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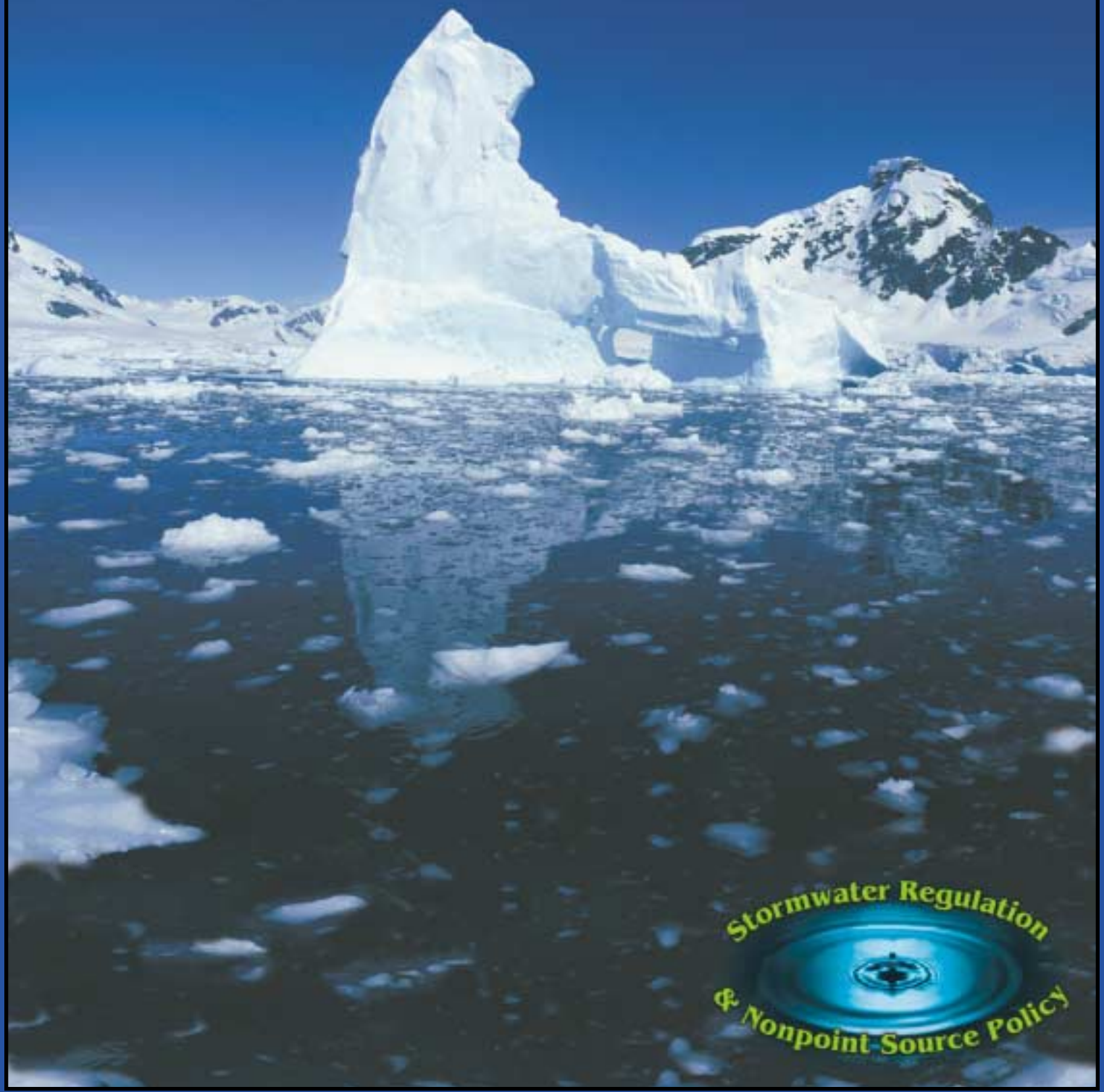

Stormwater Regulation & Nonpoint Source Policy

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Stormwater Regulation And Nonpoint Source Policy – Complimentary Or Contradictory?

Erich P. Ditschman, Associate Editor
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Clearly we are in need of more tools to address nonpoint sources of pollution. The latest National Water Quality Inventory indicates that agriculture is the leading contributor to water quality impairments, degrading 60 percent of the impaired river miles and half of the impaired lake acreage surveyed by states, territories, and tribes. Runoff from urban areas is the largest source of water quality impairments to surveyed estuaries (areas near the coast where seawater mixes with freshwater).

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Editorial Staff

WATER RESOURCES IMPACT

EDITORIAL . . . READERSHIP RESPONSIBILITY

N. Earl Spangenberg, Editor-In-Chief

The November, 2000 issue of IMPACT had several articles which resulted in a flurry of exchanges between me, the Associate Editor, several authors, and several readers. The upshot of it all will become part of the March issue, when everyone has had a chance to have their say.

I want to take this opportunity, however, to clarify our editorial procedure and policy, and to make an appeal for your active participation in the discussion process in *IMPACT*.

The editorial procedure for IMPACT relies first on the background and understanding of the Associate Editor responsible for a particular issue, then on me. I bear the ultimate responsibility for what appears in each issue.

Needless to say, we start with an implicit understanding of the integrity and responsibility of the author.

One unfortunate outcome of this abbreviated editorial process is a lack of depth in the review process. Consequently, observations which appear to start from an error in fact may not be caught if the Associate Editor or I do not have the specific background to check with an author on a particular point.

The editorial process that we are using requires a responsive and responsible readership. When there are problems in interpretation, understanding, or fact, they need to be brought to the attention of the entire readership, and appropriate corrections need to be made, if necessary.

All of our Associate Editors and authors are willing and eager to participate in discussions of the material appearing in *IMPACT*. In order to make *IMPACT* work as a journal of opinion and ideas, the readership needs to take an active role in the discussion process. When you have a concern or comment, do not hesitate to contact the author, Associate Editor, or me with your comments. We will share them as seems appropriate and necessary, and we will do what we can to turn the commentary into a dialogue.

With your help and participation, we can develop a valuable continuing discussion of contemporary water resources management problems.

Please keep this goal in mind as you read what we have to offer in each issue. Think about what you might have to offer to a continuing discussion, and don't hesitate to step into the ring.

WATER RESOURCES IMPACT

PRESIDENT'S MESSAGE

John S. Grounds III, AWRA President, 2001

My enthusiasm for working with the entire AWRA family comes from the accomplishments, visions, and relationships developed across all levels of membership. The strength and commitment from the Board of Directors, technical and administrative committees, state sections, student chapters, staff, and publications all come from within the talents and desires of our individual members. I know that we will continue to carry the momentum developed in the past and establish an ever-stronger future for AWRA.

Sir Isaac Newton is regarded as the founding exemplar of modern physical sciences including analytical geometry, calculus, fluid dynamics, mechanics, chemistry, and gravitation. He developed most of the tools in our water resources toolbox for design and analysis. His position within the scientific community allowed him to be elected twice.

You have within you the genius to advance water resources management and research. You have become a member of AWRA but now I ask that you join those that have accepted the challenge to lead the organization. Become a member of a technical committee. If you are already a committee member, then volunteer to chair the committee or to take the lead by organizing a session of papers at the Annual Conference, or organize a completely new committee.

Share your talent. I have the windows open. Now I want you to be heard.

INTRODUCTION: STORMWATER REGULATION AND NONPOINT SOURCE POLICY – COMPLIMENTARY OR CONTRADICTORY?

Erich P. Ditschman

Two years ago when I threw this topic on to the editorial table late one winter afternoon, I was concerned about the regulatory limitations for pursuing nonpoint source pollution control. In particular, I saw the Phase II stormwater regulations as novel end-of-pipe justification for addressing urban sources for nonpoint pollutants. The regulations identify specific measures that attempt to change behavior that can leave an imprint on the water that runs off our urban landscape. These measures include public education, outreach, and participation, construction site runoff control, post-construction runoff controls, and pollution prevention and good housekeeping. Illicit discharge elimination programs are targeted at pipes, so under strict definition are not related to nonpoint sources.

So at the time it seemed that, yes, Phase II was another tool added to the nonpoint source tool box, though regulatorily speaking it was a NPDES permit justified by an outfall to a receiving body and, in most cases, many outfalls. Peggy Johnson, Clinton River Watershed Council Executive Director Emeritus, would explain in the early days that the nonpoint source program worked from the landscape to the river's edge while the NPDES Phase I and II program worked from the outfall back up into the landscape.

Clearly we are in need of more tools to address nonpoint sources of pollution. The latest National Water Quality Inventory indicates that agriculture is the leading contributor to water quality impairments, degrading 60 percent of the impaired river miles and half of the impaired lake acreage surveyed by states, territories, and tribes. Runoff from urban areas is the largest source of water quality impairments to surveyed estuaries (areas near the coast where seawater mixes with freshwater).

Over 40 percent of our assessed waters still do not meet the water quality standards states, territories, and authorized tribes have set for them

The most common NPS pollutants are sediment and nutrients. These wash into water bodies from agricultural land, small and medium-sized animal feeding operations, construction sites, and other areas of disturbance. Other common NPS pollutants include pesticides, pathogens (bacteria and viruses), salts, oil, grease, toxic chemicals, and heavy metals. Beach closures, destroyed habitat, unsafe drinking water, fish kills, and many other severe environmental and human health problems result from NPS pollutants. The pollutants also ruin the beauty of healthy, clean water habitats. Each year, the United States spends millions of dollars to restore and protect the areas damaged by NPS pollutants (USEPA Pointer No. 1 EPA841-F-96-004A).

In addition, over 40 percent of our assessed waters still do not meet the water quality standards states, territories, and authorized tribes have set for them. This amounts to over 20,000 individual river segments, lakes, and estuaries. These impaired waters include approximately 300,000 miles of rivers and shorelines and approximately five million acres of lakes – polluted mostly by sediments, excess nutrients, and harmful microorganisms. An overwhelming majority of the population – 218 million – live within 10 miles of the impaired waters. (U.S. Environmental Protection Agency Office of Water (4503F), Washington, DC 20460 http://www.epa.gov/water/, EPA841-F-00-009, October 2000)

Prior to the NPDES Phase I and II programs, we relied heavily on the Section 319 program as the guiding light to our relatively voluntary approach to addressing nonpoint source programs. State programs under Section 319 can include both regulatory and nonregulatory state and local approaches. Section 319(b)(2)(B) specifies that a combination of nonregulatory or regulatory programs for enforcement, technical assistance, financial assistance, education, training, technology transfer, and demonstration projects" may be used, as necessary, to achieve implementation of the BMPs or measures identified in Section 319 submittals (Federal Register, Vol. 63, No. 6, Friday, January 9, 1998, Proposed Rules).

While the Section 319 Grant program has led to many successful projects (see http://www.epa.gov/owow/nps/Success319/ vol. I and II), it seemed odd that this program was unavailable to assist municipalities in funding aspects of urban nonpoint source protection because they were under a NPDES Phase II Permit. It was from this recognition that the title for this edition was born.

However, now it seems that such a question is too narrowly focused. Perhaps better questions are: Is our federal and state regulatory framework adequate to address the nonpoint source pollution problem responsible for much of surface water degradation? We are making progress, but is it enough? What else should be done? What else can be done?

While I have not asked specific questions of contributing authors, I did invite them to address topics that lie at the root of these types of questions. In this edition we:

- Explore the implications of the Phase II stormwater regulations for municipalities in Michigan (Cowles).

- Examine the results of an urban Section 319 water quality monitoring program (Campbell).

- Discuss effective stormwater management tools and approaches for controlling and/or preventing polluted stormwater runoff (Clarke).

On a personal note – I want to thank the authors for delivering these outstanding articles with extremely short notice due an unexpected illness occurring at a critical time in the development of this issue. As with all *Water Resources IMPACT* editions, your comments in light of these articles are very welcome.

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PURE AS RAIN: THE REGULATION OF STORM WATER IN MICHIGAN

Fred E. Cowles

Storm Water . . . Many people still think of it as "Pure as Rain." Water environment professionals know that rain is not as pure as it used to be. Air pollution does not stay in the air. Rain now comes down as acid. With it comes an array of pollutants, most significantly the bioaccumulative contaminants of mercury and PCB. But the water-quality impacts of storm water only begin with air pollution. Regulation of storm water cannot address these problems. Our friends working with air emissions will need to deal with these.

Before discussing HOW storm water will be regulated, it is useful to discuss WHY storm water should be regulated. The task of regulating storm water is much too difficult and complex and expensive to be undertaken lightly.

As the rain reaches the ground it ceases to be rain – it is now storm water. No one but nature regulates the rain, but we can regulate the storm water. But why? The answer lies in the general condition of Michigan's waterbodies and the potential causes of the problems.

Michigan has 328 waterbodies listed as impaired. Definitive studies have not been completed to determine the exact causes. These studies will be done as part of the TMDL (Total Maximum Daily Load) program. Half of these waterbodies are suspected to be impaired by causes often associated with storm water, such as untreated sewage, nutrients, and reduced biological diversity.

From the moment the rain hits the ground, the character of the water changes in response to the uses to which we have put to the land. As the water flows across the landscape, additional characteristics are added in response to our drainage systems.

In a natural landscape, rain never actually reaches the ground. Rain hits leaves, and then the water gently trickles to and into the ground. The water stays "pure as rain" and gently replenishes the earth. Society has virtually eliminated the natural landscape. Now, rain falls to the ground at high velocity and smashes into the earth, thus mobilizing soil particles that are carried away with the water. Bare soil is now common on farms and construction sites. Elsewhere, the rain hits hot, hard asphalt, where it is warmed before it moves quickly to a river. Thus, the impervious asphalt (and concrete, roofs, etc.) denies the ground water of replenishment, while at the same time causing unnaturally high flow in the river at an unnaturally high temperature. Some people find our drainage systems a convenient means for ridding themselves of undesirable substances, such as sewage, yard clippings, or crankcase oil. Others allow the escape of valuable substances, such as soil, fertilizers, and pesticides. The storm water continues to change as each of society's modifications to the natural earth imparts its characteristics to it. Our rivers and streams, thus, bear the burden of our prosperity.

Storm water regulation is not new . . . actions to correct and prevent environmental damage caused by storm water have been taken for decades by state and local officials

No one planned to cause these insults. They simply resulted from our incremental thinking and the assumption that exploiting our resources is the means to a higher standard of living. Now we must find ways to maintain that standard of living while improving our quality of life. Regulation of storm water is one step in that direction.

Storm water regulation is not new. Actions to correct and prevent environmental damage caused by storm water have been taken for decades by state and local officials. The first movement toward storm water regulation began in the 1970s, but the first prospective storm water regulation at the federal level began in 1990 with Phase I, which had three categories of permit requirements. First, many types of industries needed to get permits requiring pollution prevention plans for storm water. Second, construction sites over five acres in size needed permit coverage, in Michigan by Permit-by-Rule, requiring soil erosion plans and weekly inspections by a certified operator. Third, municipalities with separate storm sewer systems serving over 100,000 people were required to gather data, educate the public, address illicit connections, and deal with other aspects of storm water pollution to the maximum extent practicable.

The Phase II program will be a major expansion on Phase I. By 2003, construction sites greater than one acre in size will have requirements similar to those for sites greater than five acres, and municipalities in urbanized areas will need to comply with six minimum measures to reduce pollution from storm water to the maximum extent practicable. Other municipalities may also be regulated.

All NPDES delegated states, and EPA regions for non-delegated states, are busy compiling the details on their regulatory programs. While all programs must address the same requirements, significant differences are expected as a result of the flexibility in the federal regulations. This flexibility is necessary due to the variability between the states.

In Michigan, the statutes enabling local governments to provide their citizens with drainage are inconsistent. County Drain Commissioners have unique authority for drains created through a petition process. Cities have authority that villages and townships do not have, and a variety of other governmental entities, such as road agencies, have somewhat autonomous authority for drainage.

All of these drainage authorities frequently have interconnected and undocumented drains. This fact of life has led Michigan to think of Municipal Separate Storm Sewer Systems (MS4s) more as a geographic area that drains storm water, and less as a system of conduits or pipes. This area concept is important because cooperation between the various authorities is necessary in almost all cases for all six minimum measures to be adequately addressed.

The federal Phase II regulations require delegated states (like Michigan) to "designate small MS4s . . . as regulated small MS4s to be covered under the NPDES storm water discharge control program" and to " . . . issue permits . . . to all regulated small MS4s" (see 40 CFR 123.35(b) and (d)). Of course, the regulations are much more complex and prescriptive, although, Michigan is moving to establish rules that will consider all jurisdictions with population densities greater than 1000 per square mile for designation as a regulated MS4. The consideration would include factors for total population, whether the jurisdiction is adjacent to a regulated MS4, whether a completed Total Maximum Daily Load determination calls for storm water impact reduction, and whether sensitive or pristine waters are impacted. This approach would integrate the new programs for Phase II with the existing Phase I programs, so there would be no distinction.

Permit coverage will be provided by a general permit that incorporates the requirements of the federal regulations, including the six minimum measures. These measures require:

- public education and outreach,
- public involvement and participation,
- * illicit discharge detection and elimination,
- construction site storm water runoff control,
- * post-construction storm water management, and
- pollution prevention and good housekeeping for municipal operations

Michigan already has a general permit for municipal storm water, but no one is required to have it. It is a Voluntary MS4 Permit. After the Phase II rules require permit coverage, Michigan municipalities will have an option. Currently, 42 jurisdictions have volunteered for storm water permit coverage. These forward-looking communities recognize that storm water discharges have a negative impact on their waters and their quality of life. They decided that it is better to look at their problems holistically and that their corrective actions will be less expensive as a result of cooperative efforts. This voluntary permit is really a Watershed Management Tool. It brings communities together:

- to assess their water resources and identify threats and opportunities,
- to define both short and long term goals,
- to determine objectives and actions needed to achieve those goals,
- to consider the costs and the benefits of the proposed actions,
- to document the plan and make commitments for action,
- to implement the plan, and
- to evaluate progress and refine the plan.

This voluntary permit fulfills the Phase II requirements, but it provides much more flexibility than can be expected in a more traditional permit. This flexibility stems from Michigan's confidence in the Watershed Management Process. Interjurisdictional cooperation and informed public involvement provide assurances that effective actions will be taken to address the problems of greatest concern with the citizens closest to the water resources. Better decisions about local waters can be made at the local level than can be made by the state or federal governments. Annual progress reports will document actions taken to eliminate illicit discharges, to evaluate public education efforts, and to reduce pollutants in storm water. The effectiveness of this voluntary, watershed-based approach will be evaluated in 2006. If it is nearly as effective as expected, it will be made a permanent part of the regulation of storm water in Michigan.

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FEEDBACK! . . .

Let us know what you think. We want to encourage dialogue. Write or e-mail your comments to the Associate Editor or to me. We appreciate everyone who has sent their comments to us so far and ask that you continue to do so. We would like to get everyone involved in some "conversation" on various topics.

Earl Spangenberg, Editor-In-Chief
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POLLUTANT REMOVAL EFFICIENCY OF AN URBAN STORMWATER WETLAND IN LANSING TOWNSHIP, MICHIGAN

Ellyn J. Campbell, Karen Wayland, Kathleen Pelikan, Erich P. Ditschman, and Patrick E. Lindemann

INTRODUCTION

Stormwater runoff from urban watersheds transports a variety of nonpoint source (NPS) pollutants to receiving waterbodies, including nutrients, metals, sediment, oxygen-demanding wastes, and toxic organic chemicals that can cause water quality degradation and impairment. Urban stormwater runoff can also negatively affect the natural hydrology of receiving waters by changing the frequency and volume of peak flows. Constructed wetlands have recently become an attractive alternative to expensive, traditional structural facilities that control and treat urban stormwater, while providing the additional benefit of green space and urban wildlife habitat. Further documentation of the benefits of constructed stormwater wetlands can help facilitate their adoption by communities who need to develop stormwater management programs.

One such stormwater wetland facility, the Tollgate Drainage District Wetlands (Tollgate Wetlands), was built in 1998 in Lansing, Michigan, as a low-cost alternative to traditional structural stormwater treatment options. The Tollgate Wetlands is a 12-acre site used to receive stormwater runoff from 234 acres of residential and commercial properties, and consists of a series of stepped ponds, waterfalls, wetlands, spillways, and a peat/sand filter. In 1999, the Ingham County Drain Commissioner received a Section 319 grant from the Michigan Department of Environmental Quality to study the effectiveness of the Tollgate Wetlands at reducing stormwater pollutants. This article discusses the results of the short-term water-quality monitoring project, which was conducted from April to September 2000.

METHODS

Three inflow sampling stations were chosen to characterize the quality and quantity of stormwater flow from three distinct land uses (single-family residential, multi-family residential, and commercial). These inflow sampling stations were established in storm sewers upstream of the Tollgate Wetlands. An outflow station was located at the outfall pipe from the wetland, which allowed analysis of treated stormwater exiting the Tollgate Wetlands

From April to September 2000, ISCO 6700 automated sampler and bubbler flow meters installed at each sampling station continuously measured flow and collected composite samples for analysis of nutrients (ammonia nitrogen, nitrate + nitrite nitrogen, total Kjeldahl nitrogen, and total phosphorus), total metals (cadmium, copper, and lead) and total suspended solids.

Mass pollutant loading values were calculated for each composite sample date at each station by multiplying the total cumulative flow volume experienced during the composite sample interval by the concentration measured during that interval. The mass loadings for the three inflow stations were summed to determine the mass loadings of each constituent into the wetland. The mass loadings for the only output station were used for the mass loadings out of the wetland. The removal efficiency of the Tollgate Wetlands for each of the eight constituents was calculated as the percentage reduction in pollutant mass as a result of flow through the wetland system. Loadings measured at each inflow station were divided by the corresponding drainage area in order to make accurate comparisons of contributions among the different land uses.

RESULTS AND DISCUSSION

Observed Loading Per Land Use

During the April to September 2000 study period, over 30 measurable storm events were sampled and analyzed. Table 1 illustrates the acreage-adjusted loadings entering the wetland from each land use type.

Results indicate that commercial land use contributed the greatest loadings per acre for five of the eight constituents of concern, including the most biologically available nutrient constituents, as well as total lead and total suspended solids during the period of study. Single-family residential land use loadings paralleled or exceeded those observed from commercial use with the exception of total Kjeldahl nitrogen. The third land use investigated in this study, multi-family residential, consistently contributed the lowest acreage-adjusted loadings for five of the eight constituents and the greatest loading for total cadmium.

Clearly, additional research into the processes that have contributed to the high removal efficiency of the Tollgate Wetlands would improve the design of these systems in other locations within the Great Lakes region

While the observed loading data are somewhat limited due the short study period, these results indicate that the commercial land use within the Tollgate drainage district generates the greatest pollutant loadings per acre, followed by single-family residential areas and multi-family residential areas, respectively.

TABLE 1. Tollgate Wetlands Acreage-Adjusted Storm-Event Loadings for Three Inflow Stations for Study Period From Mid-April to September 2000.

	Total Loadings to Tollgate Wetland (in lbs/acre)							
Site	Ammonia Nitrogen	Nitrate + Nitrite Nitrogen	Total Kjeldahl Nitrogen	Total Cadmium	Total Copper	Total Lead	Total Suspended Solids	Total Phosphorus
Commercial	15.018	21.436	8.440	0.007	0.222	9.522	526.785	2.919
Single-Family Residential	12.866	89.824	3.042	0.008	0.706	0.046	166.242	2.083
Multi-Family Residential	3.753	31.604	5.745	6.753	0.103	0.030	51.612	0.829

TABLE 2. Tollgate Wetlands Total Mass Loadings and Removal Efficiency Rates for Study Period From Mid-April to September 2000.

	Total Loadings (in lbs)							
Site	Ammonia Nitrogen	Nitrate + Nitrite Nitrogen	Total Kjeldahl Nitrogen	Total Cadmium	Total Copper	Total Lead	Total Suspended Solids	Total Phosphorus
Commercial	561.664	801.725	315.658	0.258	8.305	356.111	19701.770	109.182
Single-Family Residential	1506.579	10518.374	356.187	0.977	82.671	5.442	19466.996	243.935
Multi-Family Residential	176.970	1490.141	270.869	318.399	4.878	1.407	2433.493	39.110
Outflow	36.254	545.134	86.673	0.388	7.620	0.914	16905.005	103.193
Total Inputs	2245.213	12810.240	942.714	319.634	95.854	362.960	41602.259	392.227
Total Outputs	36.254	545.134	86.673	0.388	7.620	0.914	16905.005	103.193
Removal Efficiency (%)	98.39	95.74	90.81	99.88	92.05	99.75	59.37	73.69

Total Mass Loading and Tollgate Wetland Pollutant Removal Efficiency

In order to evaluate the pollutant removal effectiveness of the wetland system during the study period, total pollutant inflow and outflow loads were determined. As Table 2 illustrates, the total mass of NPS pollutants exported from the wetlands was appreciably less than loading into the wetland for most constituents, indicating that the wetland was successful at reducing NPS pollutant loads. The high removal efficiencies may be a result of the treatment redundancy of the wetlands design, with multiple ponds, riffles for oxygenating water between ponds, and dual pumps that continuously recirculate water from the lowest pond to a limestone cascade at the top of the wetlands.

Sediment removal efficiency may have been affected by the occurrence of a debris dam that was removed in the final month of the study. The removal of a debris dam caused a surge in the outflow of the wetland, possibly disturbing deposited sediment in the detention pond above the outflow point. Because of the short time period of this study, the concentration spike after clearing the outfall pipe may have resulted in overestimating the normal export load of the wetlands, thus, an underestimation of the removal efficiency of some constituents.

While the pollutant removal efficiency of the Tollgate Wetlands compares favorably with other studies in the literature, it is difficult to directly compare the removal efficiencies because the design of wetland systems varies dramatically from site to site. Important variables affecting potential removal efficiency of stormwater wetlands include size, design volume, depth, vegetation, and hydrologic residence time (Schueler, 1992; Kadlec and Knight, 1996; Kuehn and Moore, 1995). For example, an extended detention wetland may, by nature of its design, exhibit lower removal efficiencies for nutrients than shallow marshes or pond/wetland systems (Schueler, 1992). In addition, climatic conditions and precipitation volumes experienced in this study differ from other studies described in the literature.

Two other factors make cross-study comparisons of removal efficiencies problematic. First, some studies base their removal efficiencies on concentrations, not loads,

and many studies that utilize loads, do not list the formula used to make those calculations. Secondly, the study period varies from project to project, and seasonal variations in pollutant removal rates may be significant. Nevertheless, the results of this study compare favorably with the range of removal efficiencies reported in other studies. In a handbook on the design of storm water wetlands, Schueler (1992) presents a table of removal efficiencies culled from the literature. In the studies summarized by Schueler, efficiencies for total suspended solids ranged from 20 to 98 percent, total phosphorus from -2 to 97 percent, nitrite from 4 to 95 percent, total Kjeldahl nitrogen from -10 to 40 percent, and total lead from 6 to 90 percent. Clearly, additional research into the processes that have contributed to the high removal efficiency of the Tollgate Wetlands would improve the design of these systems in other locations within the Great Lakes region. Kuehn and Moore (1995) found that the performance of treatment wetland ponds designed to be identical is fairly consistent in similar environments, thus, the Tollgate Wetlands could serve as a model for other communities in this region.

In general, several environmental benefits of stormwater wetlands are tentatively confirmed by this study. First, the study illustrates that the large volume of stormwater that enters the Tollgate Wetlands during a storm event is retained by the wetland and is slowly discharged over a period of time after the storm. Since the study period occurred during the growing season, the difference in flow into and out of the wetland may be a combined effect of storage and evapotranspiration, as well as infiltration into the groundwater system. Continuation of monitoring over several years would provide an opportunity to more fully develop a water budget for the wetlands system to examine seasonal differences.

A second benefit of the Tollgate Wetlands shown by these results is the reduction in NPS loadings as stormwater moves through the system. Mechanisms for pollutant removal in constructed wetlands include uptake by vegetation and microbes, filtration and sedimentation, sorption on vegetation and particulate matter, and transformations that remove the pollutant from the system (i.e., denitrification) (Kadlec and Knight, 1996; Schueler, 1992). Some of these processes are biological and should thus be expected to exhibit seasonal variations. For example, release of NPS pollutants when vegetation dies off and decays after the growing season has been documented in other constructed wetlands (e.g., Raisin and Mitchell, 1995). Again, seasonal variability in removal efficiencies at the Tollgate Wetlands could be described by continuous monitoring over several years. Further monitoring targeted at some of the specific processes previously mentioned would also provide a better understanding of the mechanisms responsible for pollutant removal.

CONCLUSIONS

The results of the water quality monitoring section of this project suggest that the Tollgate Wetlands may significantly improve the quality of storm water from the Tollgate Drainage District, as well as reduce the volume of water that leaves the drainage district as surface runoff. More long-term study is necessary to fully understand the temporal variability of the wetland's treatment functions and the processes responsible for pollutant removal.

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STORMWATER STRATEGIES: COMMUNITY RESPONSES TO URBAN RUNOFF POLLUTION

George Aponte Clarke

INTRODUCTION

Stormwater runoff is a serious problem for our nation's waters. Americans cannot swim in or eat fish from 40 percent of our nation's waterways, in part because of stormwater pollution (U.S. Environmental Protection Agency, 2000). Most Americans live in areas where urban runoff pollution adversely affects water quality. As urban and suburban areas expand, the problem spreads as well, impairing waters, destroying habitat, and threatening public health. The economic impacts are also significant. Even a partial accounting shows that hundreds of millions of dollars are lost each year through added government expenditures, illness, or loss of economic output (U.S. Environmental Protection Agency, 1998).

The polluted stormwater runoff problem has two main components – the increased volume and speed of runoff from impervious surfaces, and the concentration of pollutants in the runoff. Together, they cause dramatic changes in hydrology, water quality, and aquatic life (Klein, 1979; Jones and Clark, 1987; Booth, 1990; Galli, 1990). Both components are closely related to development in urban and urbanizing areas (Booth and Reinelt, 1993; Schueler, 1994; U.S. Environmental Protection Agency, 1997). When impervious cover (roads, highways, parking lots, and rooftops) reaches as little as 10 to 20 percent of the area of a watershed, ecological stress becomes clearly apparent (Klein, 1979; Booth and Reinelt, 1993; Schueler, 1994). When it rains or when snow melts, the runoff washes over these surfaces carrying harmful pollutants into receiving waters, often without any treatment.

Stormwater Strategies is now the foundation of an ongoing, comprehensive stormwater educatin and outreach effort inspiring communities to take action

The sources of stormwater pollution are diverse and often diffuse and include development, construction, non-stormwater discharges, and everyday activities such as maintaining lawns, driving cars, and walking pets. These activities contribute significantly to the mix of sediments, toxic metals, pesticides, oil, grease, nutrients, and trash that despoil our waterways. Urban stormwater is not alone in polluting the nation's waters. The environmental, aesthetic, and public health impacts of diffuse pollution will not be eliminated until urban stormwater pollution is controlled.

STRATEGIES THAT PREVENT STORMWATER POLLUTION AND SAVE MONEY

While the impacts are significant, the problems are not intractable. Increasingly, communities are taking on the challenge of stormwater pollution-and succeeding. More and more, local officials have demonstrated that strategies to prevent and control urban and suburban stormwater pollution are effective, can be economically advantageous, and can provide ancillary benefits to the community.

In a recent report entitled "Stormwater Strategies: Community Responses to Runoff Pollution"(Lehner *et al.*, 1999), the Natural Resources Defense Council (NRDC) highlights over 150 examples of environmentally effective and economically advantageous stormwater strategies in a variety of settings across the country. The report provides a unique opportunity for communities developing or improving stormwater programs to learn from the experiences of their peers. This is particularly important in light of new federal regulations which requires many small-sized to mid-sized communities to develop and implement municipal stormwater programs and protect water quality.

Stormwater Strategies identifies numerous tools and approaches already in use that control or prevent polluted stormwater runoff. It finds that reducing stormwater pollution does not have to be an overwhelming problem for communities. Stormwater Strategies shows that when motivated, communities are able to develop strong, cost-effective programs to fight this problem. Local governments, developers, community-based organizations, and citizens are implementing key strategies that address stormwater in new development and redevelopment, promote public education and participation, control construction site runoff, detect and eliminate illicit discharges, and prevent pollution in municipal operations. This article offers a taste of Stormwater Strategies by highlighting one case study in each of these categories, with an emphasis on preventing stormwater pollution.

Addressing Stormwater in New Development and Redevelopment

By far, the most important category of stormwater strategies focuses on land use and development. It encompasses a wide range of measures, including regional or watershed planning, buffers and open space preservation, infill development, conservation design, and site-specific structural and nonstructural treatment. One of the best strategies a municipality or developer can employ is to minimize the aggregate amount of new impervious surfaces. Developers of the Prairie Crossing project in Grayslake, Illinois, prevented runoff pollution and saved money by using conservation design strategies. The developers first reduced impervious cover by clustering 317 residences on only 132 acres of the site, which

left 80 percent as open space. The developers also designed the developed area around a natural drainage system consisting of vegetated swales, restored prairie, and stormwater wetlands. Modeling indicates that this stormwater "Treatment Train" system will remove approximately 85 percent of nutrients, metals, and suspended sediments and reduce peak flows by 68 percent. Furthermore, eliminating curbs and gutters saved developers $2.7 million. The development is very appealing to homebuyers, with sales comparable or better than conventional developments in the area (Lehner *et al.,* 1999: 224).

Promoting Public Education and Participation

Individuals play a key role in reducing stormwater impacts both in their own day-to-day activities and in supporting municipal programs and ordinances. The most successful programs accomplished three goals: they educated the public about the nature of the problem, they informed people about what they can do to solve the problem, and they involved citizens in hands-on activities to reduce pollution or restore waterways. One example of this success is the Urban Watch Program in Monterey, California. Trained citizen volunteers regularly monitor the city's outfalls. This provides important background information on the stormwater system, identifies sources of pollution, and helps target pollution prevention outreach efforts. For example, monitoring helped identify restaurants, a key source of grease and detergents, as an important audience for education. By using volunteers, the city saves approximately $40,000 per year in staffing costs (Lehner *et al.,* 1999:182).

Controlling Construction Site Runoff

The case studies demonstrate that preventing pollution from construction sites is politically and economically feasible and can dramatically reduce pollution. For example, Herzog *et al.* (1998) found that in Geauga County, Ohio, and St. Joseph County, Indiana, aggressive, widespread seeding and mulching of newly developed lots reduced erosion by up to 86 percent and reduced phosphorus loadings by 80 percent. They also discovered that homebuyers perceive these "green" lots to be worth $750 more than comparable lots that are not seeded or mulched ("brown" lots), more than twice the additional cost to developers of the seeding and mulching (Lehner *et al.,* 1999:236). When economic incentives are not enough, education, regular inspections, and enforcement become critical to preventing stormwater impacts from construction. The case studies also show that proper planning, a clear set of requirements, and phasing of construction activities to minimize land disturbance are critical.

Detecting and Eliminating Nonstormwater Discharges

Local governments have found that identifying and eliminating nonstormwater discharges is a simple, cost-effective way to address some of the worst stormwater pollution. One such approach is used in the Charles River Basin, Massachusetts, where nonstormwater discharges into storm sewers are a leading cause of impairment. Together, the U.S. Environmental Protection Agency, local environmental groups, and basin municipalities have been aggressively working to stop these discharges through inspections and stiff penalties.

Informing the public plays an important role, as well. Flags that indicate the quality of the river's water are a low cost way of informing the public about daily conditions and water quality trends (Lehner *et al.,* 1999:107). This helps build public support for cleaning up the river and raises awareness about behaviors that affect water quality.

Implementing Pollution Prevention for Municipal Operations

A wide range of municipal operations can affect stormwater quantity and quality. The case studies reveal that some local governments have been able to manage their municipal operations to reduce stormwater pollution. They have done so in a variety of ways, including reducing the use of harmful chemicals in the maintenance of municipal properties and vehicles, improving the maintenance and cleaning of roads and stormwater infrastructure, and training staff in pollution prevention. The Smart Salting program initiated by the Vermont Agency of Transportation is an excellent example of the relatively simply ways municipalities can save money through pollution prevention. Normally, those applying salt to roads measure temperature using a standard outdoor thermometer. However, the temperature of the roadbed is often several degrees warmer than the temperature of the air above it and may vary considerably over the area of snowfall. The Agency uses infrared sensors mounted on salt trucks to calculate more accurately the amount of salt needed to melt snow and ice. This simple approach reduces statewide salt use by 28 percent on average, resulting in approximate savings of $2.2 million annually (Lehner *et al.,* 1999:112). Overall, smart salting techniques can help keep local streams and ground water clean, and can reduce municipal expenditures including cleanup costs.

FINDINGS – THE FOUNDATION OF SUCCESS

Stormwater Strategies provides many specific examples of effective stormwater management practices. Looking at the case studies collectively, revealed several common themes among the successful programs. These themes, presented below, form a solid foundation for developing and implementing an effective program, especially since they are derived from actual programs and experiences.

Preventing pollution is highly effective and saves money. Incorporating pollution prevention activities before an activity takes place is almost always more effective and cost-effective than treating polluted water afterwards. Low-impact development, buffer zones, alternative landscaping, and "good housekeeping" practices in both urban and developing areas are key components to preventing pollution at the source.

Preserving and using natural features and processes have many benefits. Undeveloped landscapes absorb large quantities of rainfall and snowmelt; vegetation helps filter out pollutants from stormwater. Many communities and developers have found strategies that rely on natural processes to be highly effective and economically advantageous.

Educating and informing the general public and municipal staff improves program effectiveness. Providing information and training to the general public, local businesses, and municipal staff is a key component to many of the highlighted programs. Several communities involve the public in civic activities, such as monitoring water quality or stenciling storm drains, which not only provides educational opportunities, but also helps build support for programs and saves the municipalities money.

Strong incentives, routine monitoring, and consistent enforcement establish accountability. Essential components of this process are setting clear standards, creating strong incentives and disincentives, conducting routine monitoring and inspections, keeping the public informed, promoting public availability of stormwater plans and permits, and consistently enforcing laws and regulations. Strong enforcement is often key to significant water quality improvements.

Financial stability helps ensure effective programs. Effective stormwater programs are financially viable and affordable. Dedicated funding sources, such as stormwater utilities or service fees, are equitable ways to build stability into stormwater programs.

Strong leadership is often a catalyst for success. Success, at least at first, often requires an individual to champion the project and make it happen.

Effective administration is critical. Programs with clear goals and objectives are the most successful. Effective administration allows implementation of broad-based, multifaceted programs, which are often the most effective at controlling the diffuse problem of stormwater pollution.

RECOMMENDATIONS FOR LOCAL ACTION

The case studies demonstrate that following this set of nine local actions, derived from the broader themes above, will help build a strong framework for effective, efficient, and successful stormwater management over the long term. We recommend that these actions be considered in all phases and components of stormwater programs.

1. *Plan in advance and set clear goals.* Carefully plan programs as opposed to simply reacting to provided opportunities, crises, or transient pressures. Planning allows development of more effective and cost-effective actions. An essential outcome of planning is to address the issues and concerns of all stakeholders involved.

2. *Encourage and facilitate broad participation.* Program planning, development, and implementation should involve multiple levels of government, key members of the community, and professionals from a variety of related disciplines. A key to success is the public's understanding of the issue, how it relates to them, and what they can do about it.

3. *Promote public education opportunities.* Implement broad-based programs that reach a range of audiences and solicit different levels of public involvement. Remain committed to the education program and take advantage of existing community organizations to enhance participation.

4. *Work to prevent pollution first; rely on structural treatment only when necessary.* As discussed, prevention-based approaches are significantly more effective than treatment of polluted runoff.

5. *Establish and maintain accountability.* Enforcement, or more broadly accountability, is a key element to improving water quality.

6. *Secure financial resources.* Consider establishing a dedicated funding source, such as a stormwater utility.

7. *Tailor strategies to the region and setting.* Recognizing that every case will be different, consider strategies that are particularly tailored to the region, the specific audience, and the problem.

8. *Evaluate and allow for evolution of programs.* Set clear goals and priorities, and allow programs to develop over time. Establish clear ways to check and see that goals and objectives are being met. This opens opportunities for improvements and helps ensure long-term success.

9. *Recognize the importance of associated community benefits.* Stormwater pollution prevention measures usually offer ancillary quality-of-life benefits in addition to targeted improvements. For example, preserved areas offer parks, ponds offer beauty and habitat, clean streets are more attractive, education helps empower people, and sediment control improves fisheries and prevents flooding.

INSPIRATION FOR COMMUNITIES

Stormwater Strategies is now the foundation of an ongoing, comprehensive stormwater education and outreach effort inspiring communities to take action. NRDC is working with local and regional organizations to bring this information to community leaders and interested citizens. We continue to make presentations to elected and appointed government officials, members of the development community, professional organizations, citizen groups, conservation organizations, and the public-at-large throughout the country. We base the presentations on the report with an emphasis on the case studies, and tailor it to the interests and concerns of our audiences.

To date, we have distributed over 2,300 copies of Stormwater Strategies, while countless others have accessed the report through NRDC's Web site. More than 2,500 people have been reached through our presentations. We have received very positive feedback on Stormwater Strategies and the outreach presentations. People are particularly pleased with the comprehensive nature of the report and its focus on real world examples.

The number of examples, broad geographic coverage, diversity of strategies, and variety of situations addressed create a unique resource for communities and professionals. They see it as an excellent companion to existing technical documents.

The information highlighted in Stormwater Strategies is being used by state regulators and local decision makers as a guide as they develop stormwater policies and programs. It is an effective, educational tool and resource to build support for local programs. The report has also been used to help develop federal guidance documents. By continuing our outreach effort, we plan to further the transfer of this knowledge and these experiences to communities developing or improving stormwater programs and initiating watershed protection activities. By taking the steps highlighted in Stormwater Strategies, communities are making an effort to protect their water resources for the future.

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The Natural Resources Defense Council is a national not-for-profit environmental organization with a staff of scientists, policy analysts, and attorneys dedicated dedicated to protecting public health and the environment. Founded in 1970, NRDC has more than 400,000 members nationwide, served from offices in New York, Washington, Los Angeles, and San Francisco.

NRDC's stormwater outreach program provides an opportunity for local interests to learn about effective strategies that can be implemented as part of the recently published Phase II federal stormwater regulations.

For additional information or to schedule a speaking engagement contact Nancy Stoner, Clean Water Project Director, Natural Resources Defense Council, 1200 New York Ave., NW, Washington, DC 20005; (202) 289-2394; Fax: (202) 289-1060; E-mail: nstoner@nrdc.org.

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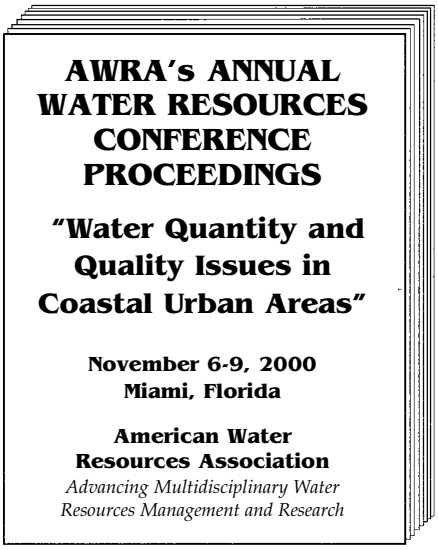

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DEMOGRAPHIC CODES

(PLEASE LIMIT YOUR CHOICE TO ONE IN EACH CATEGORY)

JOB TITLE CODES

JT1	Management (Pres., VP, Div. Head, Sect. Head, Manager, Chief Engineer)
JT2	Engineering (non-mgmt.; i.e., civil, mechanical, planning, systems designer)
JT3	Scientific (non-mgmt.; i.e., chemist, biologist, hydrologist, analyst, geologist, hydrogeologist)
JT4	Marketing/Sales (non-mgmt.)
JT5	Faculty
JT6	Student
JT7	Attorney
JT8	Retired
JT9	Computer Scientist (GIS, modeling, data mgmt., etc.)
JT10	Elected/Appointed Official
JT11	Volunteer/Interested Citizen
JT12	Non-Profit
JT13	Other _____

EMPLOYER CODES

CF	Consulting Firm	IN	Industry
EI	Educational Institution (faculty/staff)	LF	Law Firm
		FG	Federal Government
ES	Educational Institution (student)	RE	Retired
		NP	Non-Profit Organization
LR	Local/Regional Gov't. Agency	OT	Other _____
SI	State/Interstate Gov't. Agency		

WATER RESOURCES DISCIPLINE CODES

AG	Agronomy	HY	Hydrology
BI	Biology	JR	Journalism
CH	Chemistry	LA	Law
EC	Economics	LM	Limnology
ED	Education	OE	Oceanography
EG	Engineering	PH	Physics
FO	Forestry	PS	Political Science
GR	Geography	PB	Public Health
GE	Geology	SO	Soil Science
GI	Geographic Information Systems	OT	Other _____

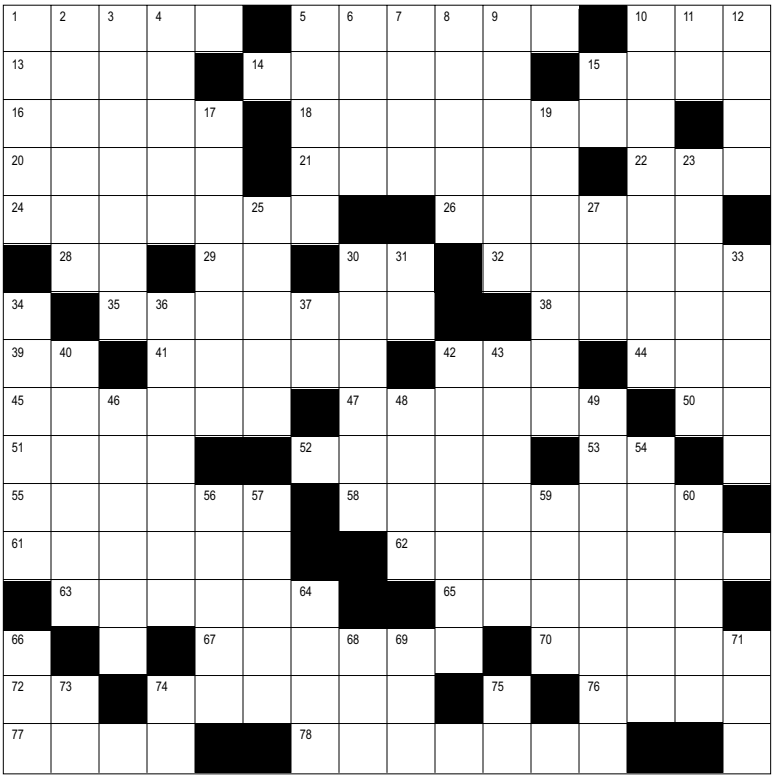
EDUCATION CODES

HS	High School	MS	Master of Science
AA	Associates	JD	Juris Doctor
BA	Bachelor of Arts	PhD	Doctorate
BS	Bachelor of Science	OT	Other _____
MA	Master of Arts		

PLEASE NOTE YOUR SELECTED CODE NUMBERS FROM ABOVE

JOB TITLE CODE ..... ☐
EMPLOYER CODE ..... ☐
WATER RESOURCES DISCIPLINE CODE ..... ☐
EDUCATION CODE ..... ☐

▲ Water Resources Puzzler (answers on pg. 24)



ACROSS
1 Missouri River tributary
5 river in Idaho
10 lake in Minnesota
13 Cape _____, Portugal
14 lake in New York
15 river in England
16 river in Oregon
18 physically painful
20 Czar of Russia
21 third person pronoun
22 location of Wabash River
24 natural abrasive process
26 type of lottery
28 day of week
29 printing space
30 location of Kankakee River
32 river in Alabama
35 river in Alaska
38 Black Sea port
39 symbol for einsteinium
41 type of pigeon?
42 river in California
44 deciduous tree
45 a visceral organ
47 fisherman
50 defensive weapon (abbr.)
51 rock layer of silica and alumina
52 prowl about
53 teen hangout? (abbr.)
55 sacred serpent figure
58 groups of information
61 farm structure
62 having importance in history
63 subjected to examination
65 dirtied
67 enthralled
70 utters a loud sound
72 location of Pearl River
74 to cause to exist
76 management school test
77 river in Kenya
78 arranged in threes

DOWN
1 starter for fruit or vine
2 Wagner or Goulet
3 sour tasting
4 nostrils
5 father of Charlemagne
6 river in Minnesota
7 goddess of the rainbow
8 type of moth
9 site of the Battle of Hastings
10 fold, spindle, or _____
11 personification of U.S. Gov't.
12 lake in Minnesota
15 not off
17 seaport in Italy
19 approachable
23 mass of interstellar dust
25 soup or plant
27 Federal Housing Admin.
30 lake in Alaska
31 location of Red River
33 capital of Jordan
34 city in Maryland
36 of little worth
37 a preposition
40 lake in Iowa
42 a boastful person
43 city on the Rio Grande River
46 defensive encampment
48 builder of the Ark
49 study of the flow of matter
54 body of running water
56 speak
57 ancient name for Aswan
59 to mix
60 Mediterranean gulf
64 used to express annoyance
66 tributary to Danube River
68 had lunch
69 followed by cent or capita
71 airport code for Midwestern city
73 sobriety group
74 location of the American River
75 location of the James River

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▲ Future Issues of IMPACT

MARCH 2001
DAVID W. MOODY, GUEST EDITOR
FAYE ANDERSON, GUEST EDITOR
INTERNATIONAL WATER RESOURCES MANAGEMENT ACTIVITIES – PART I: WHAT'S HAPPENING OUT THERE?
E-MAIL: dwmoody@aol.com / fayeand@siu.edu

MAY 2001
JEFFERSON G. EDGENS, ASSOCIATE EDITOR
FOREST ROADS
E-MAIL: jedgens@ca.uky.edu

JULY 2001
DAVID W. MOODY, GUEST EDITOR
FAYE ANDERSON, GUEST EDITOR
INTERNATIONAL WATER RESOURCES MANAGEMENT ACTIVITIES – PART II: RESPONSES TO PART I AND U.S. AGENCY PERSPECTIVES
E-MAIL: dwmoody@aol.com / fayeand@siu.edu

SEPTEMBER 2001
RICHARD H. MCCUEN, ASSOCIATE EDITOR
HISTORICAL ASPECTS OF WATER RESOURCES
E-MAIL: rhmccuen@eng.umd.edu

NOVEMBER 2001
JONATHAN JONES, ASSOCIATE EDITOR
URBAN BMPS AND RECEIVING WATER IMPACT
E-MAIL: krwright@wrightwater.com

JANUARY 2002
JIM ZOKAN, GUEST EDITOR
WATER MANAGEMENT ISSUES ON INDIAN TRIBAL LANDS
E-MAIL: jzokan@flash.net.com

If you wish to submit an article for any of the above issues, contact the Associate Editor who is working on the issue that addresses that topic.

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ASSISTANT PROFESSOR IN SATELLITE OCEANOGRAPHY

The Department of Geomatics Engineering at the University of Calgary invites applications for the position of Assistant Professor in Satellite Oceanography, effective July 1, 2001. Applicants should have a PhD in oceanography, engineering, physics, or a related field, with a demonstrated research excellence in one or more of the following areas: analysis of altimetric and other satellite observations for oceanographic modeling; satellite remote-sensing for environmental/disaster-monitoring of oceans and coastal zones, and/or ocean floor mapping; and analysis and modeling of ocean dynamics, particularly in relation to ocean-atmosphere interaction on regional and global scales.

The applicant is expected to provide leadership and vision to the remote sensing and environmental monitoring core of the undergraduate program and the development of a graduate program in satellite oceanography. The selected candidate must have the capability to teach various undergraduate courses related to remote sensing and data analysis in addition to other fundamental engineering courses such as object oriented programming. It is expected that the research will be integrated with other areas of geomatics engineering. The applicant should have the academic background required and the willingness to register as a Professional Engineer in the Province of Alberta.

The Department of Geomatics Engineering is actively involved in all aspects of geomatics engineering and comprises 18 faculty members, more than 60 graduate students, and 45 students in each year of the undergraduate program. State-of-the-art geomatics engineering equipment and computer facilities are available. Information on the program can be found at http:// www.geomatics.ucalgary.ca/.

The University of Calgary is a co-educational, non-denominational, government supported institution with a student population of about 22,000. The City of Calgary itself has a population of over 800,000 and is situated within an hour's drive of Banff National Park, one of the most beautiful parts of the Rocky Mountains.

In accordance with Canadian Immigration requirements, priority will be given to Canadian citizens and permanent residents of Canada. The University of Calgary is committed to Employment Equity.

Applications should include a detailed curriculum vitae and a complete list of publications. Three letters of reference should be sent directly by the referees to:

Head, Department of Geomatics Engineering
The University of Calgary
2500 University Drive NW
Calgary, Alberta T2N 1N4
(e-mail: marguerite@geomatics.ucalgary.ca)

Closing Date: March 31, 2001

▲ Water Resources Continuing Education Opportunities

MEETINGS, WORKSHOPS, SHORT COURSES

FEBRUARY 2001

22-23/Sixth Caribbean Islands Water Resources Congress. Mayaguez, PR. **Contact** Puerto Rico Water Resources Res. Inst., P.O. Box 9040, Mayaguez, PR 00681-9040 (787/265-3826; fax: 787/832-0119; e-m: WRRI_RUM@rumac.upr.clu.edu)

22-23/Conf. on Stormwater & Urban Water Systems Modeling. Toronto, ON, Canada. **Contact** Dr. Lyn James, CHI, 36 Stuart St. Guelph, ON, Canada N1E 4S5 (519/767-0197; fax: 519/767-2770; e-m: info@chi.on.ca; web: http://www.chi.on.ca)

MARCH 2001

11-14/American Water Works Association – Infrastructure Conf. Orlando, FL. **Contact** AWWA, 6666 W. Quincy Ave., Denver, CO 80235

14-17/Riparian Habitat & Floodplains. Sacramento, CA. **Contact** Diana Craig (707/562-8930; e-m: dcraig01@fs.fed.us; http://www.tws-west.org/riparian)

20-23/Arid West Conf. 2001. Albuquerque, NM. **Contact** Les Bond (505/682-1359; e-m: bond@wazoo.com; web: http://www.weather.nmsu.edu/nmfma/index.htm)

20-23/Small Watershed Programs: Past, Present, & Future – 7th Nat'l. Watershed Conf. Richmond, VA. **Contact** John W. Peterson, Nat'l. Watershed Coalition, 9304 Lundy Ct., Burk, VA 22015-3431 (703/455-6886; fax: 703/455-6888; e-m: jwpeterson@erols.com)

APRIL 2001

4-6/Eleventh Tennessee Water Res. Sym. Montgomery Bell State Park, Burns, TN. **Contact** Dr. John "Jack" Gordon, TTU, Civil & Environ. Engr., Prescott Hall 216, Box 5015, Cookeville, TN 38505 (931/372-3257; fax: 931/372-6352; e-m: jgordon@tntech.edu)

22-26 / IV Inter-American Dialogue on Water Management. Foz do Iguaru, Brazil. **Contact** Secretariat of Water Resources (SRH) (55-61-317-223-4760; e-m: 4dialogo@bol.com.br

30-May 2/AWRA's Spring Specialty Conf. – Water Quality Monitoring and Modeling. San Antonio, TX. Contact AWRA, 4 West Federal St., P.O. Box 1626, Middleburg, VA 20118-1626 (540/687-8390; fax: 540/687-8395; e-m: info@awra.org) (see announcement below)

MAY 2001

9-12/Lake Superior Geology – 47th Annual Institute. Madison, WI. **Contact** 47th Annual Inst. on Lake Superior Geology, c/o M.G. Mudrey, Jr., WI Geological & Natural History Survey, 3817 Mineral Pt. Rd., Madison, WI 53705 (608/263-2495; fax: 608/262-8056; e-m: mgmudrey@facstaff.wisc.edu; web: http://www.ilsgeology.org/2001mtg.html)

AWRA's Spring Specialty Conference
WATER QUALITY MONITORING AND MODELING
April 30-May 2, 2001 / The Menger Hotel / San Antonio, Texas

The need to understand the current state of water quality has never been greater. Understanding is not merely reporting a water quality observation but rather involves developing insight to explain its value. Specifically, our insight must help explain the relationships between human activities and desired water quality. A continued growth in population, coupled with increased expectations of acceptable water quality, places an ever growing demand on this need to understand. The financial ramifications associated with limited understanding are increasing dramatically. It is therefore crucially important for us to be monitoring appropriate system attributes at correct spatial and temporal scales. Our interpretation (i.e., modeling) of collected data must capture true system functionality while clearly relating management alternatives to desired water quality goals. The drive to establish Total Maximum Daily Loads (TMDLs) for over 20,000 river segments, lakes, and estuaries across the U.S. highlights our need to better understand water quality and to do so soon. The focus of this conference is freshwater quality, including both surface water and ground water. Presentations will summarize monitoring studies including both long-term and one-time synoptic field data collection efforts, along with strategies designed to support adaptive management restoration efforts. Presentations will also cover modeling efforts including all organized methods of data interpretation from statistical analysis through numerical simulation of hydrodynamics and associated water quality transformations. Finally, significant attention will also be given to the relationship between monitoring and modeling in various studies.

Watch Your Mail For Your Copy Of The Preliminary Program

SuperSaver Full Registration (due by March 19, 2001)

Mem. $380; Non-Mem. $470 / 1-Day Mem. $200; 1-Day Non-Mem. $280 / Student Mem. $70; Student Non-Mem. $90

Early Registration (due by April 18, 2001)

Mem. $410; Non-Mem. $500 / 1-Day Mem. $230; 1-Day Non-Mem. $310 / Student Mem. $90; Student Non-Mem. $110

On-Site Registration

Mem. $440; Non-Mem. $530 / 1-Day Mem. $260; 1-Day Non-Mem. $340 / Student Mem. $110; Student Non-Mem. $130

15-18 / Fourth National Conf. and Exposition of the National Hydrologic Warning Council. Columbus, OH. **Contact** Dean Bolton (614/889-7154; http://www. alertsystems.org

20-23 / Small Watershed Programs: Past, Present and Future - 7th Annual Watershed Conf. Richmond, VA. **Contact** John W. Peterson, National Watershed Coalition, 9304 Lundy court, Burke, VA 22015-3431. (703/ 455-6886; fax: 703/455-6888; e-m: jwpeterson@ erols.com)

20-24/World Water and Environmental Resources Congress. Orlando, FL. **Contact** www.asce.org/conferences/wwercongress

31-June 2/Water & Rural History. Reno, NV. **Contact** W.D. Rowley, History Dept., Univ. of NV, Reno, NV 89557 (e-m: rowley@scs.unr.edu)

JUNE 2001

3-8/Association of State Floodplain Managers – 25th Annual Conf. Charlotte, N.C. **Contact** asfpm, 2809 Fish Hatchery Rd., Ste. 204, Madison, WI 53713-3120 (608/274-0123; fax: 608/274-0696; e-m: asfpm@floods,org; http://www.floods.org)

6-8/2001 Watersheds of Change – Canadian Water Resources Assn. – 54th Annual Conf. Guelph, Ontario, Canada. **Contact** Reid Kreutzwiser, Dept. Geography, Univ. of Guelph, Guelph, ON N2L 3G1 (549/824-4120; fax: 519/837-2940; e-m: reidk@uoguelph.ca)

6-8/ECOSUD 2001 – 3rd Intern'l. Conf. – Ecosystems & Sustainable Development. Alicante, Spain. **Contact** Conf. Secretariat, http://www.wessex.ac.uk/conferences/2001/ecosud01/

10-14 / Great Lakes Science: Making it Relevant. Green Bay, WI. **Contact** (http://www.iaglu.org.conference)

10-15/5th Intern'l. Conf. – Diffuse/Nonpoint Pollution & Watershed Mgmt. Milwaukee, WI. **Contact** IWA Conf. c/o Inst. for Urban Environmental Risk Mgmt., Marquette Univ., Milwaukee, WI 53201-1881 (fax: 414/288-7521; e-m: mburkart@nstl. gov; http://www.mu.edu/environment/iwa-page.htm)

15-19 / Hands Across the Water: Linking Land, Lake and Sea - Coastal Zone 01. Cleveland, OH. **Contact** NOAA Coastal Services Center, 2234 S. Hobson Ave., Charleston, SC 29405-2413 (http://www.csc.noaa.gov/cz2001)

18-27/6th Scientific Assembly of the Intern'l. Assn. of Hydrological Sciences. Maastricht, The Netherlands. **Contact** IAHS Maastricht 2001, c/o Conf. Agency Limburg, P.O. Box 1402, 6201 BK Maastricht, The Netherlands

25-27/3rd Intern'l. Conf. – Future Groundwater Resources at Risk. Lisbon, Portugal. **Contact** L. Ribeiro, Centro De Valoizacao de Recursos Minerais DO I.S.T., I.S.T. Av. Rovisco Pais 1096, Lisboa, Codex, Portugal (351-1-841 72 47; fax: 351-1-841 74 42)

27-30/Joint AWRA/UCOWR Summer Specialty Conf. – Decision Support Systems for Water Resources Mgmt. Snowbird, UT. Contact AWRA, 4 West Federal St., P.O. Box 1626, Middleburg, VA 20118-1626 (540/687-8390; fax: 540/687-8395; e-m: info@awra.org)

27-30/Transbasin Water Transfers – U.S. Committee on Irrigation & Drainage. Denver, CO. **Contact** Larry D. Stephens (303/628-5430; fax: 303/628-5431; e-m: stephens@uscid.org)

JULY 2001

30-Aug. 2/Managing River Flows for Biodiversity: A Conf. on Science, Policy, & Conservation Action. Ft. Collins, CO. **Contact** Nicole Silk (e-m: nsilk@tnc.org; www.freshwaters.org/ccwp/conference.html)

18-27/Intern'l. Association of Hydrological Sciences – 6th Scientific Assembly. Maastricht, The Netherlands. **Contact** IAHS Maastricht 2001, c/o Conference Agency Limburg, P.O. Box 1402, 6201 BK Maastricht, The Netherlands (43 3619192; fax: +31 43 3619020; e-m: cal.conferenceagency@wxs.nl)

AUGUST 2001

5-8/AWRA International Specialty Conf. on Globalization & Water Mgmt. Dundee, Scotland. Contact AWRA, 4 West Federal St., P.O. Box 1626, Middleburg, VA 20118-1626 (540/687-8390; fax: 540/687-8395; e-m: info@awra.org)

7-10 / International Tsunami Symposium 2001. Seattle, WA. **Contact** E.N. Bernard, NOAA/PMEL, 7600 San Point Way N.E., Seattle, WA 981156349 (206/526-6800; fax: 206/526-4576; e-m: bernard@pmel. noaa.gov; http://www.pmel.noaa.gov/its2001)

27-23 / 9th National Nonpoint Source Monitoring Workshop. Indianapolis, IN. **Contact** CTIC, Nonpoint Source Workshop, 1220 Potter Dr., Ste 170, West Lafayette, IN 47906 (765/494-9555; fax: 765/494-5969; e-m: ctic@ctic.purdue.edu; http://www.ctic. purdue.edu/CTIC/NPSCall.html)

SEPTEMBER 2001

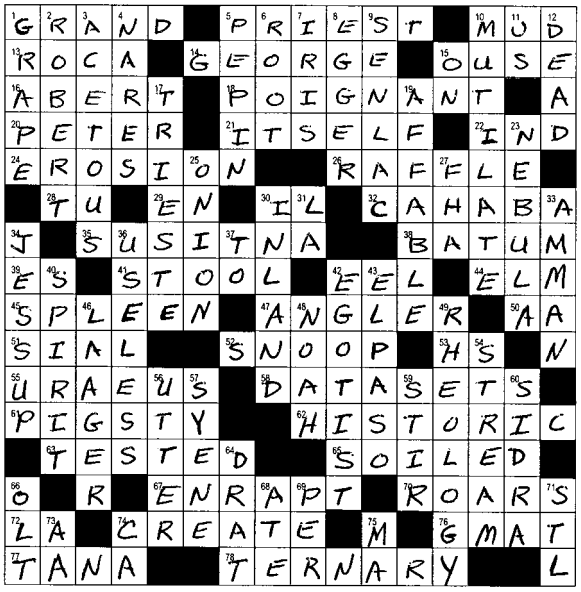
10-12/Environmental Health Risk 2001. Cardiff, Wales, UK. **Contact** Conf. Secretariat RBM 2001, Wessex Inst. of Technology, Ashurst Lodge, Ashurst, Southampton SO40 7AA, UK (http://www.wessex.ac.uk/conferences/2001/envh01/)

11-13/River Basin Mgmt. 2001. Cardiff, Wales, UK. **Contact** Conf. Secretariat RBM 2001, Wessex Inst. of Technology, Ashurst Lodge, Ashurst, Southampton, SO40 7AA, UK (http://www.wessex.ac.uk/conferences/2001/river01/)

11-14/Modflow 2001 & Other Modeling Odysseys – Internat'l. Ground Water Modeling Conf. & Workshops. Golden, CO. **Contact** Internat'l. Ground Water Modeling Ctr., 1500 Illinois St., Colorado School of Mines, Golden, CO 80401; (303/273-3103; fax: 303/384-2037; e-m: igwmc@mines.edu); submit abstract to: http://www.mines.edu/igwmc/events/modflow2001

19-21/Introductory & Advanced Workshops on USEPA, SWMM4.4 & PCSWMM GIS 2000 Stormwater

Solution to Puzzle on pg. 20



Modeling. Toronto, ON, Canada. **Contact** Dr. Lyn James, CHI, 36 Stuart St. Guelph, ON, Canada N1E 4S5 (519/767-0197; fax: 519/767-2770; e-m: info@chi.on.ca; web: http://www.chi.on.ca)

22-23/Conf. on Stormwater & Urban Water Systems Modeling. Toronto, ON, Canada. **Contact** Dr. Lyn James, CHI, 36 Stuart St. Guelph, ON, Canada N1E 4S5 (519/767-0197; fax: 519/767-2770; e-m: info@chi.on.ca; web: http://www.chi.on.ca)

24-26/Water Resources Mgmt. 2001. Halkidiki, Greece. **Contact** Conf. Secretariat WRM 2001, Wessex Inst. of Technology, Ashurst Lodge, Ashurst, Southampton, SO40 7AA, UK (http://www.wessex.ac.uk/conferences/2001/wrm01/)

NOVEMBER 2001

6-7 / The Practice of Restoring Native Ecosystems. Nebraska City, NE. **Contact** National Arbor Day Foundation, P.O. Box 81415, Lincoln, NE 68501-1415 (402/474-5655; fax: 402/474-0820; e-m: conferences@arborday.org

12-15/AWRA's Annual Water Res. Conf. Albuquerque, NM. Contact AWRA, 4 West Federal St., P.O. Box 1626, Middleburg, VA 20118-1626 (540/687-8390; fax: 540/687-8395; e-m: info@awra.org)

CALLS FOR ABSTRACTS

ASAP (Abstracts Due) – Environmental Health Risk 2001. September 10-12, 2001. Cardiff, Wales. **Contact** Conf. Secretariat RBM 2001, Wessex Inst. of Technology, Ashurst Lodge, Ashurst, Southampton, SO40 7AA, UK (http://www.wessex.ac.uk/ conferences/2001/envh01/)

ASAP (Abstracts Due) – River Basin Mgmt. 2001. September 11-13, 2001. Cardiff, Wales. **Contact** Conf. Secretariat RBM 2001, Wessex Inst. of Technology, Ashurst Lodge, Ashurst, Southampton, SO40 7AA, UK (http://www.wessex.ac.uk/conferences/2001/river01/)

FEBRUARY 16, 2001 (Abstracts Due) – The Practice of Restoring Native Ecosystems. November 6-7, 2001, Nebraska City, NE. **Contact** National Arbor Day Foundation, P.O. Box 81415, Lincoln, NE 68501-1415 (402/474-5655; fax: 402/474-0820; e-m: conferences@arborday.org

MARCH 1, 2001 (Abstracts Due) – 9th National Nonpoint Source Monitoring Workshop. August 27-23, Indianapolis, IN. **Contact** CTIC, Nonpoint Source Workshop, 1220 Potter Dr., Ste 170, West Lafayette, IN 47906 (765/494-9555; fax: 765/494-5969; e-m: ctic@ctic.purdue.edu; http://www.ctic.purdue.edu/CTIC/NPSCall.html

MARCH 15, 2001 (Abstracts Due) – AWRA International Specialty Conf. on Globalization & Water Mgmt. Dundee, Scotland. Contact AWRA, 4 West Federal St., P.O. Box 1626, Middleburg, VA 20118-1626 (540/687-8390; fax: 540/687-8395; e-m: info@awra.org) **(see announcement on pg. 25)**

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AWRA-University of Dundee
First International Specialty Conference On

GLOBALIZATION AND WATER MANAGEMENT

August 5-8, 2001 / Dundee, Scotland

This summer AWRA members will have a unique opportunity to learn about the impacts of globalization on water management activities from experts from around the world and at the same time vacation in the beautiful and historic countryside of Scotland. This event is not to be missed.

For several years the AWRA International Activities Committee has sought ways in which AWRA might become more fully engaged in water activities at the international level. As must be clear to all by now, water is widely regarded as a critical resource of the 21st century. Water experts believe that stresses on water supply will reach crisis proportions by 2025. As a result, agencies of the United Nations, the World Water Council, the Global Water Partnership, the Inter-American Water Resources Network, and a number of environmental organizations have placed water at the top of their list for action by national governments.

AWRA and its members have a wealth of expertise and experience with water management at all levels that could benefit other countries, especially those in the developing world. Similarly, there is much to be learned from the water management experiences of others, especially those of indigenous peoples. One approach to promote these kinds of exchanges is to sponsor sessions at AWRA conferences that deal with international water issues. This the Committee is committed to doing.

Another approach is to seek out international collaborators and to sponsor joint conferences with them on topics of mutual interest. This year, the Committee was very fortunate to make contact with Dr. Patricia Wouters, Director of the Water Law and Policy Program at the University of Dundee, Dundee, Scotland. Dr. Wouters is a noted scholar in the area of water law and policy and for some years has sponsored the very successfully series of Dundee Professional Training Seminars on water law and policy (www.dundee.ac.uk/cepmlp/water). This year Dr. Wouters has agreed to collaborate with AWRA by co-hosting the first AWRA International Specialty Conference on Globalization and Water Management at the University of Dundee in place of her annual program.

The goals of the conference are to discuss the impacts of globalization on water management in the early 21st century. This theme provides the basis for discussing the need for a broad interdisciplinary approach to water resources management that integrated economics, hydrology, law, and policy. Topics will cover the spectrum water management activities from the new paradigms for dispute resolution in the context of conflicts over fresh water management at national and international levels, cultural differences in valuing and pricing water, and approaches to valuing water ecosystem functions and services, trends in the management of utilities to provide water supplies and sanitation services, to practical actions and management strategies to deal with the projected stresses on water resources. The conference will be an excellent chance to present your approaches to water management to an international audience and to learn about international water issues and the management approaches promoted by colleagues from Europe, the United Kingdom, and other parts of the world who will attend the meeting.

A description of this conference would remiss if something was not said about the setting of the University of Dundee. The City of Dundee is located on the Firth of Forth estuary just a few miles from the North Sea coast. It is located just south of the Gampian Mountains and scores of beautiful highland glens, castles, country houses, ruins of churches and abbies, and Pictish monuments. Some 20 minutes to the southeast is the town of St. Andrews with its historic university (the third oldest university in the United Kingdom), cathedral ruins, and golf course. An hour to the south is Edinburgh with its famous castle and Holy Rood Palace. This is a wonderful location for an extended family vacation.

The complete "Call for Papers" will be available on line (info@awra.org) and from the AWRA Headquarters Office by February 19, 2001.

The AWRA International Activities Committee is also working to develop AWRA contributions to a variety of other meetings over the next few years. A short list of future events include:

- Stockholm Water Forum, Stockholm Sweden, August 12-15, 2001
- Fourth Inter-American Dialogue on Water Management, Foz do Iguaçu, Brazil, Sept. 2-6, 2001
* Fourth Water Information Summit, Panamá City, Republic of Panamá, October 25-27, 2001
- Third World Water Forum (World Water Council), Kyoto, Japan, March 2003
- XIth World Water Congress (IWRA), Madrid, Spain, September 2003

FUTURE AWRA MEETINGS

2001

APRIL 30-MAY 2, 2001
SPRING SPECIALTY CONFERENCE
WATER QUALITY MONITORING AND MODELING
San Antonio, Texas

JUNE 27-30, 2001
SUMMER SPECIALTY CONFERENCE
DECISION SUPPORT SYSTEMS FOR WATER RESOURCES MANAGEMENT
Snowbird, Utah

AUGUST 5-8, 2001
INTERNATIONAL SPECIALTY CONFERENCE
GLOBALIZATION AND WATER MANAGEMENT
Dundee, Scotland

NOVEMBER 12-15, 2001
AWRA's ANNUAL WATER RESOURCES CONFERENCE
Albuquerque, New Mexico

2002

NOVEMBER 4-7, 2002
AWRA's ANNUAL WATER RESOURCES CONFERENCE
Philadelphia, Pennsylvania

For additional information / info@awra.org

Send Us Your Feedback On This Issue *(comments on previous issues are also welcome) . . . Water Resources IMPACT* has been in business for two years and we have explored a lot of ideas. We hope we've raised some questions for you to contemplate. "Feedback" is your opportunity to reflect and respond. We want to give you an opportunity to let your colleagues know your opinions . . . we want to moderate a debate . . . we want to know how we're doing. Send your letters by land-mail or e-mail to Erich P. Ditschman (Associate Editor for this issue) or if you prefer, send your letters to Earl Spangenberg (Editor-In-Chief). Either way, please share your opinions and ideas. Please limit your comments to approximately 350 to 400 words. Your comments may be edited for length or space requirements.

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