West Virginia Water Resources Research Institute
Annual Technical Report
FY 2008

Introduction

Research Program Introduction

West Virginia Water Research Institute

Introduction

The West Virginia Water Research Institute (WVWRI) addresses the key water resource issues facing policy makers, agency staff and the public. Our research program is guided by the West Virginia Advisory Committee for Water Research. It includes representatives from the following:

$ West Virginia Department of Natural Resources $ West Virginia Department of Health & Human Resources $ West Virginia Chamber of Commerce $ West Virginia Coal Association $ West Virginia Department of Environmental Protection $ West Virginia Farm Bureau $ U.S. Federal Bureau of Investigation $ U.S. Geological Survey $ U.S. Environmental Protection Agency $ U.S. Department of Energy - National Energy Technology Laboratory $ U.S. Army Corps of Engineers - Huntington, WV District $ West Virginia University

The Advisory Committee develops the Institute's research priority list, reviews its progress and selects startup projects at its annual meeting. With this direction, the Institute recruits new researchers to study emerging water research issues. Because the Advisory Committee understands future regulatory and economic driving factors, these issues tend to grow in importance and have often led to follow-on funding from their agencies.

Funding Strategy

The Institute receives a grant of roughly $92,000 annually through the U.S. Geological Survey CWA section 104b program. We use this funding to develop research capabilities in priority areas and to provide service to State agencies, its industry and citizen groups. Our strategy relies on using the USGS section 104b funding to develop competitive capabilities that, in turn, translate into successful proposals funded by a broad spectrum of Federal and State agencies.

Our strategy also relies on maintaining a broad cadre of researchers within WVU and other institutions within the state. We also work with faculty from institutions across the country to form competitive research partnerships. As West Virginia University is the State s flagship research institution, its researchers have played the dominant role. Our funding strategy relies on successful competition for Federal dollars while teaming with State agency and industry partners. The later provide test sites, in-kind support and invaluable background data. In addition, the full-time Institute staff has increased from 12 to 14 in the last year with the addition of a project manager and outreach coordinator. Roughly two-thirds of the Institute is directly engaged in research projects.

Research Priorities

The WVWRI issued a request for proposals in 2008. The following is a list of state research priorities identified by the WV Advisory Committee for Water Research.

Energy production impacts on water resources (oil and gas drilling; hydroelectric; biofuels; etc.); Nutrient reduction/nutrient control/sources of air deposition Mercury (informational fact sheets) Valley fills (viability of fill areas for community uses; protect as a water source; how to handle sewage); Flooding Aquatic ecosystem integrity (anti-degradation, water quality criteria, nutrient/pathogen impacts, headwater stream valuation/mitigation) Water metrics (methods for measuring physical, chemical, biological components, in situ monitoring, PPCP's, pathogens in drinking water) Uses for mine water discharge (drinking water potential for underground mine pools, irrigation, industrial heating/cooling) Industrial processes and urban sprawl (water budgets, contaminants, flooding, ground-water recharge, storm water applications) Evaluation of water resources (uses)

Future Direction

The following programs of the WVWRI are expected to continue to remain stable and grow modestly into the future:

$National Mine Land Reclamation Center $Hydrology Research Center $Northern WV Brownfields Assistance Center $Watershed Assistance Center

Outreach

The WVWRI performs outreach through meetings, workshops, conferences, site visits, web site, newsletters, and publications.

A web site (http://wvwri.nrcce.wvu.edu) contains information on all the WVWRI programs and projects. This site is updated on an on-going basis as new information becomes available. This year a new site design is being developed and is scheduled to be launched by the end of 2009.

WRI 96 - Experimental Investigation into the Changes in Hydrologic and Environmental Quality Associated with Valley Fills

Basic Information

Title:	WRI 96 - Experimental Investigation into the Changes in Hydrologic and Environmental Quality Associated with Valley Fills
Project Number:	2007WV96B
Start Date:	3/1/2007
End Date:	2/28/2009
Funding Source:	104B
Congressional District:	WV-1
Research Category:	Climate and Hydrologic Processes
Focus Category:	Hydrology, Water Quality, Floods
Descriptors:	None
Principal Investigators:	Todd Petty, Paul Ziemkiewicz

Publication

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Project Number: 10008586

State Water Resources Research Institute Program/USGS 104(b) FY 2009 Funds

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Problem and Research Objectives

Mountaintop removal /valley fill mining is a controversial process that may have far-reaching impacts on central Appalachian watersheds. Our project sought to quantify spatial and temporal variation in organic matter processing within Pigeon Creek, an intensively mined sub-watershed of the Tug Fork River in southern West Virginia. Our objectives were to: 1) quantify variation in organic matter retention and decomposition among streams differing in size (drainage area), gradient, and structural complexity; and 2) quantify the effect of valley fills on stream flow, water chemistry, organic matter processing, and benthic invertebrate colonization of detritus packs in 1st order perennial streams. Our study area consists of 26 sites distributed across a wide range of stream sizes (ephemeral channels to large perennial streams). Four of the small perennial sites were located below large valley fills and were paired to four undisturbed sites. At each site we quantified water temperature (continuous), stream flow (continuous), habitat quality and complexity, water chemistry (seasonal), artificial leaf and stick transport, leaf pack decomposition, and invertebrate colonization. Organic matter decomposition rates were variable, but unrelated to any environmental factors that we measured. Drainage area, channel complexity, and mining had a significant interactive effect on transport distance of leaves and sticks. Sites below valley fills had enhanced flow levels which resulted in higher transport levels. These results add to our understanding of complex interactive effects of mining on stream ecosystem functions and our ability to compensate for lost headwater functions through restoration actions downstream.

Principal Findings and Significance of Findings

Organic Matter Processing Along a Drainage Area Continuum in a Mined Watershed

Results

Structural Complexity

Principle Components Analysis grouped structural complexity measures into 2 axes: Principle Component 1 (PC 1) and Principle Component 2 (PC 2) (Table 1). PC 1 includes measures of: retentive score, number of retentive features per meter, large woody debris per meter, RVHA score, coefficient of variation of depth, and mean distance (meters) to retentive feature. Principle Component 2 includes coefficient of variation of depth and RVHA score.

Transport Distance and Structural Complexity

Basin area is important for organic matter retention; there was a significant positive relationship between basin area and overall transport distance (R2= 0.6625). Basin area was the best predictor of transport distance for each season (Figure 1). For small and medium perennial sites, the retentive score was the best predictor of dowel transport distance (R2=0.8374) and artificial leaf transport distance (R2=0.9068) (Tables 2 and 3). PC 1 was correlated with average dowel transport distance and artificial leaf transport distance in medium and large perennial sites (Tables 4 and 5). There was not one good predictor of transport distance for small perennial sites (Tables 6 and 7). However, average dowel transport distance was negatively correlated with number of retentive features per meter (-

0.6185). For ephemeral/intermittent sites, the number of large woody debris (R^2=0.5880) and number of retentive features per meter (R^2=0.6646) were only moderately good predictors of dowel and leaf transport distance (Tables 8 and 9).

Decomposition , Temperature and Macroinvertebrates

There was no significant relationship between decomposition and basin area (R^2= 0.0305, Prob>F=0.5177, alpha=0.05). Also, there was no interaction between season and type (Prob>F=0.6478, alpha=0.05). However, season had a significant effect on decomposition (R^2= 0.7842, Prob>F=<0.0380, alpha=0.05); Summer 2008 was significantly different from both Fall 07 and Spring 08 (alpha=0.05, Q=2.48). Decomposition was also not affected by any of the habitat variables or conductivity (Prob>F=0.6329, alpha=0.05). Decomposition was not significantly related to % collector gatherers, % predators, % shredders, or % other (Table 10). However, Fall 07 decomposition was related to Fall 07 % other (Correlation=-0.7722). Spring 2008 decomposition was also related to Spring 2008 % other (Correlation=-0.5271). There was not one good predictor of decomposition in this watershed; however, decomposition was slightly negatively correlated with minimum temperature and maximum daily temperature range (Table 10).

Average Temperature was not significantly different across DA type (Prob>F=0.2036, alpha=0.05). CV Temp was not significantly different across DA type (Prob>F=0.9953, alpha=0.05). Mean daily range of temp was not significantly different across type (Prob>F=0.3470, alpha=0.05). Macroinvertebrate abundances were not significantly different across basin area types except for % other (Prob>F=0.0253, alpha=0.05). Ephemeral headwater and large perennial sites were significantly different from intermittent, small perennial, and medium perennial sites.

Discussion

Small streams possessed the highest OM processing power in the watershed; transport is low in ephemeral and intermittent streams. This is consistent with other studies (Minshall et al. 1983; Naiman et al. 1987; Vannote et al. 1980). Stream restoration to recover OM processing function at best will need to focus on small perennial streams rather than larger mainstems (Figure 2). Larger sites exhibited higher and a wider range of transport distances. If headwaters cannot be recovered, it will not make much of a difference to try and restore large perennial sites because not enough organic matter processing power can be gained from them. Small perennial sites exhibited a wider range of habitat conditions to allow room for stream restoration. However, our results also indicate that only moderate gains may be made from restoration efforts in small perennial sites (Figures 3 and 4). Figure 4 shows a slight negative relationship between transport distance and PC 1 score. While transport distance was also negatively correlated with distance to retentive feature, no other structural complexity variables were good predictors in small perennial sites. The loss of the processing power of ephemeral and intermittent sites may be not able to be recovered.

There is some indication that structural complexity influences OM retention in small streams (Figure 4). Mining may have as much of an effect on stream structure than all the residential development in the area. Many streams are pinned against roads and houses and these things have a direct effect on stream structure. Downstream areas are affected by residential development and many upstream areas are affected by mining. These two interacting factors are hard to separate in a study encompassing the entire watershed. Structural complexity improvements downstream will need to encompass the effects of the residential development on many small perennial sites. These streams have a large range of habitat conditions and many show room for improvement. However, results show that ephemeral and intermittent sites cannot be replaced and a perennial site can never be made into an ephemeral or intermittent site.

There was no direct effect of drainage area on organic matter decomposition in this watershed, however ephemeral and intermittent sites had a wider range of decomposition rates (Figure 5). Temperature and conductivity also did not significantly differ across drainage area either (Figure 6). This could help explain the lack of a significant difference in decomposition rate across drainage area. Also, our "organic matter" was secured into place with rope and rebar. In larger sites, most of the natural organic matter would be flushed out because of higher flows and less structural complexity.   Benefield et al. (2000) suggests that downstream locations naturally have fewer resources and therefore leaf packs may attract macroinvertebrates, artificially elevating the decomposition rate. Our values for large streams may only represent potential decomposition.

Organic Matter Processing Downstream of Valley Fills in Headwater Streams

Results

Structural Complexity and Transport Distance

When valley fill and control sites were grouped together, the best predictor of dowel transport distance was coefficient of variation of depth (Table 11). For grouped sites, coefficient of variation of water level was the best predictor of decomposition rate ($R2= 0.9321$). For valley fill sites alone, coefficient of variation of depth ($R2= 0.7478$), and large woody debris per meter ($R2= 0.7820$) were good predictors of dowel and artificial leaf transport distance, respectively. For control sites, coefficient of variation of depth ($R2= 0.7083$ for dowels; $R2=0.9315$ for leaves) was the best predictor of transport distance.

Comparisons Between Valley Fill and Control Sites

There was no significant difference between valley fills and non-valley fills in terms of decomposition, however valley fills had a larger range of values (Figure 7).   There was also no significant difference between valley fills and non-valley fills in terms of retention, however controls had a larger range of values. Valley fill sites also had a wider range of habitat conditions (Figures 8 and 9). But, there was not a significant difference between control and valley fill sites in terms of retention score and RVHA. Although not statistically significant, water levels below valley fills tended to be less variable than those at control sites (Figure 10).

Discussion

There is an altered flow regime below valley fills: flows below valley fills were more stable than in control sites (Figure 10). Valley fills' sediment ponds and altered geology allow for flows to be more stable and higher than those of control sites. While this did not have a significant effect on dowel transport distances or decomposition, it is possible that flow interacts with other factors that cancel out the effects that flow alone would have or organic matter processing.

Organic matter retention and decomposition rates did not differ between control and valley fill sites. This is contrary to what I predicted. In terms of decomposition, it is possible that valley fills sites are more "sterile". In order for leaves to break down, a leaf needs to first be conditioned by fungi and bacteria, and then macroinvertebrates take over in breaking the leaf down (Webster and Benfield 1986). Fungal and bacterial assemblages were not measured in this study, so there is no way to know if these differed between valley fill and control sites. Streams draining control sites were mostly forested and streams draining valley fills drained a more barren area. Control sites may have much more opportunity for fungal and bacterial colonization than valley fill sites. If leaves in control sites were better colonized then this could potentially cancel out the effect of the higher flows in valley fill sites. In other words, valley fill sites have the potential for higher decomposition rates, but this potential is possibly negated by the fact that these streams drain a relatively sterile landscape.

Transport distances were only measured once every two weeks. This was probably too spaced out for these small, flashy streams. Valley fill sites have a different flow regime and may be moving the dowels in a different way. A flashy control site will push all of the dowels out after a rain even whereas a valley fill site may continuously move dowels for the entire period of time. After two, four, or six weeks the valley fill and control sites have moved the dowels the same distance but in potentially very different ways.

One of our valley fill sites (Big Muncy UNT R1) was positioned above the sediment pond instead of below it. This valley fill was older than the other fills; this fill was approximately 20 years old whereas the others were approximately 10 years old. This site had a much higher coefficient of variation of water level than even our control sites (Table 12). Although no solid conclusions can be drawn from this single sample, the data suggest that sediment ponds do help in controlling the flashiness of the streams draining valley fills.

Although no statistically significant differences could be found between valley fill and control sites, the noticeable difference in flow may indicate that there are underlying, interacting factors that affect organic matter processing in these sites. These subtle effects are difficult to tease apart. Also, headwater streams are inherently highly variable and it is hard to separate the variability due to land use from the inherent variability.

Works Cited

Benfield, E. F., J. R. Webster, J. J. Hutchens, J. L. Tank, and P. A. Turner. 2000. Organic matter dynamics along a stream-order and elevational gradient in a southern Appalachian stream. Verhandlungen der Internationalen Vereinigung für theoretische und angewandte Limnologie 27:1341-1345.

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Vannote, R. L., G. W. Minshall, K. W. Cummins, J. R. Sedell, and C. E. Cushing. 1980. The river contiuum concept. Canadian Journal of Fisheries and Aquatic Sciences 37(1):130-137.

Webster, J. R., and E. F. Benfield. 1986. Vascular Plant Breakdown in Freshwater Ecosystems. Annual Review of Ecology and Systematics 17(1):567-594.

Publications

Manuscript in preparation.

Awards and Achievements

Information Transfer Program

Presentations given at 2008 Southern Divison AFS Spring Meeting , 2008 Mid-Atlantic Regional Water Resources Research Conference, 2009 West Virginia AFS Meeting.

Student Support

Megan Minter, M.S., Eric Merriam, M.S..

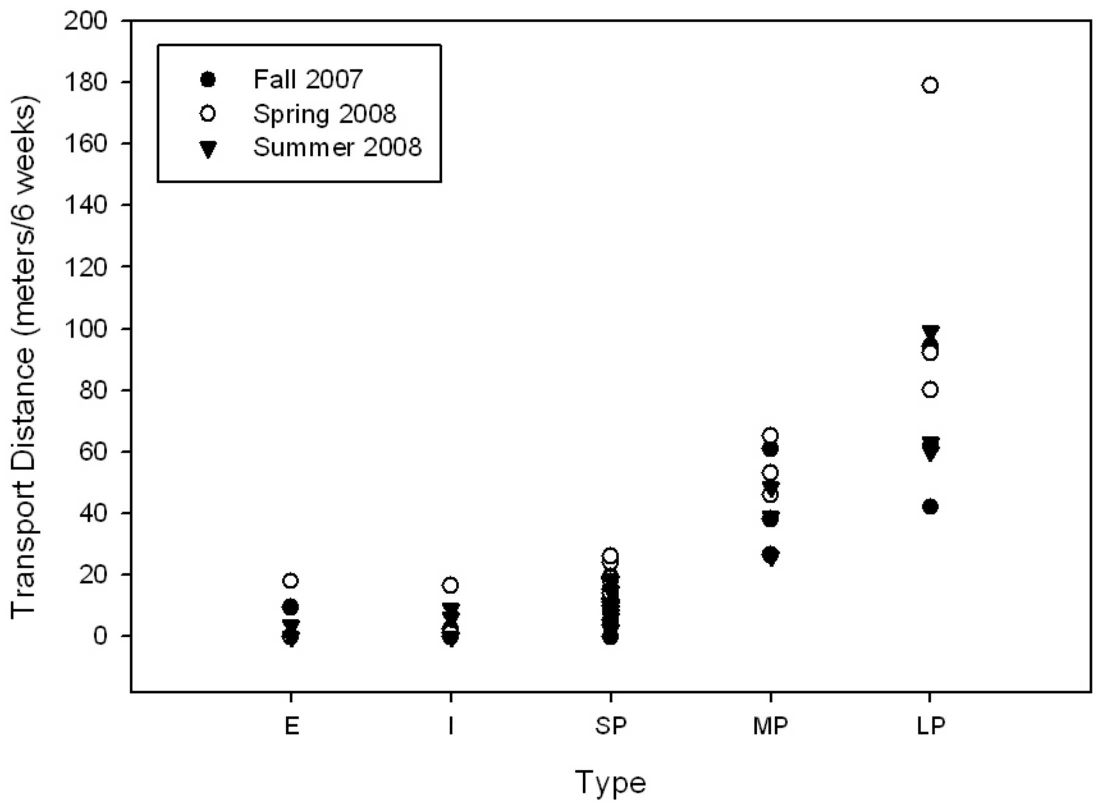


Figure 1: Relationship between seasonal dowel transport distance and drainage area (E=ephemeral, I=intermittent, SP=small perennial, MP=medium perennial, LP=large perennial).

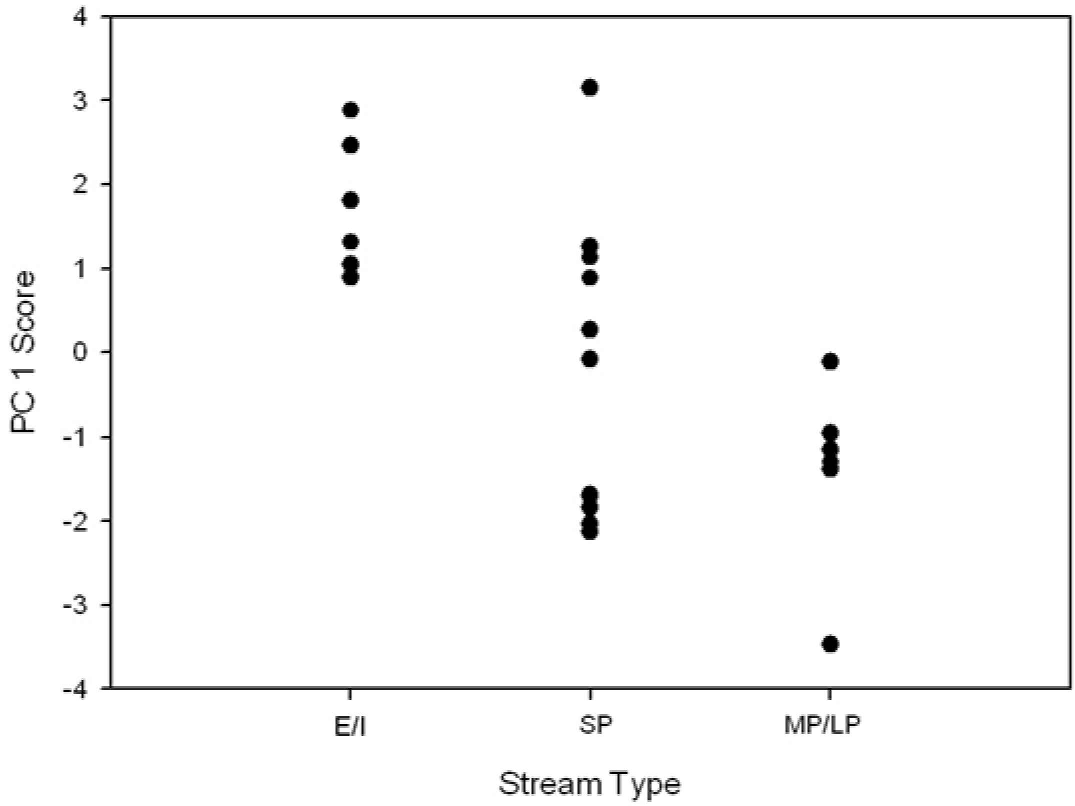


Figure 2: Distribution of Principle Component 1 scores (structural complexity measures) over grouped stream type. The higher the PC 1 score, the more structurally complex the site is.

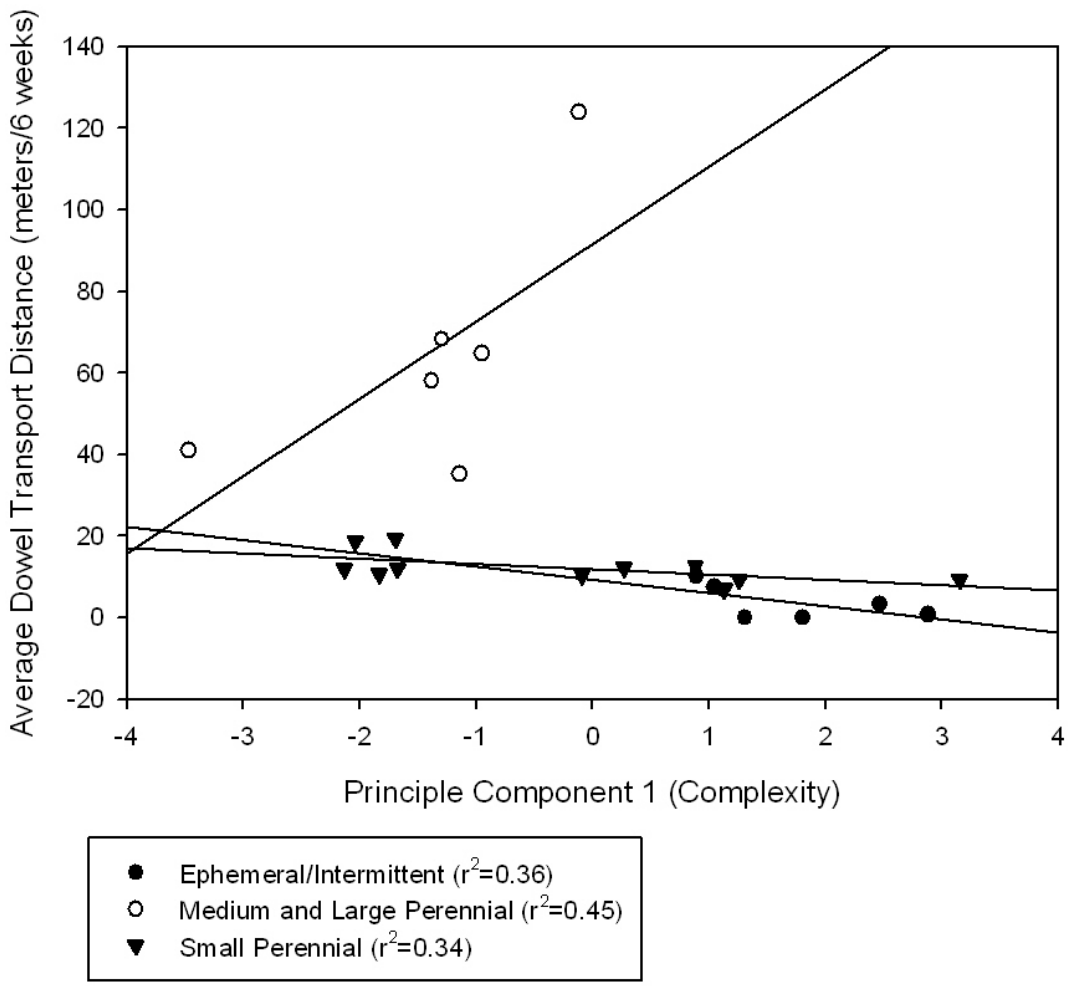


Figure 3: Principle Component 1 Score (complexity measures) and dowel transport distance averaged across all seasons.

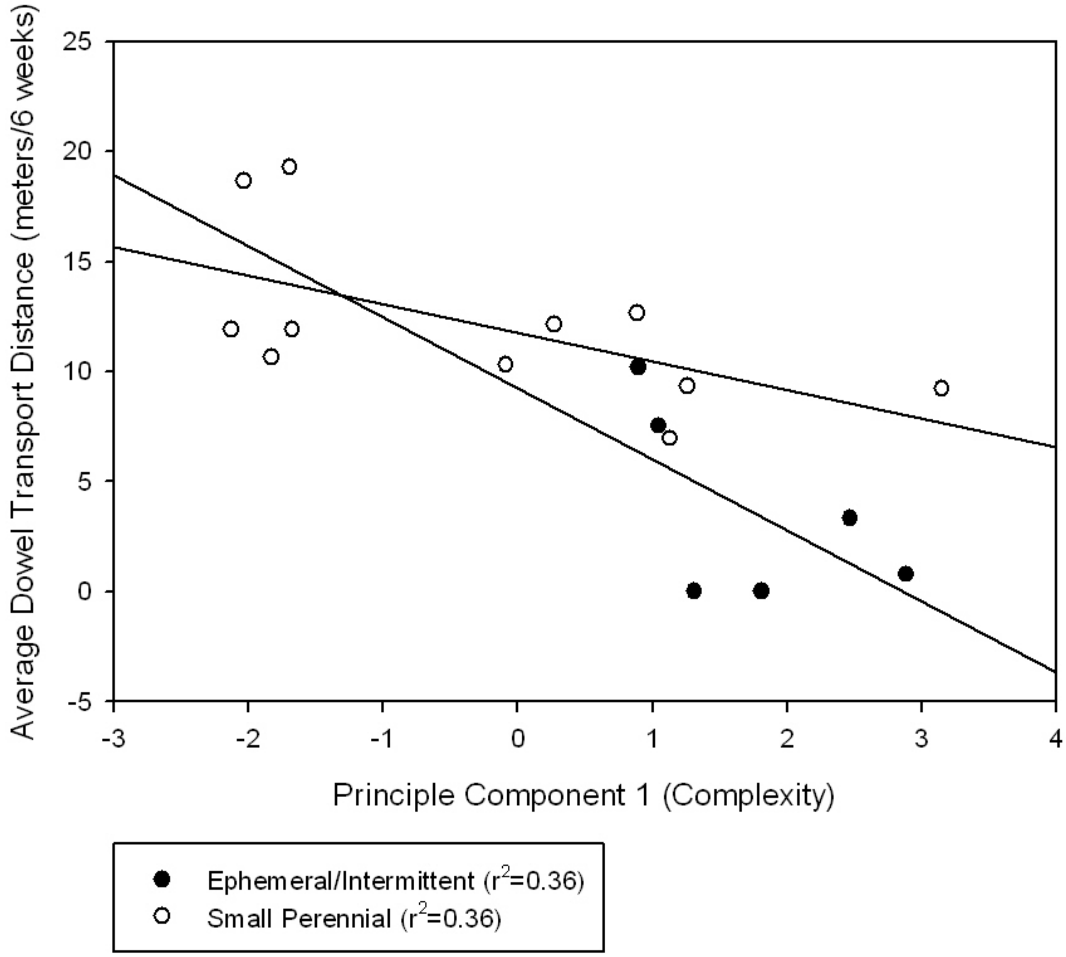


Figure 4: Principle Component 1 Score (complexity measures) and dowel transport distance averaged across all seasons. For Principle Component 1, the higher the score, the more complex the site is. There is a slight negative relationship between PC 1 and average dowel transport distance.

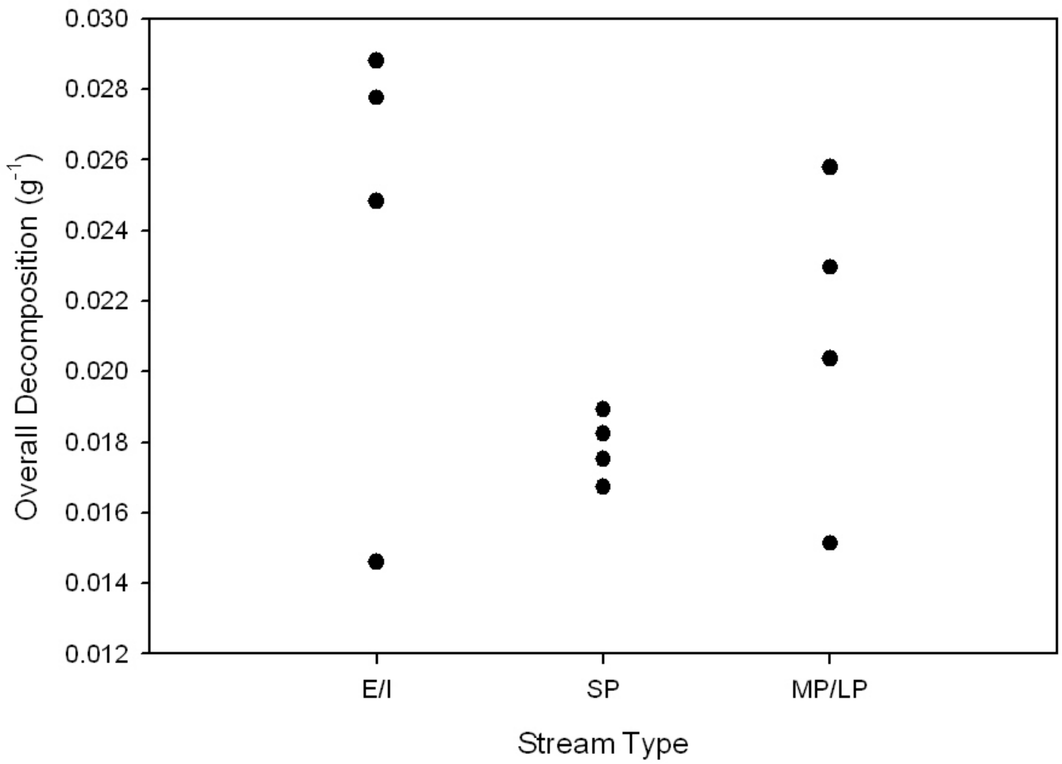


Figure 5: Range of decomposition values across stream types.

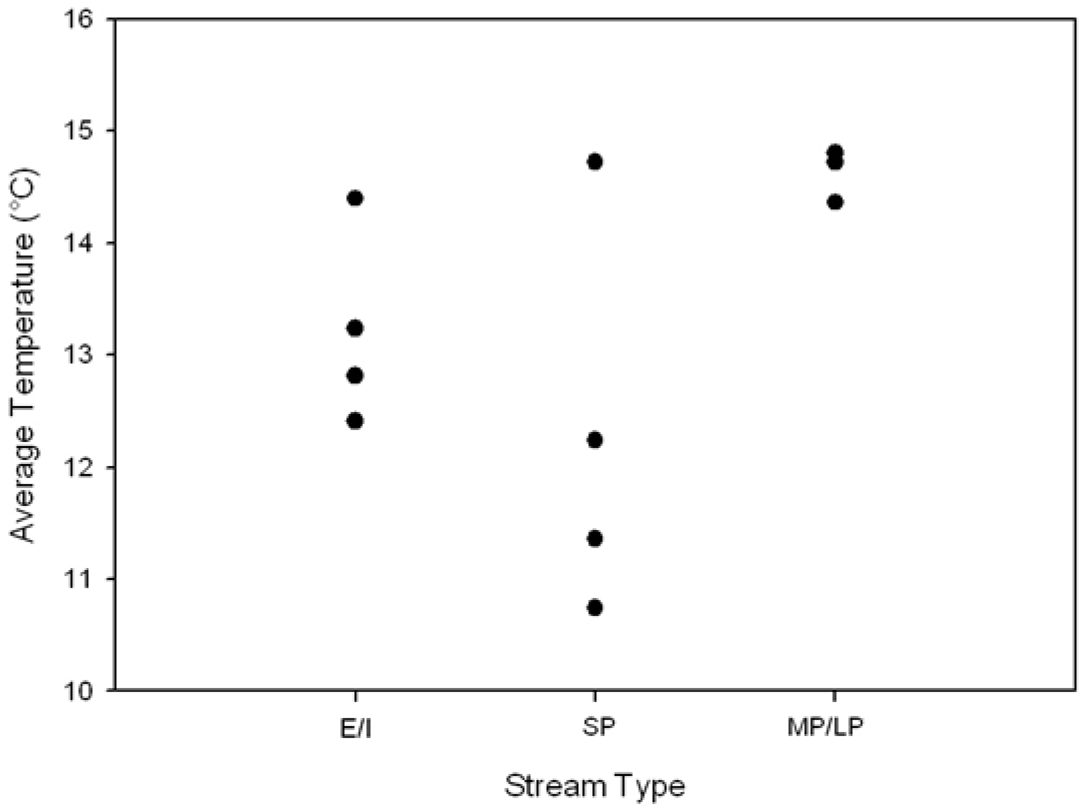


Figure 6: Range of temperature values across stream types.

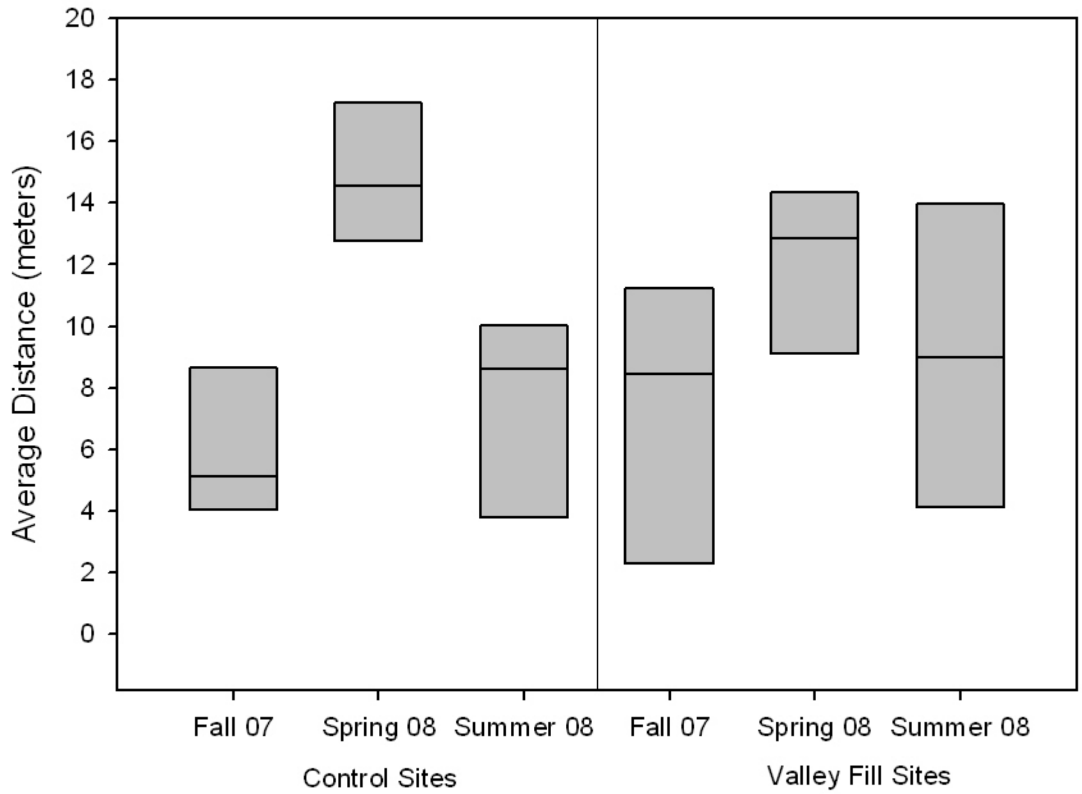


Figure 7: Average dowel transport distance for each season.

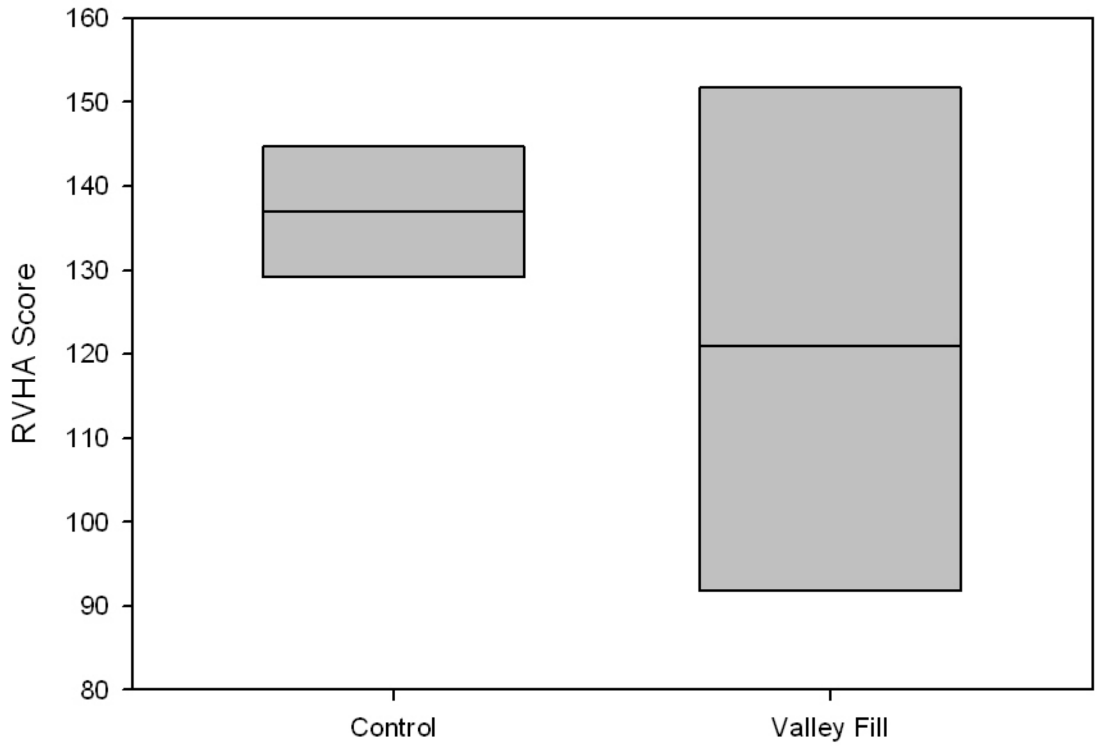


Figure 8: Rapid Visual Habitat Assessment Scores for each stream type.

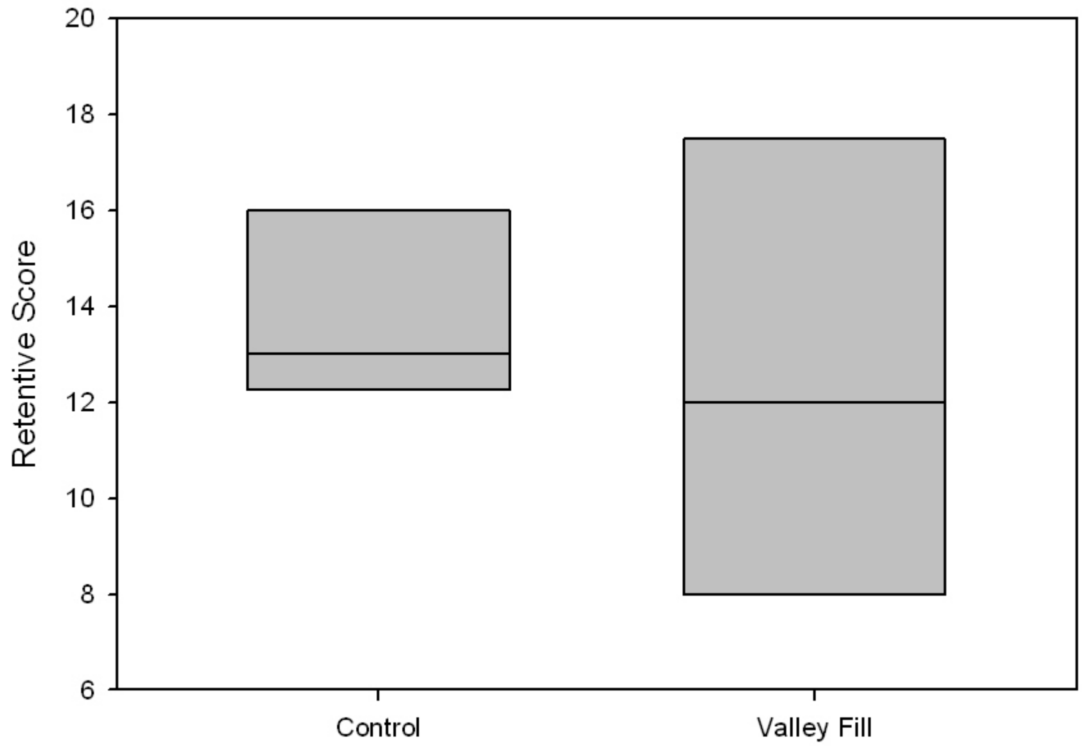


Figure 9: Range of retentive scores for control and valley fill sites.

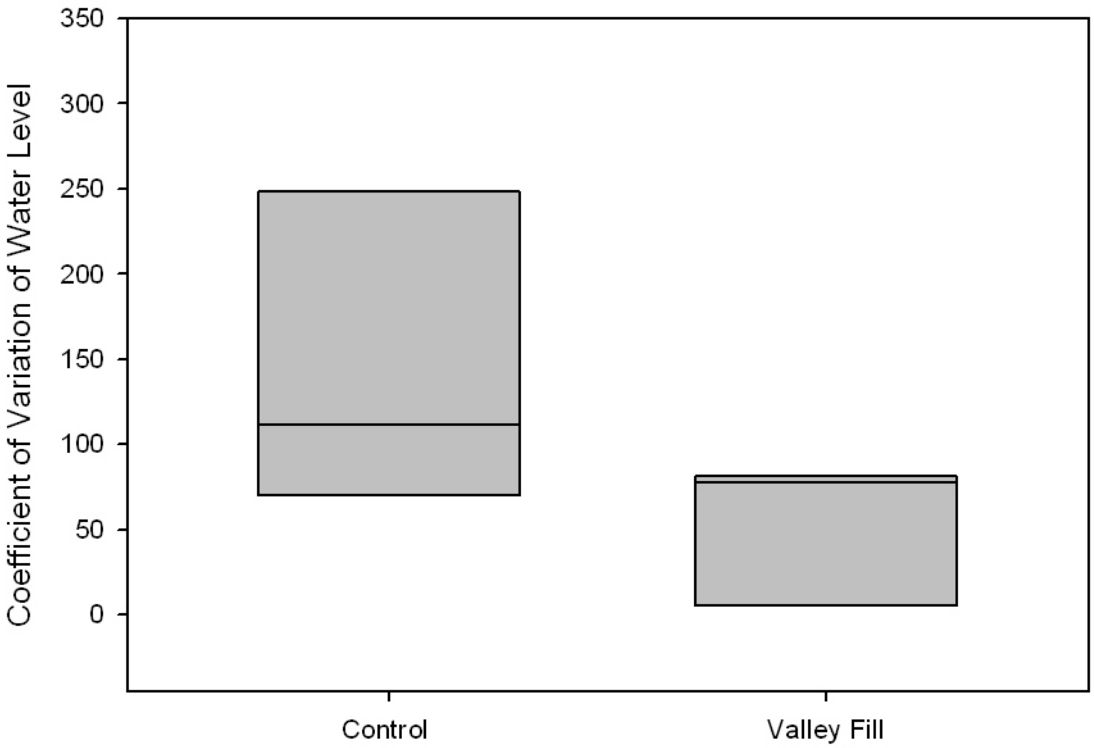


Figure 10: Range of values for the coefficient of variation of water level in control and valley fill sites. Big Muncy UNT R1 was not included in this graph.

Table 1: Principle components analysis results.

	PC 1	PC 2
Eigenvalue	3.34	1.21
Total Variance Explained	55.65	75.77
Total Retentive Score	+0.9140	.
Number of Retentive Features per Meter	+0.8103	.
Large Woody Debris per Meter	+0.7917	.
Rapid Visual Habitat Assessment	+0.7372	-0.5602
Coefficient of Variation of Depth	+0.5135	+0.7946
Mean Distance to Retentive Feature	-0.6426	.

Table 2: Simple Linear Regression models for average dowel transport distance (meters/ 6 weeks) at small and medium perennial sites.

Predictor	n	Corr	P	Estimate	Intercept
Retentive Score	6	0.8374	0.0105	8.54	9.70
RVHA	6	0.1882	0.3902	0.88	-26.49
log (average gradient)	6	0.0529	0.6613	-53.12	66.83
log (large woody debris per meter)	6	0.1548	0.4403	664.98	51.39
Coefficient of Variation of Depth	6	0.0956	0.5510	40.30	0.47
Retentive Features per meter	6	0.0022	0.9300	106.60	63.11
Mean distance to retentive feature (meters)	6	0.1798	0.4020	-0.27	75.37
Principle Component 1	6	0.4473	0.0073	18.97	91.64

Table 3: Simple Linear Regression models for average leaf transport distance (meters/30 mins) at small and medium perennial sites.

Predictor	n	Corr	P	Estimate	Intercept
Retentive Score	6	0.9068	0.0034	8.35	-13.86
RVHA	6	0.0756	0.5980	0.52	-14.20
log (average gradient)	6	0.0786	0.5905	-60.92	42.30
log (large woody debris per meter)	6	0.1429	0.4600	600.66	27.94
Coefficient of Variation of Depth	6	0.1710	0.4150	0.60	9.10
Retentive Features per meter	6	0.1898	0.7199	409.39	32.47
Mean distance to retentive feature (meters)	6	0.0357	0.3878	-0.26	50.25
Principle Component 1	6	0.4476	0.1462	17.84	65.29

Table 4: Correlations between structural complexity variables and average dowel transport distance. Correlation coefficient is listed first followed by the p-value.

Variable	Ephemeral and Intermittent	Small Perennial	Medium and Large Perennial
Coefficient of Variation of Depth (meters)	-0.9642, 0.0358	-0.5952, 0.0534	0.3092, 0.5510
Large Woody Debris per meter	0.7668, 0.0752	-0.5543, 0.0768	0.3934, 0.4403
Mean distance to retentive feature (meters)	0.7168, 0.1090	0.5863, 0.0748	-0.4241, 0.4020
Principle Component 1	-0.6022, 0.2059	-0.6018, 0.0501	0.6688, 0.1464
Retentive Features per meter	-0.6660, 0.1487	-0.6185, 0.0425	0.0467, 0.9300
Retentive Score	-0.0248, 0.9628	-0.5580, 0.0744	0.9151, 0.0105
RVHA Score	-0.1238, 0.8153	-0.3392, 0.3075	0.4338, 03902

Table 5: Correlations between structural complexity variables and average leaf transport distance. Correlation coefficient is listed first followed by the p-value.

Variable	Ephemeral and Intermittent	Small Perennial	Medium and Large Perennial
Coefficient of Variation of Depth (meters)	0.7307, 0.0990	-0.5912, 0.0554	0.2749, 0.5980
Large Woody Debris per meter	0.7160, 0.1096	-0.5584, 0.0742	0.3780, 0.4600
Mean distance to retentive feature (meters)	0.2062, 0.6951	0.1819, 0.6149	-0.4357, 0.3878
Principle Component 1	0.1444, 0.7849	-0.4652, 0.1494	0.6690, 0.1462
Retentive Features per meter	-0.6323, 0.1779	-0.5211, 0.1002	0.1890, 0.7199
Retentive Score	-0.8153, 0.0480	-0.4047, 0.2170	0.9522, 0.0034
RVHA Score	-0.9495, 0.0505	-0.2263, 0.5035	0.4136, 0.4150

Table 6: Simple Linear Regression models for average dowel transport distance (meters/6 weeks) at small perennial sites.

Predictor	n	Corr	P	Estimate	Intercept
Retentive Score	11	0.3114	0.0744	-0.38	15.33
RVHA	11	0.1151	0.3075	-0.04	17.11
log (average gradient)	11	0.0052	0.8322	-1.63	12.84
log (large woody debris per meter)	11	0.3072	0.0768	-33.66	14.25
Coefficient of Variation of Depth	11	0.3542	0.0534	-0.11	20.30
Retentive Features per meter	11	0.3825	0.0425	-65.17	14.43
Mean distance to retentive feature (meters)	11	0.3438	0.0748	0.19	8.91
Principle Component 1	11	0.3622	0.0501	-1.29	11.77

Table 7: Simple Linear Regression models for average leaf transport distance (meters/30 mins) at small perennial sites.

Predictor	n	Corr	P	Estimate	Intercept
Retentive Score	11	0.1638	0.2170	-0.12	3.35
RVHA	11	0.0512	0.5035	-0.01	3.80
log (average gradient)	11	0.0851	0.3840	-2.93	3.63
log (large woody debris per meter)	11	0.3118	0.0742	-15.15	3.27
Coefficient of Variation of Depth	11	0.3495	0.0554	-0.05	5.94
Retentive Features per meter	11	0.2716	0.1002	-24.54	3.18
Mean distance to retentive feature (meters)	11	0.0331	0.6149	0.02	1.65
Principle Component 1	11	0.2163	0.1494	-0.45	2.19

Table 8: Simple Linear Regression models for average dowel transport distance at ephemeral/intermittent sites.

Predictor	n	Corr	P	Estimate	Intercept
Retentive Score	6	0.0006	0.9628	-0.05	4.49
RVHA	6	0.0153	0.8150	-0.04	8.07
log (average gradient)	6	0.0485	0.6749	2.96	0.71
log (large woody debris per meter)	6	0.5880	0.0752	178.49	-10.14
Coefficient of Variation of Depth	6	0.9296	0.0358	-0.02	11.59
Retentive Features per meter	6	0.4435	0.1487	-45.97	7.69
Mean distance to retentive feature (meters)	6	0.5137	0.1090	0.53	-1.88
Principle Component 1	6	0.3626	0.2059	-3.23	9.25

Table 9: Simple Linear Regression models for average leaf transport distance (meters/30 mins) at ephemeral/intermittent sites.

Predictor	n	Corr	P	Estimate	Intercept
Retentive Score	6	0.0425	0.6951	0.09	-0.83
RVHA	6	0.0208	0.7849	0.01	-0.42
log (average gradient)	6	0.0023	0.9283	-0.14	0.84
log (large woody debris per meter)	6	0.5539	0.0990	37.09	-2.16
Coefficient of Variation of Depth	6	0.9016	0.0505	-0.00	2.47
Retentive Features per meter	6	0.6646	0.0480	-12.96	1.78
Mean distance to retentive feature (meters)	6	0.5126	0.1096	0.12	-0.50
Principle Component 1	6	0.3998	0.1779	-0.74	1.99

Table 10: Correlations between average decomposition rate (g^{-1}) and water quality and macroinvertebrate data.

Variable	Correlation	Signif Prob
Coefficient of Variation of Temperature	0.0080	0.9803
Maximum Temperature (°C)	-0.1387	0.6672
Minimum Temperature (°C)	-0.5080	0.0918
Average Temperature (°C)	-0.0008	0.9980
Conductivity (µS/cm)	-0.3946	0.2043
Maximum Daily Temperature Coefficient of Variation	-0.0438	0.8924
Maximum Temperature Daily Range (°C)	0.5236	0.0806
Mean Daily Temperature Coefficient of Variation (°C)	-0.3729	0.2325
Mean Daily Temperature Range (°C)	0.4435	0.1487
Overall % collector gatherer	-0.0636	0.8444
Overall % other	0.2664	0.4026
Overall % predator	0.1250	0.6988
Overall % shredders	-0.5038	0.0949

Table 11: Correlations between structural complexity variables as predictors and dowel transport distance (meters/6 weeks). In these correlations, valley fill and control sites were grouped.

Predictor	Corr	n	p-value
Retentive Score	-0.2908	8	0.4847
RVHA	-0.3896	8	0.3401
Average Gradient	-0.2832	8	0.4967
LWD per meter	-0.3598	8	0.3814
Coefficient of Variation of Depth	-0.8262	8	0.0115
Retentive Features per meter	-0.1123	8	0.7911
Mean distance to retentive feature (meters)	0.3526	8	0.3917
Principle Component 1	-0.3504	8	0.3948

Table 12: Correlations between structural complexity variables and dowel transport distance (meters/6 weeks) in control sites.

Predictor	Corr	n	p-value
Retentive Score	-0.0438	4	0.9562
RVHA	-0.1204	4	0.8796
Average Gradient	-0.1353	4	0.8647
LWD per meter	-0.5658	4	0.0334
Coefficient of Variation of Depth	-0.8088	4	0.1912
Retentive Features per meter	-0.0738	4	0.9262
Mean distance to retentive feature (meters)	-0.0337	4	0.9663
Principle Component 1	-0.3506	4	0.6494

WRI 97 - Chemical and Flow Characterization of Mining Impacted Streams Using Continuous Water Quality Monitoring and Watershed Modeling

Basic Information

Title:	WRI 97 - Chemical and Flow Characterization of Mining Impacted Streams Using Continuous Water Quality Monitoring and Watershed Modeling
Project Number:	2007WV98B
Start Date:	3/1/2007
End Date:	2/28/2009
Funding Source:	104B
Congressional District:	West Virginia District 1
Research Category:	Not Applicable
Focus Category:	Water Quality, Surface Water, Models
Descriptors:	None
Principal Investigators:	Jen Fulton, J. Brady Gutta, John D. Quaranta, Paul Ziemkiewicz

Publication

Chemical and Flow Characterization of Mining Impacted Streams Using Continuous Water Quality Monitoring and Watershed Modeling

WRI-97

2009 Annual Report

Principal Investigators:

Jennifer Fulton, M.S.
John Quaranta, Ph.D.
Brady Gutta

West Virginia Water Research Institute
West Virginia University

May 28, 2009

Introduction

Efforts to characterize stream water chemistry typically rely upon discrete samples collected over relatively large time intervals. Many important episodic flushing and peak loading events are not captured by these traditional water chemistry sampling protocols. Furthermore, dissolved metal dynamics in mining impacted streams often respond to seasonal and climatic changes (Petty and Barker 2004), and can fluctuate dramatically within a 24 hour period (Nimick et al. 2003). Discrete samples therefore may not adequately represent the true constituent load of the stream, particularly in mining impacted systems (Fytas and Hadjigeorgiou 1995).

Watershed models such as the Watershed Characterization and Modeling System, or WCMS (Strager et al. 2004) also tend to generalize stream water chemistry conditions. WCMS applies loading rates from land use types within a watershed to characterize general stream water quality and flow conditions. Loadings from known mine discharges can be incorporated into the model, producing an estimate of average chemical concentrations in a given stream. The model is based on average annual flow conditions, ignoring extreme loading events that may occur at varying flows throughout the year. WCMS therefore provides only a general estimation of stream water quality.

In order to gain a better understanding of water chemistry dynamics in acid mine drainage (AMD) impacted systems, water chemistry data will have to be collected at significantly smaller time intervals. Advances in instrumentation now allow for nearly continuous monitoring of many water quality parameters. Although sensor technology is not yet available to continuously measure many chemical constituents that may be of concern in these systems, regression models can be used to estimate chemical constituent concentrations and loads from the continuously measured parameters and discrete analytical samples (Christensen et al. 2000). A continuous estimation of chemical concentration will provide a more accurate representation of water chemistry variability in mining impacted systems. Improvement in the accuracy of chemical loading estimates will enable more effective design of AMD treatment systems, and may provide an important tool for TMDL development (Rasmussen et al. 2003).

Continuous monitoring and regression analysis have been used extensively to estimate constituent concentrations in Kansas watersheds (Christensen 2001; Christensen et al. 2000). The parameters of concern in these watersheds included alkalinity, fecal coliform bacteria, total suspended solids, sulfates, nitrates, and phosphorus. These parameters of concern were estimated using pH, specific conductance, temperature, dissolved oxygen, and turbidity data measured hourly with a YSI sonde. The U.S. Geological Survey reported that continuous data collection in these watersheds enabled the identification of important seasonal trends, and provided a more accurate representation of actual chemical loads being transported downstream (Christensen et al. 2000; Rasmussen et al. 2003).

Comparison of continuous water chemistry data to the chemical concentrations predicted by WCMS will enable us to evaluate the predictive ability of WCMS, and will allow us to place an error bound on the model predictions. The ability of WCMS to predict actual water chemistry parameters has never been evaluated in an AMD system, limiting the utility of WCMS in decision making processes. By associating a measure of error with the model predictions, future WCMS predictions can be made with a known level of accuracy. This will greatly enhance the utility of WCMS in AMD impacted watersheds, particularly in the evaluation of projected load reductions possible with various AMD treatment options.

Research Objectives

The objectives of the project are to:

1) Identify continuously monitored parameters or combinations of parameters that can be used as surrogates for variables of interest in AMD impaired systems, such as acidity, sulfates, iron, and aluminum, and perform regression analysis to estimate constituent concentrations continuously

2) Assess the ability of WCMS to predict stream water chemistry based on landscape characteristics and known AMD discharges, and create an error bound for WCMS predictions in a mining impacted watershed

3) Use continuous water quality data to examine spatial and temporal variability of water chemistry in a mining impacted watershed

These objectives are being accomplished through the completion of three tasks:

Task 1 – We installed a continuous water quality monitoring system at four sites in a mining impacted watershed. The instrumentation recorded pH, conductivity, temperature, and water level hourly. We measured stream discharge and analyze water chemistry once a month at each site. This task is complete.

Task 2 – We have compiled existing water quality data for all known mine discharges in the study watershed. Loadings from each discharge will be incorporated into the WCMS model in order to predict chemical concentrations and loadings at each monitoring station in the watershed.

Task 3 – We are in the process of analyzing relationships between continuous data and laboratory-analyzed samples in order to provide a continuous estimation of chemical concentrations in the watershed. This continuous data is being used to examine temporal and spatial variability in water chemistry throughout the watershed. We will then compare actual stream data to the WCMS predictions, and produce error bounds for the WCMS model within the study watershed. This information will then be compiled into a final report, and presented at an upcoming West Virginia Water Conference.

Methodology

Greens Run, located in Preston County, WV is a major source of acidity to the lower Cheat River. The watershed drains approximately 11.5 square miles and has 14.9 miles of impaired stream miles. Greens Run has three major tributaries, the North Fork, the Middle Fork, and the South Fork, all of which are heavily impacted by AMD. The three forks contain five recognized abandoned mine sites, as well as one bond forfeited site. The pH of Greens Run below the confluence of these forks is generally less than 3.5. Greens Run was chosen for this project because of the high degree of water chemistry variability observed in the watershed.

Reclamation efforts in the watershed have involved the installation of a doser on the bond forfeiture site by the West Virginia Department of Environmental Protection (WVDEP), as well as two passive treatment installations completed through a cooperative effort with the Friends of the Cheat, the WVDEP, and the National Mine Land Reclamation Center at the West Virginia Water Research Institute (WVWRI). These treatment projects on the Middle Fork and the North Fork help reduce acidity entering Greens Run.

In July 2007, WVWRI installed continuous water quality monitoring systems at the mouth of all forks and below the confluence of the forks, for a total of four monitoring stations (Figure 1). Each monitoring station was comprised of a Eureka multi-parameter sonde with pH, conductivity, temperature, dissolved oxygen, and depth sensors. Similar multi-parameter sondes have been used extensively in water quality research, and their continuous monitoring and logging capabilities are used by many state and federal water quality monitoring programs (Atkinson and Mabe 2006; Christensen 2001; Christensen et al. 2000; Hall and Wazniak 2004). Each sonde was secured to a bridge structure at the site (Figure 2), and was situated at a depth slightly lower than the lowest point in the stream channel. The sondes were programmed to collect data every two hours, and data was downloaded on a WVWRI laptop computer every month (Figure 3). Probes were cleaned and calibrated monthly (Figure 4).

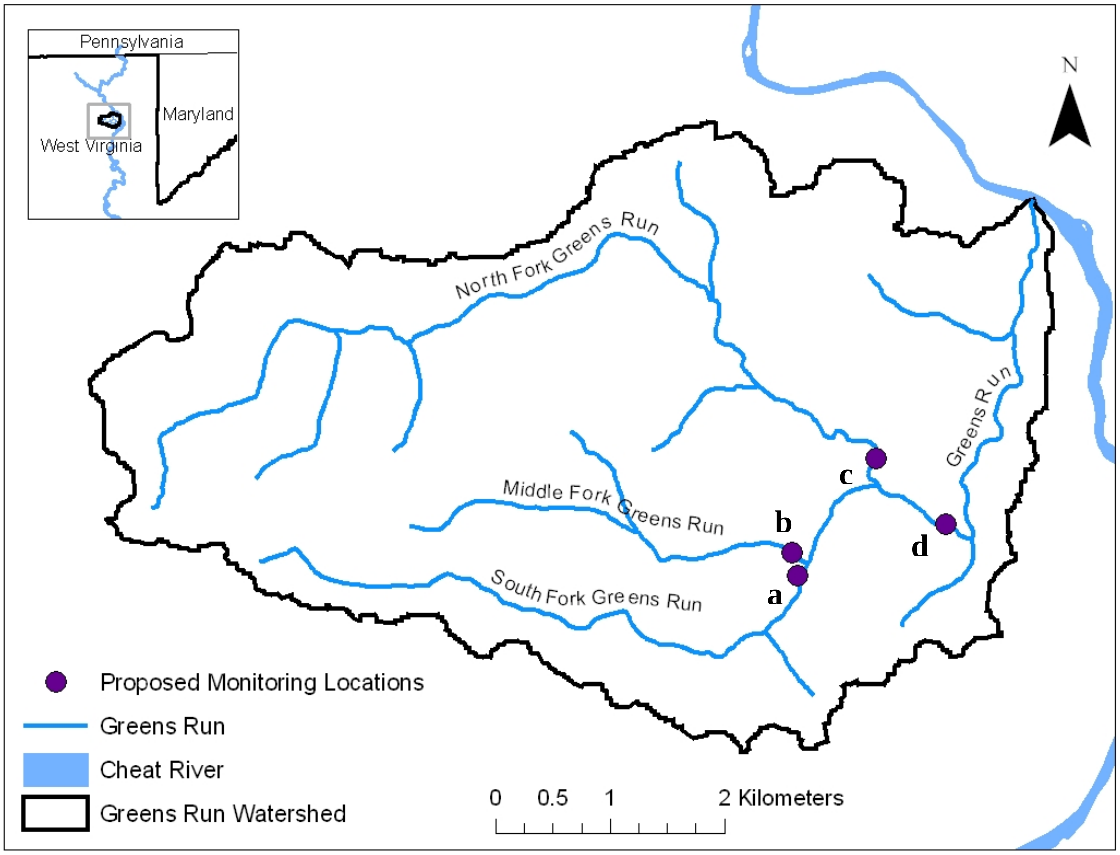


Figure 1. Location of continuous monitoring stations in the Greens Run watershed.

Figure 2. Continuous monitoring station on the Middle Fork of Greens Run.

Figure 3. Ben Mack downloading data from a Eureka sonde on lower Greens Run.

Figure 4. Joseph Kamalesh calibrating a Eureka sonde on the South Fork of Greens Run.

WVWRI staff collected water samples and measured stream discharge at each monitoring station once per month. Monthly sampling intervals have been found to effectively capture the broad range of temporal and spatial variability of water quality parameters in mining impacted systems (Petty and Barker 2004). The water samples were analyzed by the analytical lab at the National Research Center for Coal and Energy. Chilled grab samples were analyzed for alkalinity, acidity, and sulfates. Filtered (0.45 µm), acidified samples were analyzed for dissolved iron, aluminum, calcium, magnesium, and manganese concentrations. Discharge was calculated at each site using an area-velocity technique, by measuring depth and average current velocity (at 60% depth) with a digital Marsh-McBirney flow meter in ten equal cells in a cross-section of the stream.

Figure 5. Mary Beth Tajc sampling the North Fork of Greens Run

We are currently in the process of analyzing the continuous and instantaneous water quality data using stepwise multiple regression in order to produce equations that can be used to estimate chemical concentrations. Monthly discharge calculations are being used to create a stage-discharge rating curve, which will enable estimation of continuous streamflow at each site from the continuous water level data. Chemical load will then be calculated using the estimated instantaneous chemical concentrations and streamflow measurements.

Water quality data for all known mine discharges in the Greens Run watershed have been compiled into a spatially linked database (Figure 6). Using the WCMS feature within the spatial analyst extension of ESRI ArcMap 9.3, we will use the chemical loadings from each known discharge to predict chemical concentrations and loadings at each monitoring station in the watershed. These predictions will then be compared to the continuously-collected data in order to produce error bounds for the WCMS model within the Greens Run watershed.

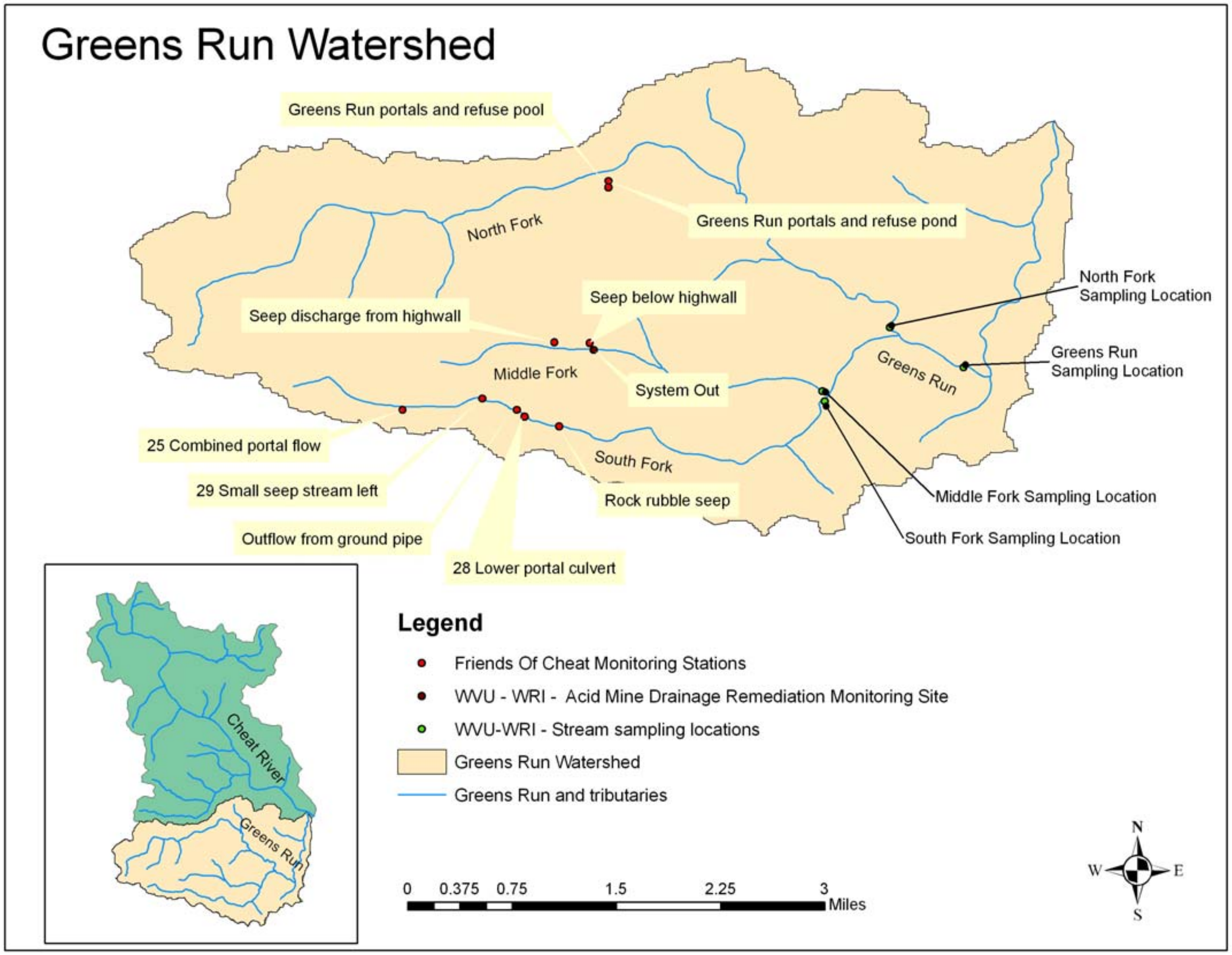


Figure 6. AMD source locations in the Greens Run watershed

Principal Findings

Continuous sonde data collection was conducted for one year, from October 2007 – October 2008 (Table 1). We sampled each stream monthly, for a total of 13 sampling events. At each visit, we collected water samples for analysis and measured stream discharge (Table 2).

Table 1. Mean sonde water quality measurements.

Site	*pH*	*Temp. (°C)*	*SC (µS/cm)*	*DO (mg/l)*
North Fork	7.04	11.00	197.55	9.73
Middle Fork	3.46	11.23	1209.33	8.98
South Fork	2.79	12.34	981.17	8.24
Greens Run	3.65	11.14	784.66	8.98

Table 2. Mean water quality parameters. Flow is expressed in GPM and all concentration measurements are expressed in mg/L.

Site	*Flow*	*Acidity*	*Alk.*	*SO4*	*Mg*	*Ca*	*Fe*	*Al*	*Mn*
North Fork	5451.90	57.28	28.10	41.86	6.80	27.15	7.47	10.89	1.22
Middle Fork	2324.54	394.87	0.01	578.38	18.32	69.48	40.26	22.25	2.13
South Fork	2329.71	319.90	0.00	393.23	12.48	46.54	36.35	16.65	2.42
Greens Run	13148.28	208.05	0.00	288.65	61.73	37.94	15.91	9.82	2.50

Significance of the Project

The most important outcome of this project will be the ability to produce continuous concentration estimations for parameters of concern in AMD systems, such as iron and aluminum. This continuous data will greatly enhance our understanding of water chemistry dynamics in acid mine drainage systems. We will be able to produce more accurate estimates of constituent loads, which will be particularly important when designing AMD treatment systems. Continuous water chemistry data will also allow us to produce error bounds for the WCMS model, enabling greater utility of WCMS for predicting benefits of future restoration actions in this watershed.

Student Support

Graduate students and undergraduate students have been utilized in the installation of the monitoring equipment, monthly data downloading and water sampling, as well as current and historic data compilation. This has provided these students and young professionals with knowledge of the design and maintenance of an automatic data logging system, field experience in water chemistry sampling procedures, and GIS/database experience.

Graduate Students
Joseph Kamalesh, M.S. in Civil and Environmental Engineering, August 2008
Ben Mack, M.S. in Plant and Soil Sciences, August 2008

Undergraduate Students
Melissa O'Neal, undergraduate majoring in Fish and Wildlife
Mary Beth Tajc, B.S. in Chemistry, May 2008

Project Publications/Notable Awards

No publications or awards associated with the project are available at this time.

Citations

Atkinson, S. F., and J. A. Mabe. 2006. Near real-time monitoring and mapping of specific conductivity levels across Lake Texoma, USA. Environmental Monitoring and Assessment 120:449-460.

Christensen, V. G. 2001. Characterization of surface-water quality based on real-time monitoring and regression analysis, Quivira National Wildlife Refuge, south-central Kansas, December 1998 through June 2001. U.S. Geological Survey in cooperation with the U.S. Fish and Wildlife Service, Lawrence, Kansas.

Christensen, V. G., X. Jian, and A. C. Ziegler. 2000. Regression Analysis and Real-Time Water-Quality Monitoring to Estimate Constituent Concentrations, Loads, and Yields in the Little Arkansas River, South-Central Kansas, 1995-99. U.S. Geological Survey, 00-4126.

Fytas, K., and J. Hadjigeorgiou. 1995. An assessment of acid rock drainage continuous monitoring technology. Environmental Geology 25(1):36-42.

Hall, M., and C. Wazniak. 2004. Continuous water quality monitoring in the Maryland Coastal Bays. Maryland Department of Natural Resources, Annapolis, MD.

Nimick, D. A., and coauthors. 2003. Diel cycles in dissolved metal concentrations in streams: Occurrence and possible causes. Water Resources Research 39(9):1247.

Petty, J. T., and J. Barker. 2004. Water quality variability in tributaries of the Cheat River, a mined Appalachian watershed. Pages 1484-1504 *in* Proceedings of the American Society of Mining and Reclamation.

Rasmussen, T. J., A. C. Ziegler, P. P. Rasmussen, and T. C. Stiles. 2003. Continuous water-quality monitoring—a valuable tool for TMDL programs. Proceedings of National TMDL Science and Policy 2003 Speciality Conference, Chicago, Illinois.

Strager, M. P., J. B. Churchill, and V. Maskey. 2004. The Watershed Characterization and Modeling System - A Hydrological Modeling Extension for Environmental Systems Research Institute ArcGIS 9X Software. Natural Resource Analysis Center, Division of Resource Management, West Virginia University, Morgantown, WV.

Information Transfer Program Introduction

The WV Water Research Institute information transfer program consists of communicating research project results to a diversified audience which ranges from regulatory agencies, academia, industry, watershed associations, legislators, general lay persons to others. Information transfer occurs in a wide variety of ways including a web site (wvwri.nrcce.wvu.edu), program newsletters, fact sheets, brochures, conferences and workshops, briefings, and meetings.

This year the WV Water Research Institute served as lead in developing and conducting a mid-Atlantic water resources research institute conference. The event was successful and the participating institute directors agree that this is something we should do at least once every three years.

The WVWRI web site is under new design to be released later this year. An updated WVWRI brochure is to be developed later this year also. The Northern WV Brownfields Assistance Center, a program of the WVWRI, releases a newsletter quarterly. Numerous fact sheets are developed on WVWRI projects as those projects are funded and undertaken.

The WVWRI just hired its first full-time outreach coordinator in response to the growth in research and funding of the WVWRI programs and projects.

WRI 105 West Virginia Water Conference 2008

Basic Information

Title:	WRI 105 West Virginia Water Conference 2008
Project Number:	2008WV118B
Start Date:	3/1/2008
End Date:	12/31/2008
Funding Source:	104B
Congressional District:	WV 1st
Research Category:	Not Applicable
Focus Category:	Water Quantity, Water Use, Water Quality
Descriptors:	None
Principal Investigators:	Tamara Vandivort

Publication

State: WV
Project Number:
Title: Mid-Atlantic Region Conference on Water and Energy
Project Type: Information Transfer
Focus Category: Water Quantity, Water Quality, Water Use
Keywords: Water, Conference, Policy, Research, Education, Economics
Start Date: 3/1/06
End Date: 2/28/07
Congressional District: WV 1st
PI: Tamara Vandivort
Email: tvandivo@wvu.edu
Co-PI's: None

Description

The West Virginia Water Research Institute at West Virginia University spearheaded a joint Mid-Atlantic Regional Water Resources Research Institutes (WRRI's) Regional Water Conference—*The Water-Energy Nexus: A Necessary Synergy for the 21st Century*. This event was co-sponsored by the Mid-Atlantic Regional WRRI's of Virginia, Pennsylvania, Washington, DC, Delaware, Maryland, New Jersey, and New York. The event was held November 17-19, 2008 at the National Conservation Training Center, U.S. Fish and Wildlife Service in Shepherdstown, WV.

With the increasing demand for both water and energy, innovative approaches are needed to manage these two resources. High oil and gasoline prices, climate change, and global politics place more demand on remaining U.S. coal, oil, and natural gas reserves. In addition, the impetus is on developing new "greener" more "environmentally-friendly" energy sources. Energy requires water in the production process and an increase in the demand for energy translates to an increase in the demand for water.

Technical papers and panel sessions were presented throughout the conference. Technical topics addressed a wide array of water and energy technologies and issues related to traditional energy sources including thermoelectric, hydroelectric, oil and gas production; alternative energy sources including biofuels, wind, and solar. Home- to industry-scale water and energy efficiency technologies and case studies were presented.

Methods, Procedures, Facilities

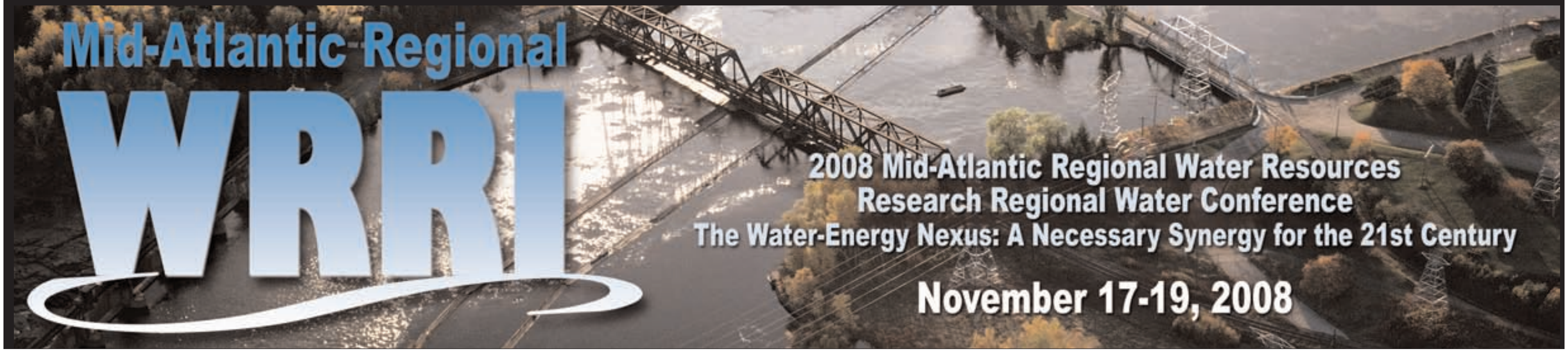
Planning

The West Virginia Water Research Institute served as lead for the conference. Directors and/or their designees from the other Mid-Atlantic Water Resources Research Institutes participated in meetings and conference calls to develop the theme, agenda, identify and contact speakers, select a facility, and develop materials for the event.

Call for Abstracts

A call for abstracts was issued. Approximately 40 abstracts were received. These were categorized by topic to develop the agenda. Authors were asked to prepare a presentation and submit a paper.

National Conservation Training Center U.S. Fish and Wildlife Service. Shepherdstown, WV



Presented by the West Virginia Water Research Institute

CALL FOR PAPERS EXTENDED

Abstracts Due July 31, 2008

The Mid-Atlantic Regional Water Resources Research Institutes (WRRI) of West Virginia, Virginia, Pennsylvania, Washington, D.C., Delaware, Maryland, New Jersey, and New York invite you to submit papers for presentation at this year's water conference.

Researchers from colleges and universities (faculty, graduate and undergraduate students), federal and state agencies, private organizations, consulting firms, and others are invited to present papers.

With the increasing demand for both water and energy, innovative approaches are needed to manage these two resources. High oil and gasoline prices, climate change, and global politics place more demand on remaining U.S. coal, oil, and natural gas reserves. In addition, the impetus is on developing new “greener” more “environmentally-friendly” energy sources. Energy requires water in the production process.

Suggested topics include, but are not limited to the following:

- Role of water in conventional and alternative energy production
- Energy needs for water supply and treatment
- Impacts of energy production on water supplies
- Downstream impacts of energy production on water quality
- Policy and regulatory issues

Papers may be submitted in any topical area addressing the interface of water and energy including technologies, practices, and/or policies.

Abstracts

Submit an abstract of 150-250 words and include the paper title, author(s), affiliation(s) of author(s), phone number(s), and email address(s). Abstracts must include sufficient content and information for adequate evaluation by the Conference Planning Committee. The Planning Committee reserves the right to accept, place in oral or poster session, or reject any paper.

Abstracts are to be submitted via email to Conference Coordinator:
Tamara Vandivort, at
Tamara.Vandivort@mail.wvu.edu.

Notification of Acceptance

Abstracts are due July 31, 2008. The Conference Planning Committee will inform the submitting author of the paper's status by August 15, 2008. If a paper is accepted, a copy of the paper in PDF format sent either by e-mail or by mail on a CD is due to the Conference Coordinator on or before October 15, 2008.

Proceedings

Proceedings will be developed from the conference. In order for a paper to be included in the proceedings, authors must:

1) Pay registration;

2) Submit completed manuscript in English by email or mailed CD to the Conference Coordinator (Papers must be received before October 15, 2008); and

3) Present paper at the conference.

Oral Presentation

Each author will be allowed 20 minutes followed by a 5 minute discussion period. The Conference will provide computers and projectors for Powerpoint presentations. If other equipment is needed, contact the Conference Coordinator. Note that additional equipment rental may be at the speaker's expense.

Poster Presentation

Interactive poster session(s) will be scheduled during the Conference. For those selected to present at the poster session(s), information on setup will be provided in the Authors' Guide provided to all authors whose abstracts are accepted.

Registration

Registration includes admittance to the conference sessions, refreshments, and reception(s). Registration rates are still to be determined. Registration is expected to be in the range of $99-$149 per person.

Venue and Lodging

The U.S. Fish and Wildlife Service National Conservation Training Center in Shepherdstown, WV is a "walking campus." Conference registration, auditorium, meeting rooms, dining room, and lodging are all accessible by a series of pathways. Comfortable, sturdy shoes are recommended. In addition, there are walking trails, fitness center, and gym.

Notice to Authors

The Water Resources Research Conference does not provide financial support to contributing authors. All authors must register for the conference and pay registration fees. An Authors' Guide will be provided to authors whose abstracts are accepted.

Questions and Assistance

For additional information on this event please call, email, or log onto the conference web site. If you have questions, need assistance, or wish to receive future water conference notices, please do not hesitate to contact us.

Mid-Atlantic Regional Water Resources Research Conference Assistance
Terry Polce, Conference Coordinating Assistant
Telephone: 304-293-2867 x 5450

E-mail: 2008waterconferenceinfo@mail.wvu.edu
Web: http://wvwri.nrcce.wvu.edu/conferences/2008/WRRI/

ABSTRACTS DUE JULY 31, 2008

Sponsors

- West Virginia Water Research Institute
- Virginia Water Resources Research Center
- Pennsylvania Water Resources Research Center
- D.C. Water Resources Research Institute
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- Maryland Water Resources Research Center
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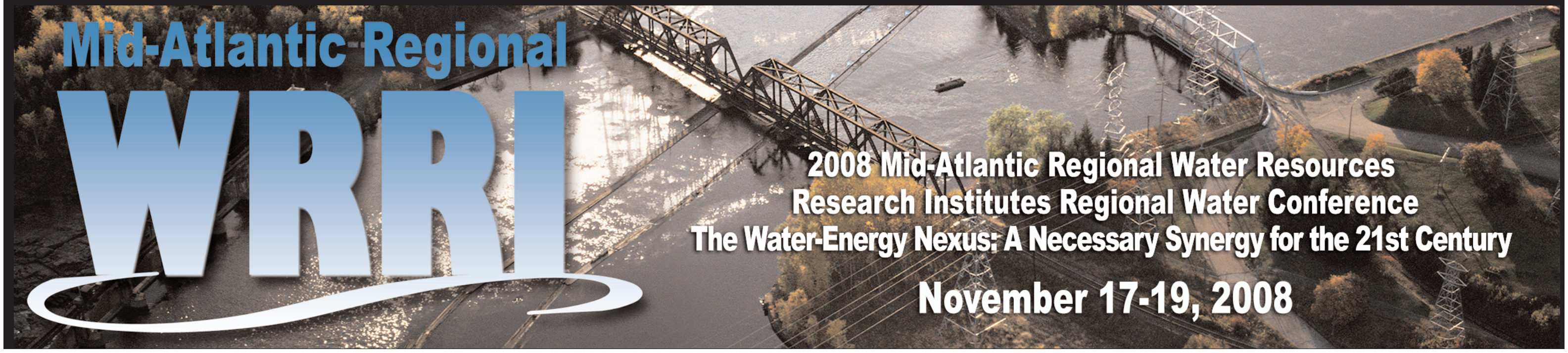
Call for Sponsors

A call for sponsors was issued. The National Research Center for Coal & Energy at West Virginia University provided $1,000.

National Conservation Training Center U.S. Fish and Wildlife Service. Shepherdstown, WV



Presented by the West Virginia Water Research Institute

CALL FOR SPONSORS

The Mid-Atlantic Regional Water Resources Research Institutes (WRRI) of West Virginia, Virginia, Pennsylvania, Washington, D.C., Delaware, Maryland, New Jersey, and New York invite you to join us in co-sponsoring the 2008 Mid-Atlantic Regional Water Resources Research Institutes Conference: The Water-Energy Nexus: A Necessary Synergy for the 21st Century.

With the increasing demand for both water and energy, innovative approaches are needed to manage these two resources. High oil and gasoline prices, climate change, and global politics place more demand on remaining U.S. coal, oil, and natural gas reserves. In addition, the impetus is on developing new “greener” more “environmentally-friendly” energy sources. Energy requires water in the production process. Some of the topics covered will include:

- Role of water in conventional and alternative energy production
- Energy needs for water supply and treatment
- Impacts of energy production on water supplies
- Downstream impacts of energy production on water quality
- Policy and regulatory issues

Be a PLATINUM, GOLD, SILVER, or BRONZE Contributor!

Your contribution to this event will help support an increase in knowledge among primary stakeholders and decision-makers in the region as we move forward to address issues related to water usage in energy production. Support a keynote speaker's travel costs, student stipends, conference materials, or a reception. The choice is yours. Any and all contributions will be used solely to support of this event.

PLATINUM $1,000
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BRONZE $250
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Audience
Attendees will range from researchers from colleges and universities (faculty, graduate and undergraduate students), policy-makers and regulatory representatives from federal and state agencies, private organizations and industry, to consulting firms, and others. Attendees will have the opportunity to present and learn about the latest research findings and policy issues related to water and energy, interact, network, and share ideas.

Venue and Lodging
The U.S. Fish and Wildlife Service National Conservation Training Center in Shepherdstown, WV is a "walking campus." Conference registration, auditorium, meeting rooms, dining room, and lodging are all accessible by a series of pathways. Comfortable, sturdy shoes are recommended. In addition, there are walking trails, a fitness center, and gym.

Questions and Assistance
To co-sponsor this event, please complete the sponsorship agreement and send it with your check made payable to West Virginia University Research Corporation to the conference coordinator at the address below.

If you have questions, need assistance, or wish to learn more about this event, please do not hesitate to contact us.

Mid-Atlantic Regional Water Resources Research Institutes Conference Assistance
Tamara Vandivort, Conference Coordinator
Terry Polce, Conference Coordinating Assistant
Telephone: 304-293-2867 x 5450
E-mail: 2008waterconferenceinfo@mail.wvu.edu
Web: http://wvwri.nrcce.wvu.edu/conferences/2008/WRRI/

Send completed form with your check made payable to **West Virginia University Research Corporation** to:

Tamara Vandivort, Conference Coordinator
West Virginia Water Research Institute
West Virginia University
PO Box 6064
Morgantown, WV 26506-6064

2008 Mid-Atlantic Regional Water Resources Research Institutes Regional Water Conference SPONSORSHIP AGREEMENT

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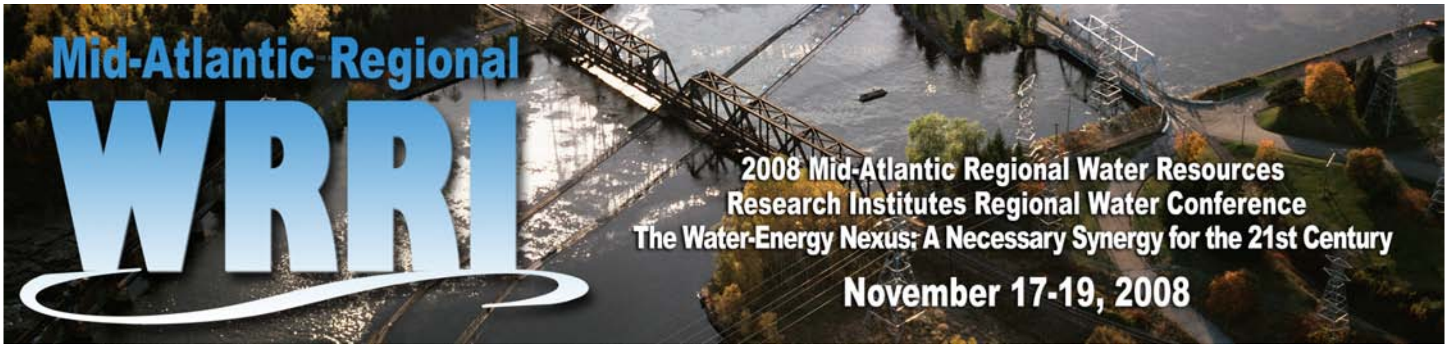
Agenda



Agenda

<u>Monday, November 17, 2008</u>

4:30 – 7:30 PM	**Registration**	**Commons**
7:30 – 9:30 PM	**Welcome Reception**	**Roosevelt Lounge**

<u>Tuesday, November 18, 2008</u>

7:30 AM – 5:30 PM	**Registration**	**Commons**
8:15 AM	**Plenary Session**	**Auditorium**

Introductory Remarks: Paul Ziemkiewicz, Director, West Virginia Water Research Institute
U.S. Department of Energy National Laboratory: Energy-Water Nexus National Lab Team,
John Gasper, Environmental Policy Analysis and Planning Manager, Argonne National Laboratory
Potomac Drinking Water Source Protection Partnership,
Joe Hoffman, Executive Director, Interstate Commission on the Potomac River Basin
Using and Protecting Water Resources in Energy Development,
Catherine Shrier, President, Watercat Consulting LLC

10:00 AM	**Break**	
10:30 AM	**Panel Session**	**Auditorium**

Water-Energy Issues in the Mid-Atlantic Region: A State-by-State Discussion
Moderator: Frank Borsuk, Aquatic/Fisheries Biologist, USEPA Region III
Panelists:
Paul Ziemkiewicz, Director, West Virginia Water Research Institute
William Hare, Director, Washington DC Water Resources Research Institute
Kaye Brubaker, Associate Professor, Civil & Environmental Engineering, University of Maryland
Elizabeth Boyer, Director, Pennsylvania Water Resources Research Institute
Stephen Schoenholtz, Director, Virginia Water Resources Research Center

11:45 AM	**Lunch Provided**	**Commons Dining Area**

(Tuesday continued on next page.)

1:00 PM **Technical Sessions**

Marcellus Shale Drilling & Implications on Water — **Instructional East Room 111**

Moderator: Steve Platt, Class II Team Leader, USEPA Region III

The Impacts on Water Resources from Drilling Operations in the Marcellus Shale, James Coleman, Team Chief Scientist, U.S. Geological Survey Eastern Energy Team

Marcellus Shale Drilling Operations from the Pennsylvania Perspective, Susan Weaver, Special Projects Manager, Water Planning Office, Pennsylvania Department of Environmental Protection *(tentative)*

The Impacts on Water Resources from Drilling Operations in the Marcellus Shale: The Pennsylvania, Maryland and New York Experience, Michael Brownell, Chief, Division of Water Resources Management, Susquehanna River Basin

Environmental Concerns Related to Completion Fluids Associated with Drilling the Marcellus Shale Roger Willis, President, Universal Well Services Inc. *(tentative)*

2:30 PM **Break – Outside Instructional East Meeting Rooms 105 and 111**

Track I – Instructional East Room 111

3:00 PM ***Coal Mining Impacts on Water***

Moderator: Todd Petty, Associate Professor, Forestry, West Virginia University

Organic Matter Retention and Decomposition in an Intensively Mined West Virginia Watershed, Megan Minter, Research Assistant, Division of Forestry and Natural Resources, West Virginia University

Interactive Effects of Large Scale Surface Mining and Residential Development on Stream Condition in a Southern West Virginia Watershed, Eric Merriam, Research Assistant, Division of Forestry and Natural Resources, West Virginia University

Ecological Functions of Headwater Aquatic Habitats On Reclaimed Surface Mines, Gretchen Gingerich, Research Assistant, West Virginia University

Using Air Permeametry to Characterize Surface Hydraulic Properties in West Virginia Minesoils, Blake Davis, Student, Division of Plant and Soil Sciences, West Virginia University

Downstream Effects of Mountaintop Coal Mining On Resident Aquatic Life, Greg J. Pond, Aquatic Biologist, EPA Region III

Track II – Instructional East Room 105

Water Resource Issues

Moderator: Alan Raflo, Research Associate Virginia Water Resources Research Center

Water, Energy, and Drought: A Look at the Relationship Between Water Use and Energy Production, Seth Sheldon, Ph.D. Student, University of Massachusetts

Power Plant Water Research Program at the National Energy Technology Laboratory, Barbara Carney, U.S. Department of Energy National Energy Technology Laboratory

Mine Pool Water as a Water Source for Power Plants, Joseph Donovan, Director Hydrogeology Research Center, West Virginia University

Active Biomonitoring for PAH, PCB and Chlordane Sources in the Anacostia Maryland Watershed, Harriette L. Phelps, Biology Professor, Emeritus, University of the District of Columbia

A Use Attainability Analysis (UAA) Conducted on a TMDL Stream for an Aquatic Life Designated Use, D. Gruber, President, Biological Monitoring, Inc.

5:30 PM **Adjourn**

7:30 – 9:30 PM **Reception** — **Roosevelt Room**

Wednesday, November 19, 2008

7:30 AM – 12 Noon **Registration** **Commons**

8:30 AM **Technical Sessions**

Track I – Instructional East Room 111

Biofuels for Energy
Moderator: Patrick Kirby, Director, Northern West Virginia Brownfields Assistance Center

Growing Switchgrass for Biofuels on Mine Land, Jeff Skousen, Professor Plant & Soil Science, West Virginia University

Sustainable Energy Park Pilot Project, Tamara Vandivort, Project Manager, West Virginia Water Research Institute, West Virginia University

Ethanol Production Plant Monitors Impacts To Water Supply and Stays in Compliance, John E. Dustman, President, Summit Envirosolutions, Inc.

Track II – Instructional East Room 105

Industry-Scale Water/Energy
Moderator: Stephen Schoenholtz, Director Virginia Water Resources Research Center

Water Quality Implications of Pipe Rehabilitation Technology, Bridget M. Donaldson, Research Scientist, Virginia Transportation Research Council

Modeling of Integrated Urban Wastewater System: Model Selection and Implementation, Tolessa Deksissa, Research Associate Washington, DC Water Resources Research Institute

ACUA: The Positive Impact of Renewable Energy on the Energy Needs for Wastewater Treatment Accompanied by the Potential of Beneficial Water Reuse for the Preservation of Water Resources, Eugene L. Petitt, Chief Engineer, Atlantic County Utilities Authority

10:00 AM **Break – Outside Instructional East Meeting Rooms 105 and 111**

10:30 AM

Nutrient Issues and Energy
Moderator: Alan Raflo, Research Associate, Virginia Water Resources Research Center

Effect of Pelletized Poultry Manure on Crop Production and Vadose Zone Water Quality, Tolessa Deksissa, Research Associate, Washington DC Water Resources Research Institute

Wastewater Irrigation: The Potential to Increase Biofuel Production While Removing Endocrine-Disrupting Hormones, Charles Walker, Postdoctoral Research Associate, Pennsylvania State University

Engineered Wetland Filters for Removing Phosphorous from Eutrophic Retention Ponds, Shawn E. Rosenquist, Ph.D. Student, Virginia Tech

Small-Scale Water/Energy
Moderator: Jane Walker, Research Associate, Virginia Water Resources Research Center

LEAFHouse – A Smart, Adaptable, Resource-Efficient Home Powered by Renewable Energy, Kaye Brubaker, Associate Professor, Civil & Environmental Engineering, University of Maryland

A Paradigm Shift: Decentralized Water Supply and Energy Systems, Tamim Younos, Associate Director, Virginia Water Resources Research Center

True Low Impact Development from the Single Family Home Perspective, Richard A. Street, Chesapeake Bay Division of Department of Code Compliance for Spotsylvania County, VA Presentation by Jane Walker, Research Associate, Virginia Water Resources Research Center

12:00 PM **Lunch Provided** **Commons Dining Area**

(Wednesday continued on next page.)

1:00 PM

Waste Products/Use/Contamination
Moderator: Tamara Vandivort, Program Coordinator, West Virginia Water Research Institute

Subsurface Comtamination from High-Alcohol Content Fuel Blends: Viscosity with Water, Kenneth Y. Lee, Associate Professor, Civil & Environmental Engineering, University of Massachusetts

Waste Items for Alternative Energy, Ricky Crews, Southeast RCAP

Alternative Uses for Algae Produced for Photosynthetic CO_2 Mitigation, Louis Landesman, Virginia Cooperative Extension, Virginia State University Columbia

Small-Scale Water/Energy
Moderator: Tamim Younos, Associate Director, Virginia Water Resources Research Center

Efficiency of Decentralized Drinking Water Treatment Systems in Rural Areas of Variations Developing Countries: A Case Study in Puebla and Queretaro, Mexico, Brittany Bogle, University of Arkansas,NSF-REU Fellow at Virginia Tech; Presentation by Tamim Younos, Associate Director, Virginia Water Resources Research Center

Analysis of Water and Energy Conservation of Rainwater Capture and Well Water Systems in a Single Family Home, Caitlin Grady, Undergraduate Research Fellow, Virginia Tech

Green Building Design: A Case Study Application to Car Dealerships and Implications for Water and Energy Conservation, Ini Li, Presentation by Caitlin Grady, Undergraduate University Research Fellow, Virginia Tech

2:30 PM **Break – Outside Instructional East Meeting Rooms 105 and 111**

3:00 PM

Water Quality/Hydroelectric Production
Moderator: Gary Wick, Unit Chief Federal Bureau of Investigation and Member of the West Virginia Advisory Committee for Water Research

Increasing Demands for Hydroelectric Production, David Meadows, Chief of Engineering and Construction Division, U.S. Army Corps of Engineers, Huntington, WV

Reservoir Water Quality Important in Hydroelectric Power Generation, Carolyn L. Thomas, Professor of Environmental Science and Biology, Ferrum College

Monitoring Invasive Aquatic Plants in Smith Mountain Lake, Virginia, Delia R. Heck, Assistant Professor of Environmental Science, Ferrum College

Large-Scale Water/Energy
Moderator: Tamim Younos, Associate Director, Virginia Water Resources Research Center

Socio-economics of Future Water Resource Needs: A Case Study of the Hampton Roads Region of Virginia, Jackie Rickards, Graduate Student, Virginia Commonwealth University

4:30 PM **Adjourn**

Facility

The National Conservation Training Center, U.S. Fish and Wildlife Service in Shepherdstown, WV was selected as the venue for this conference due to its location and availability.

Registration and Materials

On-line registration was developed and handled by the WV Water Research Institute. Lunches and materials were provided to approximately 125 attendees. A registration fee was charged to cover the costs associated with renting the facility and providing lunches and refreshments.

In addition to the agenda, a program was handed out that included abstracts associated with the presentations. Materials in the form of brochures, newsletters, and fact sheets providing information about the National Institutes for Water Research (NIWR) and water resources research institutes were also distributed.

Exhibits

Approximately 10 exhibitors participated in the conference. These included some of the water resources research institutes.

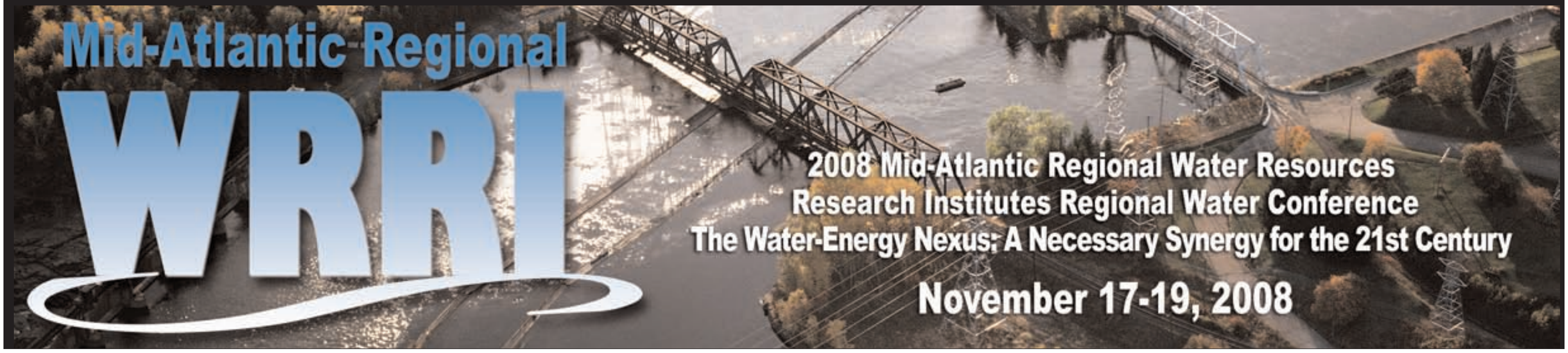
Publicity/Technology Transfer

The conference was publicized in a number of ways as follows:

#Press releases
#Article in the West Virginia State Journal
#Mid-Atlantic Water Resources Research Institute web sites.
#E-mail notices to WRRI list serves.
#Announcements provided to all on planning committee to distribute via their own agency web sites and mailing lists.
#The conference agenda, directions to the facility, an on-line registration form were all accessible via the WVWRI web site.The conference web site served as the integral tool for communicating the conference to the public. Both pre- and post-event information was placed on the web site including presentations and papers received from authors.

A flyer was developed and distributed as well.

National Conservation Training Center U.S. Fish and Wildlife Service. Shepherdstown, WV



Presented by the West Virginia Water Research Institute

AN INVITATION

The Mid-Atlantic Regional Water Resources Research Institutes (WRRI's) of West Virginia, Virginia, Pennsylvania, Washington, D.C., Delaware, Maryland, New Jersey, and New York invite you to attend the 2008 Mid-Atlantic Regional Water Resources Research Institutes Regional Water Conference, *The Water-Energy Nexus: A Necessary Synergy for the 21st Century*. This event will be held November 17-19, 2008 at the National Conservation Training Center, U.S. Fish and Wildlife Service in Shepherdstown, WV.

With the increasing demand for both water and energy, innovative approaches are needed to manage these two resources. High oil and gasoline prices, climate change, and global politics place more demand on remaining U.S. coal, oil, and natural gas reserves. In addition, the impetus is on developing new “greener” more “environmentally-friendly” energy sources. Energy requires water in the production process and an increase in the demand for energy translates to an increase in the demand for water.

Technical papers and panel sessions will be presented throughout the conference. Technical topics address a wide array of water and energy technologies and issues related to traditional energy sources including thermo-electric, hydroelectric, oil and gas production; alternative energy sources including biofuels, wind, and solar. Home and industry-scale water and energy efficiency technologies and case studies will be presented.

WELCOME RECEPTION

Monday, November 17, 2008
7:30 - 9:30 PM
Roosevelt Lounge

Please join us for a welcome reception at the National Conservation Training Center's Roosevelt Lounge. This reception is complimentary for conference attendees, but there is a charge of $35 to bring a spouse or friend. RSVP if you plan to attend by indicating on the conference registration form at:
http://wvwri.nrcce.wvu.edu/conferences/2008/WRRI/
or by emailing:
2008waterconferenceinfo@mail.wvu.edu

CONFERENCE OVERVIEW

Monday, November 17, 2008

Registration	4:30 PM - 7:00 PM
Welcome Reception	7:30 PM - 9:30 PM

Tuesday, November 18, 2008

Registration	7:30 AM - 4:30 PM
Plenary Session	8:30 AM - 10:00 AM
Panel Session	10:30 AM - 11:45 AM
Lunch Provided	11:45 AM - 1:00 PM
Technical Sessions	1:00 PM - 5:00 PM
Reception	7:30 PM - 9:30 PM

Wednesday, November 19, 2008

Registration	7:30 AM - 12:00 PM
Panel Session	8:45 AM - 10:00 AM
Technical Sessions	10:00 AM - 12:00 PM
Lunch Provided	12:00 PM - 1:00 PM
Technical Sessions	1:00 PM - 2:30 PM
Advisory Board Meeting	3:00 PM - 4:30 PM

REGISTRATION FORM

GENERAL INFORMATION

Proceedings

Proceedings will be developed from the conference and will be available on-line for all conference attendees.

Registration

Registration includes admittance to the conference sessions, lunch, refreshments, and reception(s), and conference materials. One-day attendance rates are $149.00 regular (including speakers); and $49.00 for students. Two-day attendance rates are $199.00 regular (including speakers) and $99.00 for students.

To register on line, log onto:
http://wvwri.nrcce.wvu.edu/conferences/2008/WRRI
or complete the registration form included.

Venue and Lodging

The U.S. Fish and Wildlife Service National Conservation Training Center in Shepherdstown, WV is a "walking campus." Conference registration, auditorium, meeting rooms, dining room, and lodging are all accessible by a series of pathways. There are walking trails, fitness center, and gym on location.

Questions and Assistance

For additional information on this event, please call, email, or log onto the conference web site. If you have questions, or need assistance, please contact us.

Mid-Atlantic Regional Water Resources Research Institutes Conference Assistance

Terry Polce, Conference Coordinator
Telephone: 304-293-2867 x5450

E-mail: 2008waterconferenceinfo@mail.wvu.edu

Web: http://wvwri.nrcce.wvu.edu/conferences/2008/WRRI

2008 Mid-Atlantic Regional Water Resources Research Institutes Regional Water Conference
The Water-Energy Nexus:
A Necessary Synergy for the 21st Century
November 17-19, 2008

Circle One: Dr. Ms. Mrs. Mr. Prof.

Name: ______________________________________
Last First

Organization/Company:
____

Mailing Address:
____

City, State, Zip Code:
____

Day-time Telephone:
(______________) ______________________________

E-mail Address:
____

Select Only One of the Following:

_____Regular Attendee
(All except students; includes speakers and moderators)

_____Student Attendee: Anyone enrolled in a University undergraduate/graduate program

November 18, 2008 - ONE Day Attendance
_____ $149.00 - Regular
_____ $ 49.00 - Student

November 19, 2008 - ONE Day Attendance
_____ $149.00 - Regular
_____ $ 49.00 - Student

November 18-19, 2008 - TWO Day Attendance
_____ $199.00 - Regular
_____ $ 99.00 - Student

Receptions and Lunches:
Check only the ones you plan to attend.
You may choose more than one.

I plan to attend:
_____ Welcome Reception on November 17, 2008
_____ Reception on November 18, 2008
_____ Lunch at the Facility on November 18, 2008
_____ Lunch at the Facility on November 19, 2008

USGS Summer Intern Program

None.

Student Support					
Category	**Section 104 Base Grant**	**Section 104 NCGP Award**	**NIWR-USGS Internship**	**Supplemental Awards**	**Total**
Undergraduate	2	0	0	0	2
Masters	4	0	0	0	4
Ph.D.	0	0	0	0	0
Post-Doc.	0	0	0	0	0
Total	6	0	0	0	6

Notable Awards and Achievements

One of the WVWRI's newest programs, the Northern WV Brownfields Assistance Center, has successfully submitted proposals that were funded from the U.S. EPA and the Claude Benedum Foundation. The U.S. EPA is providing $600,000 for a study on biofuels energy production on abandoned mine lands. U.S. EPA is also providing $1 million for brownfields redevelopment projects in four northern WV communities. The Claude Benedum Foundation provided $240,000 to be used to assist 15 communities "vision" the revitalization of brownfields in their communities.