachate production from solid waste landfills both during active filling and under alternative final closure designs.

U.S. EPA - on closure procedures for both hazardous waste and solid waste landfills with emphasis on design procedures, quality control and quality assurance, monitoring and modeling.

Office of Surface Mining - Expert witness - OSM versus an Ohio Coal Co.

Maxey Flats low level nuclear waste site through overview role as a member of the Governor's Maxey Flats Advisory Task Force.

Soil Science, Inc. - on landfill testing of soil additives to reduce the hydraulic conductivity of soils used for landfill covers or liners.

Oak Ridge Low Level Nuclear Waste Site - on closure techniques using a multiple layer cover system and a synthetic geonet drainage layer.

State of Colorado - on the closure of Durango Uranium Tailings Site with emphasis on reducing infiltration and radon gas migration.

Kentucky Highlands Investment Corporation - on venture capital opportunities in computer aided design software development.

State of Maryland, Water Resources Council - on regulations for silt control fences.

Sun Belt Coal, New Mexico - on reclamation of Badlands after surface mining.

Hittman Associates, Columbia, Maryland - on evaluations erosion model computer programs.

## 12. SHORT COURSES ATTENDED

Professional Development:

1. Promotion and Tenure Workshop. 4 Jan 06
2. CSREES Grants Workshop, 8-9 Feb 06
3. EEO Training, 29 Sept 06
4. Understanding Private Foundations, 12 Oct 06

Other

319 H Grant Development Seminar: 17 Sept 03.

CCDW Training: 8 Nov 03.

River Restoration from the Perspective of Ecohydrology and Ecohydraulics. 12 Sept 04.

Ecological Engineering and Ecological Restoration. 12 Sept 04.

NRCS NEH 654 Stream Restoration Design Handbook. 15 Sept 04.

1999-2001

GIS and Spatial Applications for Surface Mining: Focus on Reclamation  
 ArcInfo, ArcView, Spatial Data Analyst and Extensions in the Mining Reclamation Scenarios  
 Surface and Subsurface Modeling with GIS  
 1997-1998  
 Applied Erosion Protection Techniques,  
 Bioengineering Method for Stabilizing Channels and Stream Banks,  
 ArcView (GIS),  
 Design of Slope Erosion Control using Commercial Products,  
 RUSLE Version 1.04,  
 Agricultural Products for Trickle Irrigation  
 Technology Information Processing Systems.  
 1996  
 Certified Hazardous Waste Operation and Emergency Response [40-hr OSHA training program]. July 15-19.  
 Telemarketing. Lexington, KY. Jan 10.  
 1995  
 EPA: Landfill Bioreactor Design and Operation. Wilmington, DE. March 23-24.  
 1994  
 Environmental Mediation Training. Nov. 17-19.  
 Linear Technology and New Techniques in Waste Containment, 2/9/94  
 STORM: A Hydrologic Assessment Program. Office of Surface Mining, 3/7-8/94  
 Information Highway, 8/9/94  
 Internet: The Basics, 8/9/94  
 1992  
 Seminar Series on the Design, Operation, and Closure of Municipal Solid Waste Landfills. U.S. EPA. Nashville, TN. June 18-19, 1992.  
 Television Association of the Bluegrass Forum on Important Issues of Your Community, Government and Businesses. Jan. 3, 1992.  
 Agricultural Uses of Waste Newspaper. March 25, 1992.  
 Extension's Role in Controversial Issues. Lexington, KY. Sept. 10, 1992.  
 Kentucky Water Resources Research Institute Sem. Series - Selected topics, attendance at.  
 1991  
 16th Annual Governor's Conference on the Environment. Sept. 11-13, 1991.  
 Recycling in the Workplace. Workshop at the Third Annual Kentucky Recycling Conference, July 25-26, 1991.  
 Third Annual KY Recycling Conf. July 25-26, 1991. Owensboro, KY.  
 Kentucky Council of ADDS Spring Conference with the Environmental Quality Commission. Apr. 14-17, 1991.  
 Environmental Systems Seminar's - Selected topics; attendance at.  
 KY Section ASAE - Reuse of Decomposable Solid Waste. Sp 1991 Meeting.  
 Solid Waste Management: Local Requirements, Options, Workshop at the Environmental Quality Commission  
 Local Environmental Issues Workshop. Louisville, KY. April 14-17, 1991  
 1990  
 Sanitary Gas Management, College of Engineering, University of Wisconsin.  
 Sanitary Landfill Leachate, College of Engineering, University of Wisconsin.  
 University of Kentucky Extension Conference  
 Basic Irrigation Design for Residential and Commercial Properties. Century Rain Aid, Louisville, KY.  
 Optical Scanners for Hydrology, Water Quality, and Climatological Data. Earth Info., Lexington, KY.  
 1989  
 Southeast Region Water Quality Training Workshop.  
 NSF Grant Preparation Workshop - How to Write a Good Grant Application.  
 Fayette County Horticulture Extension Master Gardener's fall semester course.  
 1988  
 Technical Information Processing Systems. Office of Surface Mining Reclamation and Enforcement. Frankfort, KY. Sept. 14-15, 1988.  
 Master Gardener's Course. Fayette Co. Ext. Service (participated in approx. 40% of the classes).  
 International Erosion Control Association Conference. New Orleans, LA. Feb. 24-27, 1988.  
 SEDIMOT III 3-day conference (co-chair).  
 Water Resources Seminar Series - participate in the monthly seminar series.

U.S. EPA Research Symposium - participated in 12, 13, and 14 Hazardous Waste Control Symposiums.  
 Surface Mining Symposium on Mining, Hydrology, Sedimentology and Reclamation - participated in symposiums.  
 1987

Laboratory and Field Measurements of Hydraulic Conductivity and Consolidation Characteristics of Soils. College of Engineering, The University of Texas at Austin. January 6-8, 1987.

Permitting Hazardous Waste Land Disposal Facilities. U.S. EPA's Center for Environmental Research Information and Office of Solid Waste and Emergency Response. February 4-5, 1987.

1986

DAMS2: Structure Site Analysis Computer Program. Soil Conservation Service, Hydrology Unit-Engineering. January 13-16, 1986.

Centrifugal Pumps Short Courses. The Gorman-Rupp Company. Mansfield, OH. February 24-26, 1986.

The Rene Dubos Forum on Managing Land Use. The Rene Dubos Center for Human Environments. New York, NY. March 2-4, 1986.

1985

Second Hydrology Symposium on Surface Coal Mining in the Northern Great Plains. Gillette, Wyoming. Feb. 26-27, 1985.

Irrigation Specifiers and Installation School. The Toro Company. Atlanta, Georgia. May 5-6, 1985.

Open Channel Flow and Stream Alteration in Surface Mined Areas, Part I. Mini-Course No.3. 1985 National Symposium on Surface Mining, Hydrology, Sedimentology, and Reclamation. December 9, 1985.

Open Channel Flow and Stream Alteration in Surface Mined Areas, Part II. Mini-Course No. 26. 1985 National Symposium on Surface Mining, Hydrology, Sedimentology, and Reclamation. December 10, 1985.

1984

TORO Irrigation Specifier Design School. Lexington, Kentucky. Jan. 4-5, 1984.

Applications of Microcomputers in Mining. Penn. State University, University Park, Pennsylvania. April 17-18, 1984.

Kentucky Surface Mine Permitting Procedure Series:

(a) Preliminary Data Acquisition. July 26-27, 1984

(b) Design. Aug. 9-10, 1984

(c) Special Permit Considerations. Sept. 13-14, 1984

Geotechnical Engineering for Waste-Disposal Projects. College of Engineering. University of Texas at Austin. Oct. 29 - Nov. 2, 1984.

Fundamentals of Groundwater Quality. Mini-Course No. 18. 1984 National Symposium on Surface Mining, Hydrology Sedimentology, and Reclamation. Dec. 2, 1984.

Groundwater Hydrology - Fundamental. Mini-Course No. 5. 1984 National Symposium on Surface Mining, Hydrology, Sedimentology, and Reclamation. Dec. 2, 1984.

1983

Application of Microcomputers in the Mining Industry, Penn State University, March 28-30, 1983.

Effectiveness of Low Cost Methods for Urban Runoff Control: An Overview. 1983 International Symposium on Urban Hydrology,

Hydraulics, and Sediment Control. July 27, 1983.

Effectiveness of Low Cost Methods for Urban Runoff Control: An Overview. 1983 International Symposium on Urban Hydrology, Hydraulics, and Sediment Control. July 25, 1983.

Coal Mine Reserve Engineering, IMMR, OISTL, Lexington, Kentucky. August 19, 1983.

TR-20: Computer Program for Project Formulation Hydrology, SCS, Lexington, Kentucky.

DAMS2: Structure Site Analysis Computer Program, SCS, Lexington, Kentucky.

The Measurement of Water and Sediment Discharges from Mine Areas. Mini Course 14. National Symposium on Surface Mining, Hydrology, Sedimentology and Reclamation. University of Kentucky, Lexington, Kentucky. Nov. 28, 1983.

1982

Safety and Use of the Troxler Gamma and Neutron Probes. Lexington, Kentucky.

Virgil Overholt Drainage School on Design and Installation. Ohio State University. Columbus, Ohio.

Irrigation Scheduling for Water and Energy Conservation. American Society of Agricultural Engineering. Chicago, Illinois.

1981

The Toro Company Irrigation Division Workshop for University Educators. Riverside, California.

**Exhibit 2- Stream Photos for HB 175 Testimony of Richard Warner, Ph.D.**



**PHOTO 1** – This erosion gully is a common type of unnatural land feature that qualifies as an ephemeral stream. This particular erosion gully is in hillside woods that have been logged historically two times. These types of features are extensive through the hilly terrain of eastern and southern Ohio. Ohio EPA requires that these erosion gullies be replaced or mitigated at an exorbitant cost (as much as \$650 per foot), if impacted.

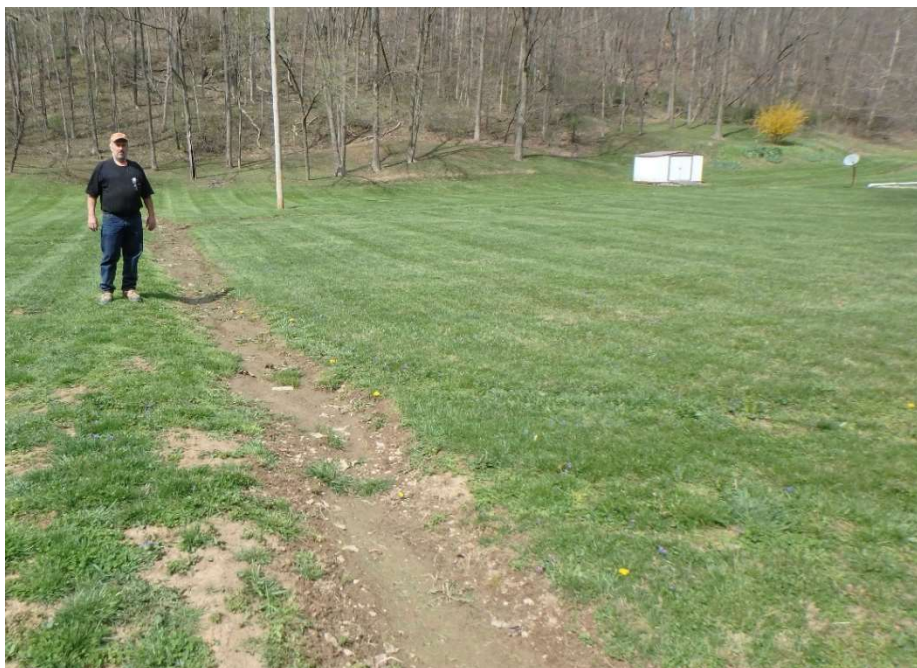


**PHOTO 2** – Erosion gullies developed in short access road to a field. These erosion gullies have a cumulative length of about 600 feet and flow into a small road ditch with intermittent flow. Ohio EPA's new General Permit requirements effective June 2020 would apply to mitigate the filling of these ephemeral streams at an exorbitant cost (as much as \$650 per foot).





**PHOTO 3** – Erosion gully developed in a 4-wheeler trail that fords a perennial stream. This erosion gully is about 350 feet in length. Ohio EPA's new General Permit requirements effective June 2020 would apply to mitigate the filling of this ephemeral stream at an exorbitant cost (as much as \$650 per foot).



**PHOTO 4** – A group of landowners created a man-made ditch about 700 feet in length to direct hillside surface runoff away from their homes and into an intermittent stream. If these landowners fill in their man-made ditch, they will be facing exorbitant off-site mitigation costs per the Ohio EPA's new General Permit (as much as \$650 per foot).



**PHOTO 5** – This perennial stream is what most folks would consider a stream as opposed to the ephemeral streams pictured in PHOTOS 1, 2, 3 and 4.



**Exhibit 3 to Written Testimony of Richard Warner, Ph.D. on HB 175**Summary of Negative Environmental Consequences of Ohio EPA's Regulation

The downstream consequences of the Ohio EPA's General Permit approach to requiring the replacement and expansion of ephemeral stream channels rather than utilizing stormwater BMPs will directly cause, but not be limited to, the following adverse effects:

- a. Water will be conveyed faster from watersheds;
- b. Faster moving water will erode stream channels;
- c. Streams will become deeper, wider and degraded;
- d. Stream bed & bank erosion will fill streams with sediment, further exacerbating flooding.
- e. Infrastructure, such as, culverts, bridges, roads and utilities may be inadequate and damaged;
- f. Downstream flooding will increase;
- g. Water quality will degrade;
- h. In-channel and floodplain habitat will be degraded;
- i. Aquatic, terrestrial and avian wildlife will have limited or no access to water in upland areas and must relocate or perish;
- j. Habitat diversity will be diminished;
- k. Groundwater recharge will be reduced;
- l. Nutrients will be rapidly transported downstream like in a pipe;
- m. Eutrophication or toxic algal bloom potential will increase for Lake Erie, the Ohio River and other water bodies.

**Presentation Testimony on HB 175 (see also full written submission dated 5/2/21)**

Honorable Members of the Committee, Chairman Koehler, Vice Chair Creech, and Ranking Member Brent.

Good morning.

My name is Richard Warner.

Referring to my resume (Exhibit 1). I am an emeritus professor at the University of Kentucky. I have dedicated much of my career to the development of environmental controls integrated with nature to enhance the protection of the environment.

Last year, I was invited by the National Academy of Science, Engineering and Medicine to provide my recommendations on management strategies to reduce environmental risk associated with development.

Today my topic is ephemeral streams. I'm here to offer my expert opinion that Ohio's environment will substantially benefit from the passage of HB 175.

Federal law currently regulates impacts from perennial and intermittent streams.

Ephemeral streams, which are the subject of this Bill, are exempt from federal regulations. While States can exceed federal standards, 36 states currently do *not* regulate ephemeral streams. Indiana Governor Holcomb last week signed into law a Bill exempting ephemeral streams from state regulation.

Ohio EPA has decided to regulate ephemeral streams with a General Permit program. I acknowledge that one purpose of this Bill is to bring Ohio in line with federal regulation and most other states. But that is not my purpose for being here. I am here to testify as to the environmental benefits of HB 175.

Ephemeral streams only flow when it rains. They are typically narrow from a few inches to a few feet wide and inherently unstable. A small erosion gully is today classified as an

“ephemeral stream”. I have attached illustrative photos of current day ephemeral streams, along with a comparison photo of a perennial stream. (Exhibit 2). Take a close look, particularly at photo 1 compared to photo 5. HB 175 would amend the definition of ephemeral streams to *ephemeral features* to make clear that the features like those shown in photos 1 through 4 are not subject to Ohio EPA regulation as “Waters of the State.”

The scientific reality is that the functions of most ephemeral streams are *negative* due to their environmentally detrimental consequences to downgradient streams and lakes. As ephemeral gullies advance, we see further increasing peak flows, erosion, sediment and nutrient supply, flooding, and adverse downstream channel impacts. Exhibit 3 to my written testimony itemizes the negative impacts of ephemeral streams.

The solution is not to replace and expand ephemeral stream pathways as Ohio EPA is now requiring. Rather, today we benefit from professionally engineered stormwater Best Management Practices, called BMPs, to replace the unstable ephemeral streams and gullies encountered at development sites. Unlike the Ohio EPA’s permit mitigation requirements, BMPs reduce flooding, mimic the natural hydrologic balance, and improve overall water quality at a fraction of the cost.

It is important to understand that many ephemeral streams, as categorized today, are not natural to Ohio. In Daniel Boone days, ephemeral streams were a sequence of beaver ponds that protected the environment by storing stormwater, sediment, and nutrients.

Ephemeral streams that exist today were created by a wide spectrum of developmental activities that increased stormwater flows, erosion, and sediment load. Ephemeral streams simply transport pollutants to downgradient streams and lakes. A wide spectrum of approved controls exists to specifically address safeguarding the environment. BMPs have design criteria that are well-researched. Such BMPs have been encouraged and approved regularly by the Ohio EPA in their Construction Activity General Permit.

Stormwater BMPs properly address the primary watershed *need* to store stormwater and slowly release it to prevent downstream adverse impacts. BMPs are our modern-day beaver dams. The use of Stormwater BMPs would effectively change my Exhibit 3 list of ephemeral stream *adverse consequences* immediately into a list of *environmental benefits*.

This Assembly also should be mindful of the tremendous mitigation cost the Ohio EPA's regulatory program promises to impose on Ohio businesses and individual landowners, absent this legislation.

Stream mitigation credits are purchased from a Stream Mitigation Bank by the foot. At the required mitigation ratio of 1.5 to 1, the expenditure for ephemeral stream mitigation currently ranges from \$350 to \$650 per foot. Due to the extensive length of ephemeral streams, mitigation expenditures can run into the millions of dollars and are required to be paid *up-front* prior to development. These enormous costs will be financially devastating to most projects.

In closing, the General Assembly should embrace this opportunity to join the majority of States not only in mirroring federal law, but also in preventing imprudent, unnecessary and costly regulation of ephemeral streams. I'm happy to answer any questions. Thank you.