



In this issue of "Watershed Lab Connections", we are highlighting another high-impact project using the wealth of data collected by the North Appalachian Experimental Watershed (NAEW) – testing of an engineering model for designing a landfill-cover utilizing the natural evapotranspiration process. Dr. Vic Hauser, Agricultural Engineer who has conducted much research into the new type of cover, is a guest writer for our feature article.

## NAEW Data Used for Engineering Validation of a Less Costly New Concept in Landfill-Cover Design

**Victor L. Hauser, PhD\***

The people of the modern world produce mountains of municipal, mining and industrial waste. The wastes require a cover to control leaching and protect the public from toxic or hazardous materials. The goals for the cover are to minimize movement of precipitation through the waste, isolate it, and control gases if produced. The cover may be the most costly feature of a containment control system.

Conventional landfill covers utilize expensive barriers within the cover to control the natural downward flow of water in the soil. The evapotranspiration (ET) cover is a new and innovative cover that uses simpler, less costly methods and it is self-renewing. The ET cover employs a layer of soil covered by native grasses to control infiltration: it works with the forces of nature rather than attempting to control them.

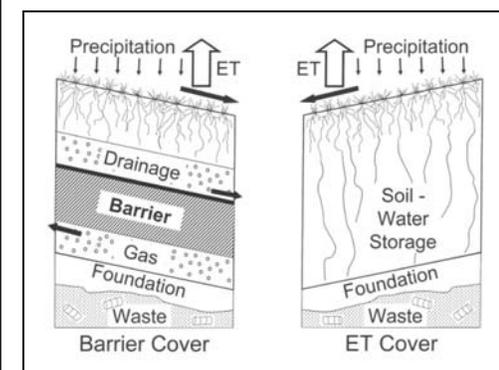
The development of the ET cover required no new research because it used proven concepts resulting from completed and published work of USDA and ARS scientists and engineers during the previous century.

Mountains of landfill waste require cover-technology to prevent leachate water from entering ground water. (Photo courtesy of "The Landfill Site" - [www.landfill-site.com/html/more\\_landfill\\_pictures.html](http://www.landfill-site.com/html/more_landfill_pictures.html))



Data and knowledge developed at the North Appalachian Experimental Watershed (NAEW) were critical elements in both development and implementation of the new waste cover. The people of the United States supported agricultural research during the previous century, including that at the NAEW. The published work formed the basis and proof of concept for the ET cover.

Engineering design of ET covers requires a tested and reliable numerical model. The Environmental Policy Integrated Climate or EPIC model was chosen for engineering design because it included critical design factors identified by agricultural research. (EPIC was originally developed by USDA, ARS engineers).



Comparison of conventional and ET waste covers. (Line drawing by Victor L. Hauser)

The final step in validating the EPIC model was testing against long-term, field measurements. *Data collected from a grass-covered lysimeter at NAEW provided the backbone of the data used for model validation. Data characteristics that were particularly important to the test were the length of the record and the fact that all parts of the water balance were measured independently.* (Continued on Page 2)

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## NAEW Data Used for Engineering Validation of a Less Costly New Concept in Landfill-Cover Design (continued...)

*The NAEW lysimeters measure all parts of the water balance and provide an estimate of measurement error – they are one of the few such facilities in the entire world. Because of the high quality and length of record found in NAEW data, the validation of the model was successful.*

The ET cover can save billions in the USA

The construction cost for a conventional cover over a small, 100-acre landfill varies between 30 and 60 million dollars. Detailed construction cost estimates by the Air Force verified the cost of both conventional and ET covers at several sites. (<http://www.afcee.af.mil/resources/technologytransfer/programsandinitiatives/landfillcovers/costperformance/index.asp>).



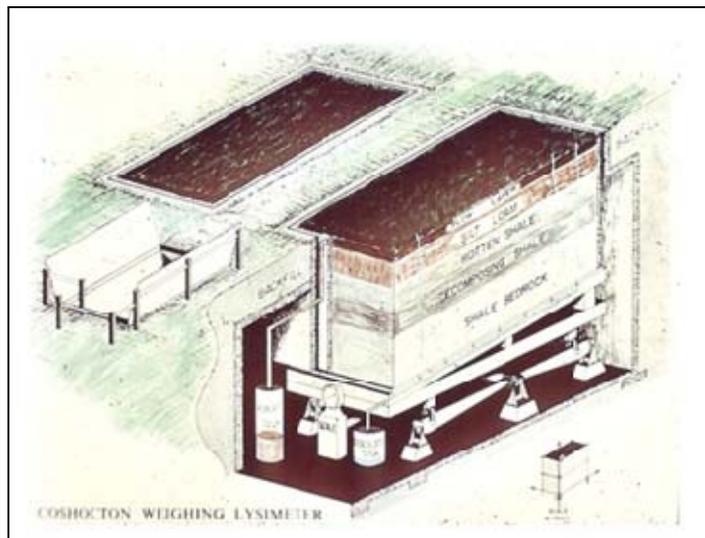
Typical native grass cover for an ET landfill-waste cover. (Photo courtesy of USDA Natural Resources Conservation Service)

Although costs vary by site, the construction cost for an ET cover is typically half that for a conventional cover. Because there are thousands of landfills in the United States, the potential cost saving is large.

*Research at the NAEW was important in developing and validating a new idea far removed from agriculture. The availability of NAEW research dramatically reduced the cost of developing and proving this new and innovative concept. The ET Cover is now being deployed on landfills worldwide. Early workers at the NAEW could not anticipate the use of their high quality data in a new concept with worldwide impact.*

For further information on ET landfill covers, please contact Victor Hauser ([vl.hauser@sbcglobal.net](mailto:vl.hauser@sbcglobal.net)) or Jim Bonta ([jim.bonta@ars.usda.gov](mailto:jim.bonta@ars.usda.gov)).

**\*Victor L. Hauser, PhD**, is a consulting agricultural engineer who previously was a research scientist for the USDA - Agricultural Research Service, and worked in the remediation industry with Mitretek Systems (now Noblis), a non-profit corporation.



Water balance lysimeter at the NAEW. (Drawing from NAEW project files.)

### For more information:

Hauser, Victor L. 2008. *Evapotranspiration Covers for Landfills and Waste Sites*. CRC Press, Taylor & Francis Group, Boca Raton, FL.

Hauser, V. L., Weand, B. L., and Gill, M. D. 2001. *Natural covers for landfills and buried waste*. *Journal of Environmental Engineering* 127(9): 768-775.

Hauser, V. L., Gimon, D. M., Bonta, J. V., Howell, T. A., Malone, R. W., and Williams, J. R. 2005. *Models for hydrologic design of evapotranspiration landfill covers*. *Environmental Science and Technology* 39(18): 7226-7233.

Air Force website (several documents): <http://www.afcee.af.mil/>, follow the links "Technology Transfer" & "Landfill Covers".

## Water-Quality Research on Experimental Watersheds: A Vital Component to American Agriculture

**WATER** – *increasingly important to everyone.* How can we safeguard it, improve its quality, and reduce its flooding and erosion potential? The 1050-ac North Appalachian Experimental Watershed (NAEW) experimental watershed facility was established by visionaries in the 1930s to answer these questions and provide science-based guidance to sustain the water and agriculture resource base. Today, increasing water demands make water research even more important.

The NAEW has been a leader in conducting research to test the effectiveness of methods to protect water resources. It is known for its technical expertise and research results, for its monitoring infrastructure, and for data used for modeling, planning, compliance, and legal issues. The data and results are sought by many scientists, universities, agricultural producers, and others worldwide. The NAEW provides science-based guidance to farmers, industry, regulatory agencies, and researchers on land management so they do not have to conduct their own experiments, and so the research has an independent base.

The value of research results from the NAEW is incalculable. The impacts include the first test of the environmental benefits of no-till agriculture, data used in the development of the curve number method for estimating runoff used worldwide, numerous educational opportunities for graduate students and others, providing science basis for regulations, grazing studies, landmark surface mining study, conservation tillage investigations, and significant savings in landfill construction (see feature article). Other important studies are too numerous to describe.

### NAEW Scientist Receives Prestigious Award



**Dr. Martin Shipitalo**, Soil Scientist at the NAEW, is the recipient of the 2011 Conservation Research Award. The international Soil and Water Conservation Society annually confers the Conservation Research Award on SWCS members whose research has led to exceptional improvements in soil conservation, water conservation, and/or related natural resources research. This award is given for research excellence or results of the research that has led to significant conservation improvements. At the Society's 66<sup>th</sup> International Annual Conference held in Washington, DC, July 17-20, 2011, Dr. Shipitalo received this award for 2011.

Dr. Martin Shipitalo is recognized as an international expert on earthworm effects on soil structure and the assessment of the effects of macropores, mostly formed from earthworms, on water and chemical transport through soil. He is a Research Soil Scientist with USDA-ARS at Coshocton, Ohio and is adjunct faculty member with Ohio State University. His international reputation has resulted in serving on PhD student committees in France, being invited to collaborate with scientists in Finland, and giving presentations at meetings in Germany, including a presentation at the Max Planck Institute. He also delivered the keynote address at the European Society of Soil Conservation, 2<sup>nd</sup> International Congress in Germany in 1996.

Dr. Shipitalo's early work involved the quantification of earthworms on soil aggregate stability. This led to a widely used conceptual model regarding the effect of earthworms on aggregation. This led to work on the effect of earthworms and soil macropores on potential movement of agricultural chemicals toward ground water. Data from this work was used to validate and refine the ARS Root Zone Water Quality Model. He has also done research on small watersheds dealing with off-site movement of agricultural chemicals. Recently, he has studied the impacts of paper mill sludge on strip mine reclamation and the resulting effects on runoff water quality.

Dr. Shipitalo continues to make major contributions to soil sciences and environmental quality research as affected by earthworms, and soil macroporosity. Thus, we recognize Dr. Martin Shipitalo as the 2011 recipient of the Society's Conservation Research Award.

## NAEW Publications Since June 2011

- Stavi, I., Lal, R., Owens, L.B. 2011. On-farm effects of no-till versus occasional tillage on soil quality and crop yields in eastern Ohio. *Agronomy for Sustainable Development*. 31(3):475-482.
- Shipitalo, M.J. and Owens, L.B. 2011. Comparative losses of glyphosate and selected residual herbicides in surface runoff from conservation-tilled watersheds planted with corn or soybean. *Journal of Environmental Quality*. 40:1281-1289.



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If you wish to be removed from or added to this mailing list, please contact Cara Renner at **[cara.renner@ars.usda.gov](mailto:cara.renner@ars.usda.gov)**

## **Have a research need?**

The NAEW wants to maximize its utility to stakeholders (industry, and private and public sectors), and we are always interested in learning about research needs that you may have. Please contact Dr. Jim Bonta by phone (740-545-6349 x 208) or by email (**[jim.bonta@ars.usda.gov](mailto:jim.bonta@ars.usda.gov)**) if you want to discuss a research need.

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