

BMP Performance: *The State-of-the-Practice and Need for Continued Research*

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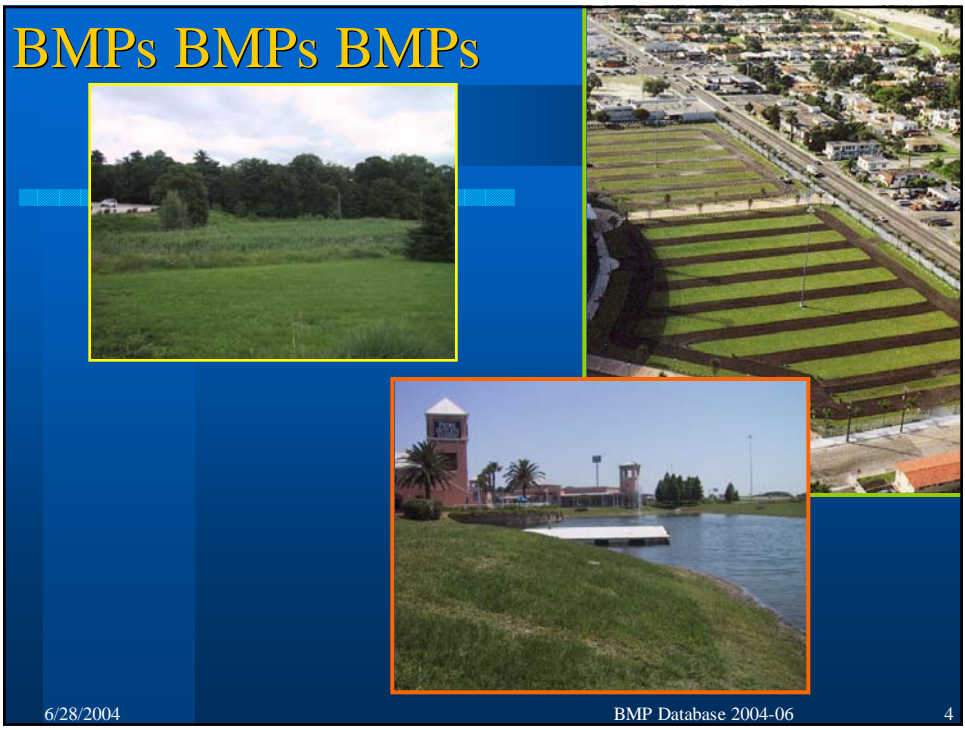
BMPs BMPs BMPs



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BMPs BMPs BMPs



Infiltration Wells



Street Sweepers



Pet Waste Ordinances

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For more information:
www.bmpdatabase.org

BMP Database Project

- **Primary Reason for its development:**
Are we using appropriate BMPs and technologies to:
 - Protect the nation's receiving waters?
 - Provide effective SWM?
 - Protect public health and welfare?
- **Database design is intended to answer such questions**
 - **Robustness of these answers** now depend on the **amount** and **quality** of data stored in the *Database*

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Project History

- **By 1990 it was clear that:**
 - Most if not all literature on BMPs and their designs, maintenance and effectiveness was based on
 - intuition
 - personal opinion, and
 - on information collected using inconsistent methods and reporting formats
 - there was no standardized guidance for:
 - scientifically sound basis in comparing “effectiveness”
 - or how to collect and manage BMP evaluation data
- **The national stormwater discharge permit program badly needed such tools**

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Project History (cont.)

- **There was a need for a centralized national, easy to use, scientifically sound products to achieve consistency such as:**
 - a set of monitoring protocols
 - a set if evaluation monitoring protocols
 - database for managing of the collected data
- **Such data would permit scientists/engineers to:**
 - Assess appropriateness of BMPs being selected
 - BMP function and design
 - Exchange design & performance information around the world under a variety of site & climate conditions

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Project History (cont.)

- In response to this need, UWRRC of the ASCE in 1994 proposed to develop these “tools”
- EPA began to fund this effort in 1995
- UWRRC set up an oversight committee
 - Involved a large number of experts throughout USA and from other countries on possible BMP evaluation methods and their data needs

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Database Project has so far Produced :

- An *International BMP Database* with performance and design data for over 200 BMP test sites (continues to grow)
A Website for this database: www.bmpdatabase.org
- Data clearinghouse with support staff
- A guidance document for the monitoring of BMPs and the collection and analysis of data
- Two data analysis reports
- New recommendations on how to compare BMPs and how to report on their performance
- Professional papers on the database and findings presented in United States, Australia and Europe

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Need for Continued Support and Enhancement of Database:

- Most of the data in *DATABASE* are for detention basins ("dry ponds"), retention ponds ("wet ponds") and wetlands (Eric will describe these)
- Little data for other types of BMPs
- Contains parametric information about each test site, the design of the BMP and the hydrologic, hydraulic and water quality data
 - All of this information permits comparisons of findings between sites throughout the world

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Need for Continued Support and Enhancement of Database (cont.):

- Does *DATABASE* have sufficient data to tell us how various BMPs function?
- The answer is a guarded "somewhat" for some BMP types, and a resounding "NO" for others.
- Much more data are needed to establish quantifiable links between BMP design parameters and their L-T performance

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Need for Continued Support and Enhancement of Database (cont.):

- **DATABASE** needs further enhancements to permit:
 - comparisons of the water quality, hydraulic and hydrologic impacts-mitigating capabilities of BMPs
 - how various BMPs work as total systems within watersheds vs. watersheds w/o BMP systems in protecting the receiving natural systems
- **Need to add fields to enter and track Low Impact Development (LID) type of systems**

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Need for Continued Support and Enhancement of Database (cont.):

- **Much more data are needed to allow objective scientific evaluation of runoff volume control practices**
 - *DATABASE* has shown that some BMPs appear to reduce surface runoff volumes
 - Need to expand data **ten-fold or more** to reliably quantify these findings under a variety of meteorological conditions throughout the United States
 - **These types of data are particularly needed to have reliable hydrologic modeling of watersheds (e.g., TMDL studies, impact assessments, system designs)**

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Need for Continued Support and Enhancement of Database (cont.):

- There are efforts to incorporate algorithms into computer hydrologic models to assess multiples of source control and other types of BMPs
 - **Without good data for calibration**, reliability of model-generated results are always in question
 - **Billions of dollars nationwide** are at stake if the management decisions are not supported by science
 - In complex urban systems we need to know when “diminishing return” are reached and waste of resources begins

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Need for Continued Support and Enhancement of Database (cont.):

- **The challenge now facing the profession is the continued existence of the *DATABASE* and its support of:**
 - research and technology development
 - improved analysis and design technologies
- **U.S. EPA contributed significant sums of money to develop the *DATABASE* and its interpretations and continues to provide some funds**
- **However, funding was lacking for about 1 year.**
- **Recently received funding from a coalition: EPA, FHWA, APWA, WERF, and Caltrans.**

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Need for Continued Support and Enhancement of Database (cont.):

- U.S.EPA's challenge to the profession and users is:
 - Develop a Permanent Funding Program Outside of the Federal Budget to:
 - sustain the *DATABASE*, and
 - insure its availability and growth
- Current and future research and development depends on the existence of the *DATABASE* and its continued growth

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Data Needed for BMPs that Reduce Runoff Volumes

- Receiving waters "see" huge increases in:
 - numbers of runoff events,
 - runoff flow rates
 - runoff volumes
- These increases change the geomorphology of streams and modify aquatic habitats
- We need much data on BMPs and their systems that manage or mitigate stormwater runoff
 - Flows rates
 - Volumes

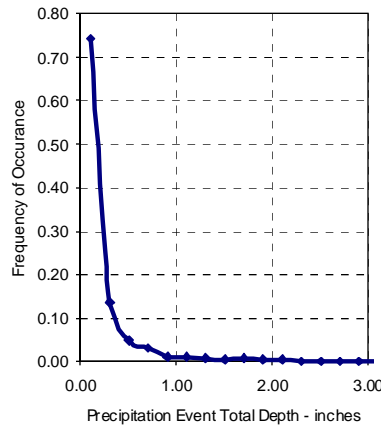
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Data Needed for BMPs that Reduce Runoff Volumes (cont.)

- **Increases in Numbers of Runoff Events :**
 - overwhelming number of runoff events in United States result from storms with depths less than 1/2 to 3/4"
 - Chart shows storm distribution in Denver, Colorado



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Data Needed for BMPs that Reduce Runoff Volumes (cont.)

Stream Bed Degradation Resulting for u/s Urbanization



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Data Needed for BMPs that Reduce Runoff Volumes (cont.)

- Data are needed to quantify for us:
 - Which BMPs best mitigate changes in runoff
 - How these BMPs perform/degrade with time
 - What maintenance will they need
 - How they may affect groundwater quality
- These are very important and critical questions if we expect to effectively protect our urban receiving waters

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Computer Model Calibration Needs

Ranges in Modeling Errors for Two “Blind Test Sites” in USA

Monitoring Site	Simulation Model	Percent Range in Errors			
		Peak Flows		Volumes	
Denver – Harvard Gulch	CUHP/SWM	-38	+11	-18	+63
	CUHP	-15	+43	-44	+52
	DR3M	-41	+6	-13	+120
	HEC	+40	+260	3.5	+190
	HSPF	-52	+1	-30	+26
	PSRM	-84	-12	-81	+24
	EPA-SWMM	-10	+83	-14	+81
	TR20	-100	-64	-100	-57

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Computer Model Calibration Needs

Ranges in Modeling Errors for Two “Blind Test Sites” in USA

Monitoring Site	Simulation Model	Percent Range in Errors			
		Peak Flows		Volumes	
<u>Seattle – Surrey Downs</u>	CUHP/SWM	n/a	n/a	n/a	n/a
	CUHP	-26	+68	-32	+97
	DR3M	-23	+62	-20	+20
	HEC	26	+200	-54	+240
	HSPF	-64	+60	-63	+28
	PSRM	-67	-16	-59	+58
	EPA-SWMM	+4	+100	-32	+97
	TR20	-100	+86	-100	+69

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Next Major Follow-up Effort

**Linking BMP Types
and Designs to**

**Their Ability to Mitigate
Receiving Water Impacts**

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Next Major Follow-up Effort (cont.)

- The goal is to clearly identify and quantify the processes at work, namely,:
- physical
 - hydrologic, geomorphic, stream power, sedimentation, erosion, etc.
- chemical
 - toxicity, oxygen availability, etc.
- biologic
 - numbers and types of species of flora and fauna, habitat, eutrophication, etc.
- **Also, we need to know what is achievable with BMPs!!!**

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Next Major Follow-up Effort (cont.)

- **To be scientifically defensible/credible, this effort needs to:**
 - Involve broad technical expertise and disciplines
 - Postulate areas of knowledge and lack thereof
 - Examine current thinking on these phenomena
 - Develop a consistent protocol for data/information development and acquisition
 - Launch a nationwide data acquisition effort
 - Scientifically analyze and quantify the findings
 - Develop technically defensible and useable tools

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Summary

- The universal use of structural BMPs (i.e., treatment facilities) will expend huge amounts of resources in United States
- Unless the chosen BMPs provide a realistic level of protection for receiving waters, their use will be a major waste of investment
- Thus, further enhancements to the existing DATABASE and its growth are needed to provide information for wiser decisions

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Summary (cont.)

- A nationwide research effort is needed to quantify the linkages between systems of stormwater BMPs and their ability to mitigate the impacts of urbanization
 - Until that is accomplished we will have to do the best we can and base our SWM decisions on the information available today

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