

WERF Conveyance System Research

On July 1, 2009, WERF began an open access policy for research reports which are more than two years old. These reports are free to the public as downloads from the [WERF Web site](#). Projects funded by U.S. EPA under the Decentralized Research grant are also free to the public. These open access reports are marked in **blue** or **green** for Decentralized Research in the chart below.

Publication Year	Project Number and Project Title	Principal Investigator and Contracting Organization	Research Objectives
1994	92-TCR-2 <i>Optimization of Vortex Separator Removal Efficiencies for CSO Treatment</i>	Mark C. Boner, P.E. WWETCO, LLC	This study covers preliminary findings and investigates the degree of contaminant removal achievable through the modification of vortex combined sewer overflow (CSO) control devices. This research specifically uses dissolved air flotation, UV disinfection and/or chemical addition
1994	92-BAR-1 <i>Time-Scale Effects of Chemically Toxic Events in Freshwater and/or Marine Ecosystems</i>	Edwin Herricks, Ph.D. Univ. of Illinois at Urbana/Champaign Simon Ashley, Ph.D. D&B/Guarino Engineers, LLC	This new WERF report presents conclusions that are critically important when addressing wet weather discharge impact assessment. It also provides a tiered protocol for assessing the effects of wet weather events on receiving water ecosystems, reviews literature and evaluates available tests for wet weather discharge impact assessment, modifies standard tests to produce complementary tests appropriate for time-scale toxicity assessment, provides a predictive tool for wet weather impact assessment, and addresses variability of exposure during wet weather events
1998	96-IRM-1 <i>Wet Weather Flow Management: A Research Needs Survey for Urban Areas</i>	Dr. James Heaney University of Colorado	This WERF report identifies information gaps and defines further research projects to fill those gaps. Provides a detailed introduction into major topic areas and includes a literature review/statement of the problem, research needs in the area, and key references. Twenty-six research topics are organized into 10 categories such as: sources and monitoring; receiving water impacts; management; models and decision support systems; regulatory policies and financial aspects; and storage treatment systems.
1998	92-BAR-1 <i>Framework for Assessing Time-scale Effects of Wet Weather</i>		
1999	97-CTS-6 <i>Benchmarking Decision Criteria for Urban Wet Weather Abatement</i>	Peter E. Moffa, P.E., DEE Brown and Caldwell	This report presents the most current federal combined sewer overflow, sanitary sewer overflow, and stormwater policies. Communities will benefit from essential criteria presented as guidance for wet weather pollution abatement and from cost-benefit analysis procedures. Reviews a history of wet weather pollution management control strategies
1999	97-CTS-8 <i>Using Flow Prediction Technologies to Control Sanitary Sewer Overflows</i>	Reggie Rowe CH2M HILL	This report provides wastewater utility managers and consultants with tools to appropriate rainfall-derived infiltration and inflow (RDII) flow projection methodologies to help control sanitary sewer overflows and wet weather in general. Criteria needed to the appropriate RDII analysis method are examined. The report contains case studies from three diverse metropolitan areas with a spectrum of available data and RDII composition to assess the applicability of various methods across the country

2000	97-CTS-3 <i>New Pipes for Old: A Study of Recent Advances in Sewer Pipe Materials and Technology</i>	James C. Thomson, P.E. Jason Consultants LLC, Inc.	This report identifies and evaluates new and alternative materials and techniques used in sewer systems and considers design developments and implications that have arisen from these new materials and methods
2001	95-WWR-1a <i>Wet Weather Flow Assessment Protocols</i>	Peter E. Moffa, P.E., DEE Brown and Caldwell	This final report presents methods for characterizing nonpoint and point sources of wet weather flows (WWFs), assessing effects of WWF-induced pollution on receiving water systems, and evaluating WWF control practices and treatment technologies. This work was based on the fact that many water quality and ecosystem problems are best solved at the watershed level than at the individual waterbody or discharger level, and ideally a framework investigation should be completed for the entire watershed before details of individual pollution sources or waterbodies are addressed.
2001	98-WSM-2 <i>Tools to Measure Source Control Program Effectiveness</i>	Betsy Elzufon Larry Walker Associates	Provides information on effectiveness measurement for stormwater and wastewater pollution prevention and public education projects. Includes cost information to implement pollution prevention programs and to measure program effectiveness. Factors and participation rates can be used to identify control strategies and plan programs. A process/framework for developing an effective pollution prevention or source control program is described.
2002	00-CTS-6 <i>Best Practices for the Treatment of Wet Weather Flows</i>	Robert W. Brashear Parsons Brinckerhoff	This report reviews available technologies to improve performance and efficiency of wet weather wastewater treatment and identifies potentially beneficial technologies and methodologies that are emerging. It assesses vortex separation, enhanced clarification, operational enhancements, flushing system, and disinfection technologies. It includes operation and maintenance requirements and cost for each. The information presented will help stormwater owners and operators choose the most appropriate, cost-effective technologies for their treatment plants.
2003	98-WWR-1P <i>Peer Review: Wet Weather Demonstration Project in Columbus, Georgia</i>	Bill Turner North Little Rock Wastewater Utility	Includes information on transferable, cost-effective protocols, performance and design relationships, and operating strategies that can be adapted by other water agencies for the planning and design of combined sewer overflow control facilities. One described approach for removing wet weather contaminants and disinfecting bacteria and other pathogens can be built at half the cost and one-tenth the footprint of conventional primary clarification and disinfection systems. The potential national cost savings could approach \$20 billion.
2003	99-WWF-8 <i>Reducing Peak Rainfall-Derived Infiltration/Inflow Rates: Case Studies and Protocols</i>	M. Steve Merrill, Ph.D., P.E. Brown and Caldwell	This report is a useful reference for water professionals who want to know the most effective ways to remove rainfall derived infiltration and inflow (RDII) from their systems. The project team conducted a literature review, analyzed 12 RDII reduction projects □ both successful and unsuccessful ones □ and compared the cost-effectiveness of each.
2003	02-CTS-7P <i>Protocols to Assess the Breakdown of Flushable Consumer Products</i>	Drew C. McAvoy, Ph.D. Procter & Gamble Company	This report outlines an approach and provides guidance on test methods that can be used to assess the flushability of consumer products. In this peer review project, WERF evaluated Procter & Gamble's overall approach, methodologies, and quality assurance procedures. Revised protocols and improved flushability standards will aid the wastewater industry by helping to ensure flushables will break down as they move through treatment systems

2003	01-CTS-20T <i>Effective Practices for Sanitary Sewer and Collection System Operation and Maintenance (Tool)</i>	Richard E. Nelson Black & Veatch	Provides users with a toolkit of effective practices for the operation and maintenance, management, and capacity assurance of sanitary sewer collection systems. The toolkit will assist utilities in developing, enhancing, and implementing programs to improve their effectiveness and efficiency
2004	97-CTS-7 <i>Development of Predictive Tools for Measuring Sewer Degradation (SCRAPS)</i>	M. Steve Merrill, Ph.D., P.E. Brown and Caldwell	This software tool helps users identify pipelines at risk of structural and operational failure. Called SCRAPS (Sewer Cataloging, Retrieval, and Prioritization System), the tool lets small- to medium-sized wastewater utilities estimate the probability and consequence of pipe failure. SCRAPS is based on a Bayesian Belief Network using conditional probabilities to estimate the risk of failure due to structural or operational mechanisms. It incorporates regional priorities and varied experiences in the development of its knowledge base.
2004	01-CTS-7 <i>An Examination of Innovative Methods Used in the Inspection of Wastewater Systems</i>	James C. Thomson, P.E. Jason Consultants LLC, Inc.	High-quality investigation and diagnosis is fundamental to the decision-making process and to the development of effective strategies for rehabilitation and replacement of our wastewater systems. This report provides a comprehensive review of the current state of the art of investigation technology for both gravity and force mains. It also reviews data management and interrogation, and a structured approach to investigation of gravity and pressure pipe is suggested. Additionally, this report includes detailed reviews of nine current technologies, providing the information utilities need to determine which technology will serve them best.
2004	01-CTS-21T <i>Post-Project Monitoring of BMPs/SUDS to Determine Performance and Whole Life Costs</i>	Les K. Lampe, Ph.D., P.E. Black & Veatch Corporation	Provides guidance to utilities on long-term maintenance and whole-life costs of Best Management Practices (BMPs) and Sustainable Urban Drainage Systems (SUDS). This report, phase 1 of a two-part project, includes a literature review and a survey of stormwater organizations in the U.S. and U.K. to identify the most commonly used BMPs and SUDS and to determine the availability of data on their cost and performance. Includes protocols for determining whole-life costs and performance data for BMPs and SUDS. In phase 2, selected BMPs and SUDS were monitored to test pollutant removal and hydrologic/hydraulic efficiency.
2004	01-CTS-21TA <i>Performance and Whole Life Costs of BMP and Sustainable Urban Drainage Systems (SUDS)</i>	Les K. Lampe, Ph.D., P.E. Black & Veatch Corporation	Documents the performance and whole life costs of Best Management Practices (BMPs) and Sustainable Urban Drainage Systems (SUDS). This second phase of the project identified preferred designs for a wide range of settings, as well as improved design procedures for more effective maintenance. The report documents maintenance costs from across the U.S. and UK, which allows planners to estimate future outlays and develop a funding system for sustaining ongoing maintenance requirements. Hydraulic modeling conducted through the project demonstrates the benefits of BMPs/SUDS in comparison to traditional drainage systems and may help promote their adoption in new developments
2005	00-HHE-6 <i>Identifying Technologies and Communicating the Benefits and Risks of Disinfecting Wet Weather Flows</i>	Peter E. Moffa (x), P.E., DEE Brown and Caldwell	The primary objective of this project was to identify and communicate the benefits and risks of disinfecting wet weather flows by evaluating the effectiveness of available disinfection technologies and identifying disinfection by-products and their potential risks to aquatic and human life. A decision-making framework was developed that could be used as a model to guide combined sewer overflow, sanitary sewer overflow, and stormwater disinfection control policies. The project also provided a summary of a disinfection demonstration test plan, which subscribers can use to design their own disinfection demonstrations, as it may be necessary for municipalities to perform site-specific disinfection demonstrations to fill data gaps and develop and implement a risk communication plan

2006	02-CTS-5 <i>Methods for Cost-Effective Rehabilitation of Private Lateral Sewers</i>	Raymond L. Sterling, Ph.D., P.E Louisiana Tech University	This report provides a road map to the assessment, analysis, program development, method selection and legal and financial implementation that will make it an easier task to decide how to implement lateral rehabilitation within an overall wastewater system rehabilitation strategy. It is intended to provide a clear understanding of problems and relevant issues, and explain available options for inspection, evaluation and repair of sewer laterals, and address the financing and legal issues that affect how the work can be carried out. With this understanding, it is hoped that directors of public works agencies, city engineers, general managers, planners, financial managers, etc. will be able to formulate a sound course of action of how to manage problems with sewer laterals in their community.
2007	02CTS5a <i>Case Studies: Methods for Cost-Effective Rehabilitation of Private Lateral Sewers</i>	Timothy Schmitt Limno-Tech, Inc.	Taken from WERF report 02-CTS-5, Methods for Cost-Effective Rehabilitation of Private Lateral Sewers, these select case studies provide examples of how public works agencies made decisions regarding inspection and rehabilitation of the private lateral portions of their wastewater conveyance system, and include detailed information on how these projects were carried out. Some case studies also cover how the agencies quantified I/I and the effectiveness of its removal; costs and financing issues; and how the agencies handled public relations and legal issues
2007	04CTS6UR <i>Inspection Guidelines for Ferrous Force Mains</i>	James C. Thomson, P.E. Jason Consultants LLC, Inc.	This report includes a rational and practical set of inspection guidelines, i.e., best management practices, for ferrous force mains which can be implemented by wastewater utilities in their condition assessment programs. The report includes: 1) A compilation of identified needs in terms of ferrous pipeline investigation from a national survey of wastewater utilities, 2) a review on ferrous pipelines of the modes of failure and the reasons, with related cost information, 3) a review of ferrous pressure pipe investigation technologies, and 4) a provisional set of guidelines for investigating ferrous force mains to be implemented during forthcoming fields trials
2007	04CTS1 <i>Minimization of Odors and Corrosion in Collection Systems, Phase 1</i>	Dirk Apgar King County Department of Natural Resources and Parks	This report summarize the current knowledge of odor and corrosion in collection systems pulled from a literature survey of over 4,000 published abstracts and gray literature sources supplied by utilities, manufacturers, and vendors in an effort to better explain the science underlying odor generation, sewer ventilation, odor characterization and monitoring, and corrosion mechanisms. A "plain-English" overview of odor and corrosion in collection systems, including how odor- and corrosion-causing compounds are formed and what to do to control them, is presented. The report provides an overview of odor- and corrosion-causing compounds and combines expertise regarding utility and asset management, affordability, regulatory and permitting, public outreach, characterization, assessment and measurement, and system planning, design, odor and corrosion abatement, and operation and maintenance.

2007	04-DEC-12SG <i>Pennsylvania Standards for Residential Site Development</i>	Scott A. Brown The Pennsylvania Housing Research Center	The State of Pennsylvania has been a leader in the promotion of decentralized stormwater management. Stormwater guidance is provided at the state level by the Pennsylvania Department of Environmental Protection (PADEP), but stormwater controls are implementation at the local level. This regulatory model is common to most if not all states in the Country. This manual is part of a broader effort by PADEP to develop a stormwater management program within the state that will change and improve the way stormwater is managed. The manual advocates a comprehensive approach to stormwater management which promotes sustainable, low-impact development ¹ through decentralization of stormwater facilities and the integration of both natural and structural controls.
2008	04CTS10S <i>Integrated GIS-Based Consequence Assessment Model for Sewer and Stormwater</i>	Rakesh B. Bahadur, Ph.D. SAIC (Science Applications International Corporation)	The “Integrated GIS-Based Consequence Assessment Model for Sewer and Stormwater” application, called SewerNet, helps to address the security needs of the wastewater community. The application will enable utility officials to make more informed decisions that will help them manage and mitigate the impacts of hazardous releases within the water supply and wastewater collection infrastructure.
2008	03CTS16Ta <i>Assessment of Grease Interceptor Performance</i>	Joel J. Ducoste, Ph.D. North Carolina State University	This report will help control FOG problems in both centralized and decentralized systems. It evaluates field grease interceptors through their separation and cleaning cycles, and provides design, sizing, and operations & maintenance criteria.
2008	03CTS16Tb <i>FOG Interceptor Design and Guidance Manual</i>	Joel J. Ducoste, Ph.D. North Carolina State University	This report outlines recommendations for sizing and configuration of grease interceptors and provides an alternative approach for sizing GIs in food service establishments. It includes a grease interceptor size calculator (Microsoft Excel® spreadsheet) to compute flows and FOG loading for specific types of food service establishments.
2008	03CTS16T <i>Fats, Roots, Oils and Grease in Centralized and Decentralized Systems</i>	Joel J. Ducoste, Ph.D. North Carolina State University	This research quantifies the chemical and physical characteristics of fats, oils, and grease deposits. It assesses the performance of root control methods in a pilot-scale sewer collection system.
2008	04-DEC-11SG <i>Low Impact Development project</i>	Curtis Hinman Washington State University	An extensive body of indicates that conventional land development and stormwater management practices are inadequate to protect streams, wetlands, and other aquatic resources. The transition from a forested landscape to a built environment increases impervious surfaces from roads, parking areas, sidewalk, rooftops, and compacted soils. Native vegetation and the upper soil layers that evaporate, transpire, store or infiltrate stormwater are typically removed. Water quality is impaired as stormwater flowing from impervious surfaces collect and convey pollutants to receiving waters. Low impact development is an emerging practice to maintain imperviousness after development.

¹ An approach to land development that uses various design and impact mitigation practices to conserve and protect natural resource system while reducing infrastructure costs.

2009	03CTS21UR <i>Contributions of Household Chemicals to Sewage and their Relevance to Municipal Wastewater Systems and the Environment</i>	Jorg E. Drewes, Ph.D. Colorado School of Mines	This study identified organic compounds from household products that may be present in municipal wastewater. Researchers selected the compounds by examining volume production, consumption pattern, and physicochemical properties. They also considered occurrence and fate of selected HPV target compounds through conventional and advanced wastewater treatment unit operations. The researchers developed quantitative structure activity and property relationships (QSPR) that can model the behavior of individual compounds through treatment processes. The report includes a database of HPV chemicals and organic compounds found in household commodities.
2009	03-SW-3 <i>Decentralized Stormwater Controls for Urban Retrofit and CSO Reduction</i>	Neil Weinstein The Low Impact Development Center, Inc.	This report synthesized the results of a research initiative commissioned by WERF. Its purpose is to help define the current state of decentralized source controls for capturing rainwater where it falls and to present a plan for implementation of decentralized controls in an urban environment specifically for the goal of CSO mitigation. The primary focus of the applied research was how decentralized controls can reduce the volume of rainwater runoff generated and, consequently, entering the combined sewer system in urban areas.
Ongoing	U2R08 <i>Methane Evolution from Wastewater Treatment & Conveyance</i>	John L. Willis, P.E. Brown and Caldwell	The evolution of methane (CH ₄) from wastewater conveyance, treatment and sludge/biosolids handling may represent a significant contribution to the carbon footprint of a wastewater utility. This study quantifies the evolution of CH ₄ from three specific sources 1) Collection systems as measured at pumping stations and plant headworks 2) Digester-gas-using equipment, and 3) Treatment of wastewater or sludge/biosolids in ponds or lagoons. Determination of these emissions will either confirm that they are not important greenhouse gas sources or indicate that they are or may be and encourage future research that would identify options to remediate identified sources. The characterization of incomplete combustion by digester gas flares and modeling of fugitive CH ₄ emissions from plant force mains was added to the original project.

Information current as of November 2009