Barriers to Harvesting Stormwater

Workshop Report

PRESENTED BY

National Water Research Institute

IN COOPERATION WITH

L.A. County Department of Public Works
County of Orange Public Facilities & Resources Department
Southern California Coastal Water Project
American Oceans Campaign

Kellogg West Conference Center & Lodge
California State Polytechnic University
3801 West Temple Avenue
Pomona, CA 91768

September 22-24, 1997

FOREWORD

This report presents the results of the 10th Nominal Group Technique (NGT) Workshop the National Water Research Institute (NWRI) has conducted since 1992. The NGT workshop process was identified by the NWRI as an ideal means to enable a group of multi-disciplinary experts, reflecting a variety of viewpoints, to identify and reach consensus on how to approach, and subsequently resolve, key issues. Examining the many issues or barriers associated with harvesting stormwaters as an additional component of our nation's water supply was a formidable challenge.

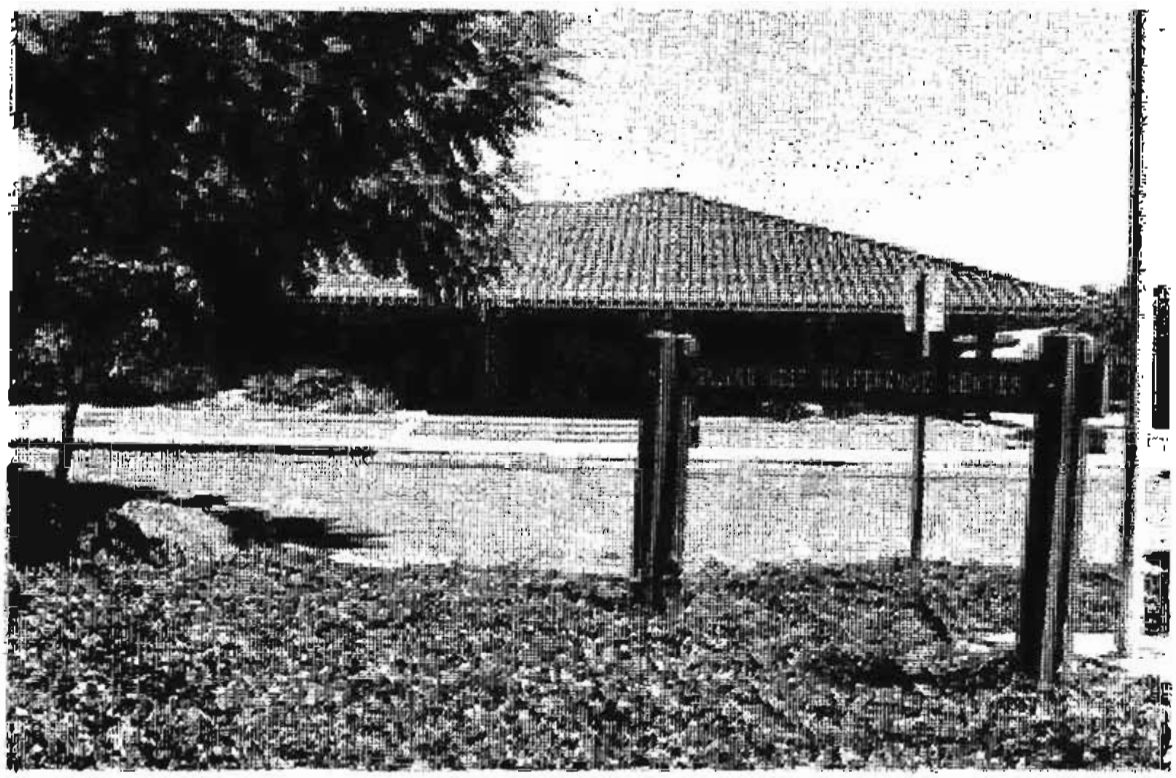
Every child learns during their early school experience that rain is a component of the hydrologic cycle. Diagrams, pictures, graphs, and crossword puzzles prompt a realization that water molecules evaporate at the surface of the global seas; rise into the atmosphere where droplets are formed and aggregate into clouds, which are then pushed by winds across the globe, and finally fall back as rain either into the sea or onto the land. Droplets that fall onto the land accumulate and pass over the surface as rivers or streams or seep into the earth to become precious subsurface supplies, called groundwater. These droplets also find their way into and out of living plants and animals.

This simple story is told only to remind the reader that rain water is a paradox. Sometimes, it is seen as the principle source of our water supply, vital to sustain life's activities, or it can be perceived as a threatening flood problem that terminates life's activities. For too long, stormwaters have been thought of as a nuisance, something to get rid of, like waste, as fast and harmlessly as possible. The design of curbs and gutters, storm drains, and channels to carry the flow to the sea or to larger water courses reflects this perception. Why not rethink this perspective and look to stormwaters as a viable source of our useable water supply?

This workshop was designed to identify the barriers inhibiting the acceptance of stormwater as a viable component of the water supply. As you will see in this report, the barriers that were identified range from technical issues, such as the capability to harvest stormwaters, to consumer acceptance; from environmental impacts to institutional and regulatory limitations.

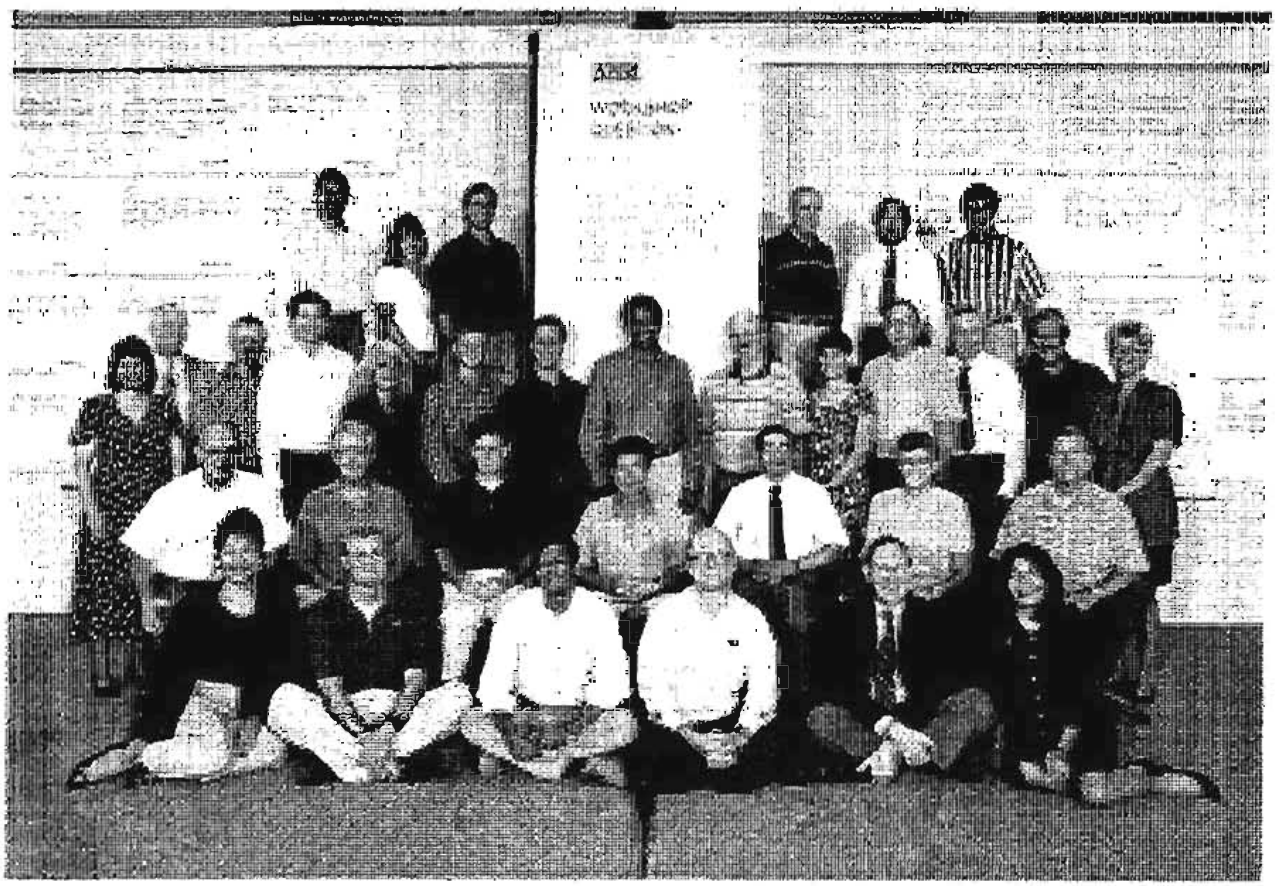
NWRI is very pleased that the workshop was so successful in producing a useful report. This document presents the insightful, creative, and forthright contributions of each participant and presents their thoughts and recommendations in a concise and readable form.

RONALD B. LINSKY
Executive Director
National Water Research Institute
Workshop Secretary



CONTENTS

PARTICIPANTS

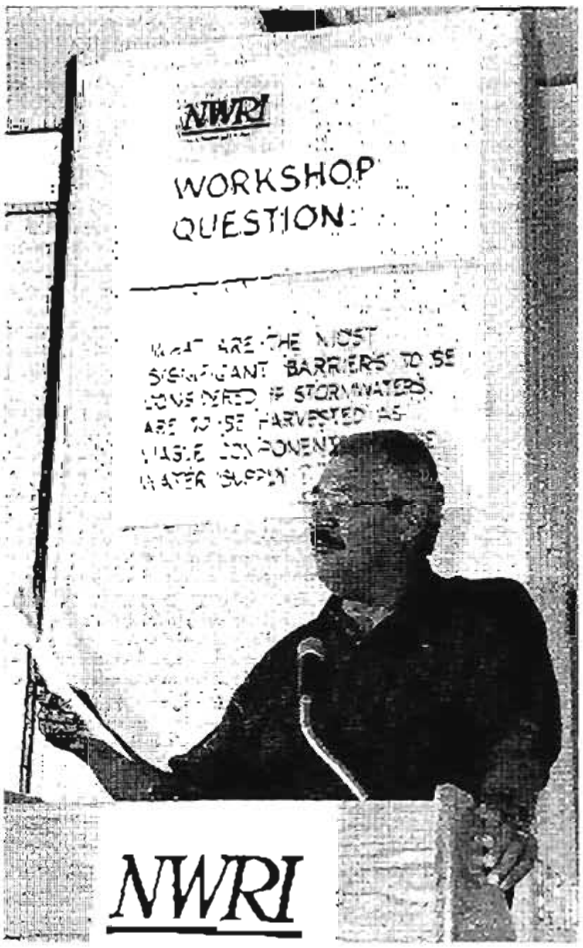


Top Row: Mike Drennan, Rachel Noble, Ken Schiff, Doug Harrison, Randal Orton, Scott Tucker

Standing: Linda Baird (Word Processor), Ron Linsky (Secretary), Don Schroeder, Scott Taylor, Ginny Lackner, Ted Morton, Steve Weisberg, Jag Salgaonkar, Dick Watson, Shari Goodwin, Glen Birdzell, Joe Pezely (Graphics), Jim Noyes, Patricia Linsky (Editor)

Seated: Bob Carnahan, Dennis Kasper, Bob Collacott, Bruce Moore, Tamim Younos, Dorothy Green, Kris Lindstrom

Floor: Bobbie Jo Gibbs (Word Processor), Mike McGowan (Graphics Assistant), Xavier Swamikannu, Mike Strenstrom, Bill Gaither (Chair), Lucy Segura (Meeting Coordinator and Lead Word Processor)


NWRI
WORKSHOP
QUESTION:
NWRI

PART 1

Working Groups' Reports


NWRI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INTRODUCTION

These summary descriptions of priority barriers to harvesting stormwater were prepared by small working groups of participants. Each of the ten descriptions represents the first step in consolidating and refining the highest priority major barrier areas originated by the participants in the NGT Workshop described in Part 2 of this report. The final section of each barrier description lists individuals who the working group recommends be invited to become Task Force members when and if the process of developing action plans to overcome these barriers moves forward. Also, after each summary description are comments by other participants. Finally, after the comments are copies of the viewgraphs used by the working group in presenting its report to the other participants.

SHARI
GOODWIN

BRUCE
MOORE

PRIORITY 1

Capability to Capture, Store, Treat, and Use Stormwater for Designated End Uses While Maintaining Essential System Hydrology, Hydraulics, and Services

WORKING GROUP MEMBERS:

Goodwin, Harrison, and Moore

Barrier Description:

The decision to incorporate stormwater into a communities' planned water supply impacts two significant infrastructure systems:

- Stormwater systems are major structural systems typically designed and constructed to provide a specified level of storm drainage service or flood protection. The use of stormwater for water supply purposes requires (1) imposing a secondary use on existing systems, and/or (2) a supplementing retrofit of existing systems, and (3) revised planning and design for as yet unconstructed systems.

  Stormwater functions are substantially inconsistent with water supply functions, requiring the rapid collection and disposal of water at the same time the water supply function would require additional diversions, storage, transport, and treatment of such flows.

- Water supply systems typically provide for fixed storage and conveyance capacities designed for relatively consistent quantity and quality of the influent supply. The addition of stormwater as a supply source (1) impacts overall source water quality; (2) requires storage for peak inflows; and, (3) causes variability in influent timing, rates, volumes and quality, resulting from stormwaters' episodic character.

  The opportunity to successfully incorporate stormwater into a water supply regime is heavily influenced by several site-specific factors. These include:

  - existing water supply sources
  - topography
  - climate
  - soil conditions; aquifer viability

- land availability
- local economic conditions
- local environmental conditions and objectives
- status and quality of existing source water supplies, as well as stormwater and water supply systems infrastructure
- local political priorities

The impacts on a community of deciding to incorporate stormwater into the water supply regime include the following:

- Dislocation and disruption of people, current land uses, and community infrastructure.

- Changes in land use character, plans, and policies.

- Major cost for construction/modification of capital facilities, relocation, and operation and maintenance.

How to Overcome the Barrier:

To address this barrier, the use of a four-step process is suggested. The resolution of scientific/technical issues will lead the effort. First, integrated engineering studies must be initiated including the development of a feasibility analysis, and the review of existing land use plans to ensure a balance between public water system needs and a sustainable ecosystem. At this level, the end use of the stormwater harvest should be determined. The stormwater collection, storage, and treatment requirements should be considered. In addition, anticipated public water supply system operation and maintenance modifications should be addressed.

Second, political concerns must be addressed. At this point, community acceptance of the project must be gained. This may be accomplished through public education and outreach activities.

The third step also involves political issues. Now, new land use and utility plans must be adopted which include stormwater as part of the public water supply.

Finally, economic issues must be resolved. A publicly-approved and endorsed funding/implementation mechanism must be in place prior to any change to the existing public water supply system. To accomplish this, local ordinances may need to be modified. Legal authority must be clearly established.

Recommended Task Group Membership:

- Doug Harrison, General Manager - Secretary
  Fresno Metropolitan Flood Control District
  Fresno, California
  (209) 456-3292

- Scott Tucker, Executive Director
  Urban Drainage and Flood Control District
  Denver, Colorado
  (303) 455-6277

- Eric Burneson, PE
  Science Applications International Corporation

- Bill Mills, General Manager
  Orange County Water District
  Fountain Valley, California

- John Beyke, Program Manager
  Storm Water
  Louisville, Kentucky

- Stephen Jenkins (Water Environment Federation)
  Environmental and Engineering Department
  San Marcos, Texas

- Frank Houston, Stormwater Program Manager
  Austin, Texas

- Eric Livingston
  State of Florida - National League of Cities Representative

- Earl Shaeffer
  State of Delaware

Comments:

"I agree with all of the points of the Working Group Report, but would like to see greater distinction, and discussion of relative importance of this issue among urban, suburban and rural areas. My feeling is that the collection and distribution system issues are most severe in urban areas where land is at a premium and distribution infrastructure is pre-existing. Suburban systems, which are often growing entities provide greater opportunity for incorporation of collection and distribution systems during land use and infrastructure planning process. Rural areas present a new challenge in the form of less centralized and less well-funded municipal

support for infrastructure systems (assuming that rural areas are not being used as storage systems for distant urban users). In rural areas, the engineering of collection systems may need (or the opportunity exists) to be based on collection by the individual, rather than community user." - Stephen Weisberg

View Graphs Used in Working Group Presentation

Priority 1

Description of the Barrier

Capability to capture, store, treat and use stormwater for designated end uses while maintaining essential system hydrology, hydraulics and services.

- Addresses physical demands of stormwater as a water supply source.
- Requires coordinated and safe operation of flood control and water supply systems during periods of variable flow rate.

Priority 1

Description of the Barrier

Harvesting stormwater for water supply purposes (urban focus) involves four fundamental considerations:

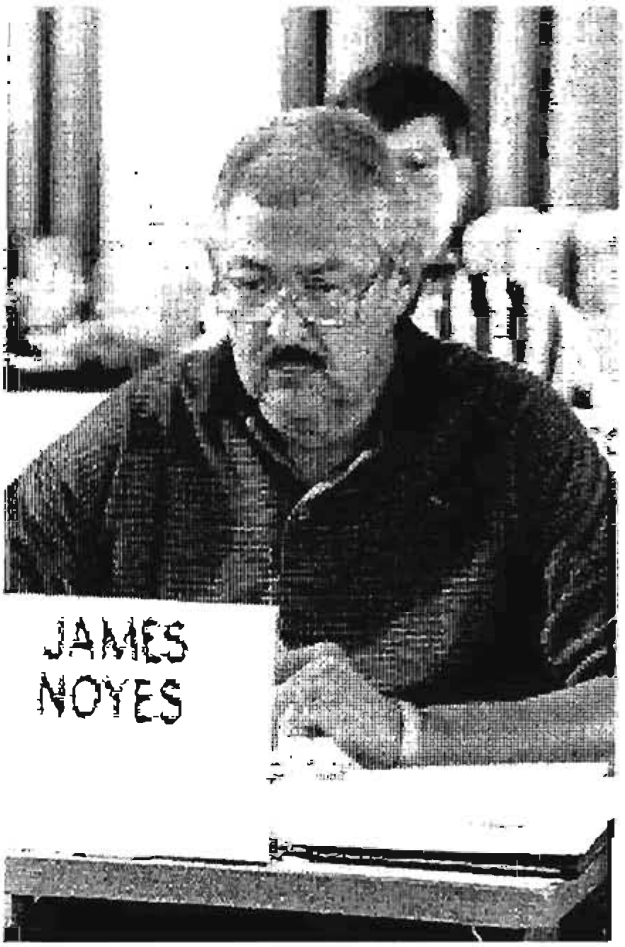
- The stormwater system must be modified.
- The water supply system must be modified.
- "Capability" is heavily dependent on site specific factors.
- Community must accept major cost and change.

Priority 1

Description of the Barrier

- May have variable end uses.
- "Capability" includes resource availability, opportunity, engineering feasibility, fiscal viability, political/citizen support.


RICHARD
WATSON


JAMES
NOYES


GLEN
BIRDZELL

PRIORITY 2

Convincing the Consumer/Public that Expenditures for Stormwater Harvesting are Necessary Public Policy and Should Start Now

WORKING GROUP MEMBERS:

Birdzell, Noyes, and Salgaonkar

Barrier Description:

The development of stormwater projects as a component of water supply is a new, low-priority, and expensive concept. Currently, there is no apparent urgency or incentive programs to focus political attention on the benefits of this concept; nor has there been an effort to coordinate the planning for water supply with stormwater programs.

How to Overcome the Barrier:

To overcome this barrier there must be concurrent technological, economic, and political efforts. The technology of harvesting stormwaters must be improved to reduce its cost. Economic incentives must be developed, such as subsidized costs or increasing the cost of competing resources. Long-term benefits of stormwater harvesting will be realized only after public education has occurred, and the public's resulting conviction has been heard by elected officials.

Recommended Task Group Membership:

- Scientific

  Glen Birdzell - City of Stockton
  Mike Cook - USEPA
  James Grafften - Permit Management Services
  Bob Ghirelli, Consultant
  Jim Noyes - LACDPW
  Jag Salgaonkar - CH2M Hill

- Public Relations

  Chuck Ellis - City Los Angeles
  Tom Soto - PS Enterprises

- Elected Officials

  Sonny McPeak - Ex. County Supervisor
  John Brown - State Water Resources Control Board
  Ruth Galanter - Los Angeles City Council

- Economics

  Steve Kassover - DWR
  Allan Highstreet - CH2M Hill
  NAFSMA representative

Comments:

"Add Michael Drennan, P.E. to Task Group. Address: MDA, Inc., 4060 Harclare Lane, Encino, CA 91436." - Michael Drennan

"Identify strategy to select lead agencies or methodology to explain possible expenditures as appropriate public policy. May be resolved by eliminating institutional barriers and identifying lead agencies (see Priority 6)." - Xavier Swamikannu

View Graphs Used in Working Group Presentation

Priority 2

Convincing the Consumer/Public that Expenditures for Stormwater Harvesting are Necessary Public Policy and Should Start Now!

Priority 2
Barrier Description

- New
- Low priority
- Expensive
- No urgency
- No incentive programs
- No political focus
- No coordinator of planning or economics

Priority 2
Approaches

- Cost incentives
- Mandated use
- Economic models
- Public education
- Technology development


RACHEL
NOBLE


RANDAL
ORTON

PRIORITY 3

Environmental Impacts of Stormwater Harvesting

WORKING GROUP MEMBERS:

Collacott, Noble, and Orton

Barrier Description:

Stormwater harvesting projects may result in environmental impacts that must be considered, either as a matter of law (e.g., impacts on endangered aquatic species) or as a matter of sound project planning. Potential impacts range from relatively tractable questions of hydrology (how does stormwater harvesting affect mean annual runoff, etc.) to relatively difficult questions concerning ecosystem responses to hydrologic alterations and unknown risks to public health from stormwater contaminants.

- Potential Wildlife Impacts: Fish and wildlife agencies will play a lead role in determining the feasibility of stormwater harvesting projects, particularly with respect to how much additional water can be removed from native drainages. A major impediment to this determination is lack of knowledge and data gaps on how aquatic species respond to reductions in stormwater flows. Some models exist on how stream organisms (primarily fish) respond to flow alterations, but our understanding of how other habitats respond is very poor. The potential impacts to species in wetlands and the nearshore coastal environment are virtually unknown. For example, stormwater is perhaps the major source of nutrients and sediments for coastal waters. Little is known on how reducing these inputs will affect nearshore biota.

- Potential Community Impacts: Reduction in stormwater flows could reduce beach sand replenishment and could reduce the water available for urban streams. In arid regions, drying of urban streams will likely generate community opposition. Conversely, higher water tables due to increased aquifer recharge could inundate residential and commercial properties, resulting in legal claims. In some areas (e.g., Ventura County), aquifer storage space is competed for, and stormwater harvesting projects will have to negotiate with other parties that seek to use groundwater basins for their own conjunctive use projects. New water supplies may be opposed by those opposed to additional urban growth. Finally, new water sources could result in increased water use and thus new, inelastic demand for water.

- Potential Public Health Risks: Neither the identity nor the quantity of pathogenic organisms is well known for stormwater. The use of stormwater to augment drinking water supplies and

body contact recreation thus constitutes an unknown risk to human health and an unknown challenge for treatment processes.

How to Overcome the Barrier:

Wildlife Impacts

- More science to understand how ecosystems respond to reductions in stormwater flows.
- Maintain minimum flows: Projects should not convert permanent streams to ephemeral streams.
- Conjunctive use: Offset stormwater losses by using other sources. Requires storage.
- Political solution: Consensus may favor other uses over instream uses.
- Work with agencies well in advance to mitigate potential impacts. Early involvement of agencies with statutory authority for the Endangered Species Act.
- Keep the scope of assessment at the regional level.

Community Impacts

- Beach sand: Artificial replenishment of beach sand. Offstream storage instead of dams or other structures that intercept sediments.
- Urban streams: Maintain minimum, negotiated flows in urban streams.
- Higher water tables: Recent court decisions support the concept of an implied easement on subsurface property rights, requiring no inverse condemnation and no compensation.
- Aquifer space as a commodity: Adjudicated groundwater basins.
- Growth inducing impacts: Integrated resource management, regional planning to incorporate externalities.
- Impact of diminished opportunities for low-level recreation (fishing, swimming, etc.).

Potential Public Health Risks

- Pathogen assays are available using both traditional and advanced pathogen detection techniques.

- Funding to conduct pathogen surveys can probably be obtained through water industry groups and should be sought.

- Heath risks may be quantified through both epidemiological studies and animal tests.

Recommended Task Group Members:

- Representative from National Estuary Program
- Ane Deister, Metropolitan Water District of Southern California (IRP)
- Hasan Nouri (Rivertech Inc., Laguna Nigel)
- Scott Tucker (Denver Flood Control)
- Ken Schiff, So. California Coastal Water Research Project
- Suzanne Goode (State Parks Dept., Malibu Sector)
- Randal Orton (Las Virgenes MWD)
- John Hanlon (USFWS)

Comments:

"In overcoming the barrier "Community Impacts," add "Impact of diminished opportunities" for low-level recreation (e.g., fishing, swimming, etc.)." - Ted Morton

"Add Dr. Burton Jones, USC, to the Task Group." - Ken Schiff

View Graphs Used in Working Group Presentation

Priority #3

Environmental Impacts of Stormwater Harvesting

Robert Collacott
Randal Orton
Rachel Noble

Overcoming the Barrier:

Wildlife Impacts

- More science
- Maintain minimum flow
- Offset stormwater losses by using other sources
- Political solutions
- Early contact with wildlife agencies
- Regional assessment

Potential Wildlife Impacts

- Fish and wildlife agencies
- Data gaps

Community Impacts

- Artificial replenishment of sand.
- Offstream storage
- Maintain minimum flows
- Public servitude
- Adjudicated groundwater basins
- IRP

View Graphs Used in Working Group Presentation

Potential Community Impacts

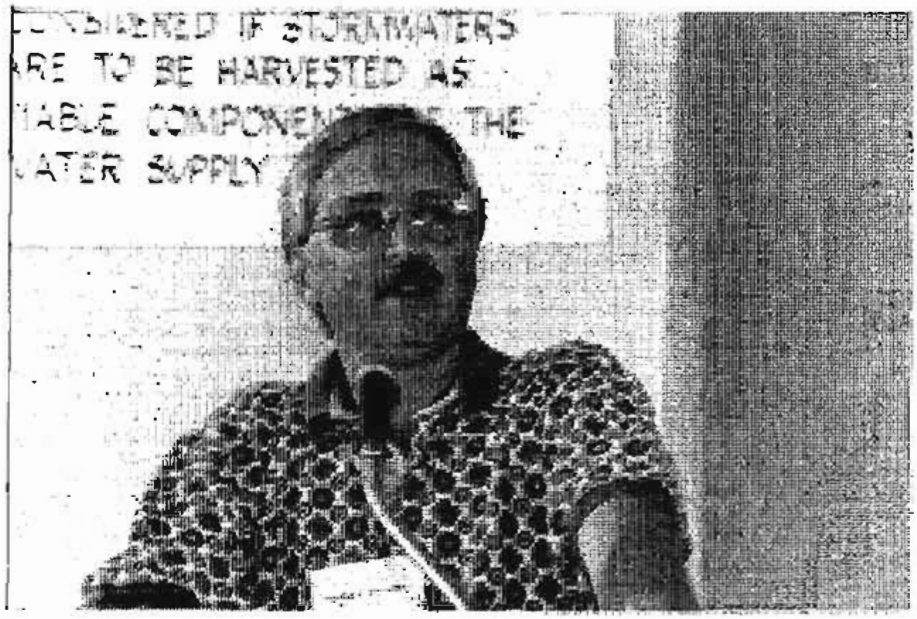
- Beach sand depletion
- Urban streams
- High water tables
- Urban growth
- New inelastic water demand

Potential Public Health Risks

- Stormwater as an untapped pathogen reservoir
- Drinking water supplies
- Body contact recreation

Health Risks

- Pathogen assays
- Epidemiological studies and animal tests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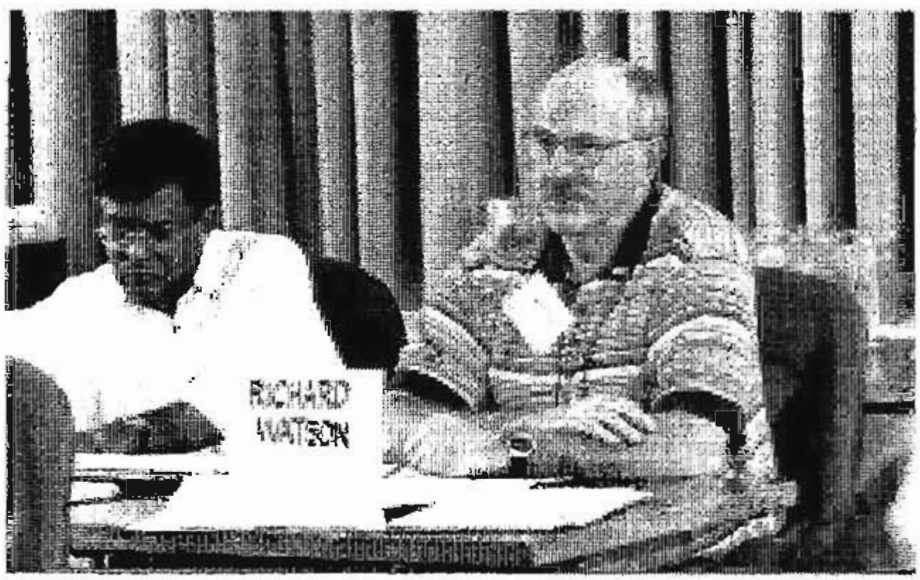

RICHARD
WATSON

PRIORITY 4

Federal, State and Local Regulations which Limit or Prevent Increased Harvesting of Stormwater

WORKING GROUP MEMBERS:

Schroeder, Tucker, and Watson

Barrier Description:

Development of stormwater harvesting projects must satisfy a wide variety of federal, state, and local regulations that may constrain implementation; present conflicting requirements; or, focus on the process rather than solutions. Furthermore, certain sources of potential contaminants to watersheds, especially agriculture, are not similarly addressed by statute or regulations.

Several specific issues follow:

- When water harvesting is considered for potable supply, laws, regulations, and guidance (e.g., Safe Drinking Water Act [SDWA] and Clean Water Act [CWA]) create overlapping and potentially-conflicting requirements. For example, the SDWA may make it impossible to use stormwater as a water supply due to watershed protection requirements.

- A plethora of federal, state, and local permits may increase project costs to the point of financial infeasibility or otherwise prevent implementation of water harvesting efforts. For example: 404 permits from the COE w/USEPA concurrence and Fish and Wildlife Service review; state 401 certification; approval of state fish and game interests; endangered species considerations; historical preservation; and, public review.

- Federal and state regulations governing the "discharge" of stormwater could adversely limit the ability to move captured stormwater from the place of capture to the place of treatment.

- State and local laws or ordinances, such as specific local prohibitions against the reuse of stormwaters for water supply, or limitations on maximum containment levels in source waters, may preclude harvesting.

- Excessive procedural and administrative requirements, rather than substantive issues in regulatory programs, may stymie project approvals or encourage litigation.

How to Overcome the Barrier:

- Work with regulators during project planning and factor in regulatory considerations early in the process.

- Educate and lobby regulators and legislators to gain support for the modification of laws and regulations to lead to a more integrated and streamlined regulatory structure.

- Analyze federal/state regulatory structures for possible impacts on post-capture stormwater transfer.

- Amend regulatory structures to facilitate stormwater capture and conveyance to treatment facilities, where necessary.

- Encourage watershed-based approaches to regulations.

Recommended Task Group Membership:

- Doug Harrison - Fresno FCD
- Scott Tucker - Denver FCD
- Roger James - Consultant
- Marty Rigby - Orange County Water District
- Jeff Wineberg - Burlington, VT
- Sat Tamaribuchi - The Irvine Company (Private sector/develop community)
- Eric Livingston - State of Florida - stormwater water regulator
- Catesby Moore - City of Tucson
- Retail water industry representative
- State Health Department representative (drinking water)
- Peter Lehner - NRDC
- USEPA representative
- State/federal legislative staff member

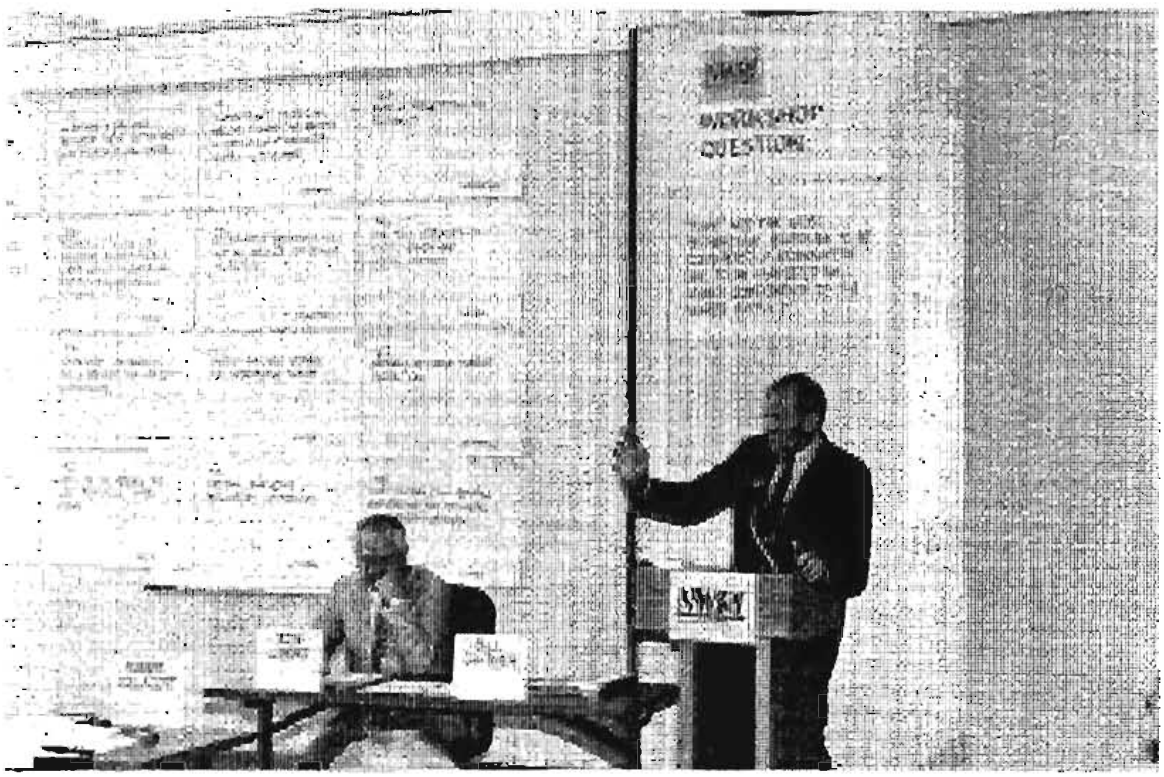
Comments:

"Consider potential impact of 'creating' waters of the United States that may result from stormwater harvesting. Waters of the United States are subject to stringent regulation and may present additional barriers." - Shari Goodwin

"Mention that anyone adding surface waters to their water supply mix must comply with the Surface Water Treatment Rule (SWTR), which could easily require capital facilities to treat the new supply. Many utilities count their blessings that they do not use local runoff." - Randal Orton

"Work to balance the need for national consistency with demand for local or regional flexibility when reviewing regulations. Add more state and federal regulators to Task Group: USEPA (Gary Hudiburg); California (Xavier Swamikannu); Michigan; New Jersey (Ed Frankel); Washington Department of Ecology, Alabama/South Carolina " - Xavier Swamikannu

"There are two groups that ultimately need to be influenced to overcome the barrier: regulators and legislators. I suggest that legislative aides to an environmentally-active state and/or federal legislators be added. Within California, Assemblyman Shelley and Wayne both maintain legislative aides knowledgeable and interested in stormwater issues." - Stephen Weisberg



View Graphs Used in Working Group Presentation

Priority 4
Barrier

Federal, state, and local regulations which limit or prevent increased harvesting of stormwater.

Priority 4
Barrier Description/Importance

- Conflicting requirements between SDWA and CWA
- Plethora of federal, state, and local permits may adversely impact project.
- Regulations governing "discharge" could limit movement of captured water.
- State and local ordinance may limit or prohibit reuse of stormwater.
- Excessive procedural and administrative requirements may stymie project implementation.

Priority 4
How to Overcome Barriers

- Work with regulators during project planning.
- Educate regulators and legislators.
- Analyze federal/state regulatory statues to facilitate SW capture and transfer.
- Encourage watershed-based approach to regulations.

Priority 4
Recommend Task Group Membership

Doug Harrison, Fresno FCD
Scott Tucker, Denver FCD
Roger James, Consultant
Marty Rigby, Orange County Water District
Jeff Wineberg, League of Cities
Sat Tamaribuchi, The Irvine Company
Eric Livingston, State of Florida
Catesby Moore, City of Tucson
Peter Lehner, NRDC
AWWA representative
State Health Department representative (drinking water)

PRIORITY 5

Lack of Demonstrated Technically-Viable and Cost-Effective Treatment Systems for Intended End Uses

WORKING GROUP MEMBERS:

Kasper and Lackner

Barrier Description:

Stormwater (urban runoff) is inherently polluted; represents a public health risk; and, needs to be treated in a manner appropriate to its end use. However, the vast majority of communities do not have stormwater treatment facilities for higher end uses. The absence of existing facilities is at least in part due to the fact that existing processes are costly relative to other sources of water and to the fact that there is a lack of operating demonstration systems. Without demonstrated successful systems, the public and elected officials will not fund stormwater harvesting.

How to Overcome the Barrier:

- Conduct research to develop guidelines on potential end uses and corresponding required treatment systems.
- Fund research and development to identify more cost-effective treatment systems.
- Fund demonstration projects which prove the technical viability of the system and its effectiveness in reducing public health risk, especially for higher end uses.
- Conduct outreach programs to inform public and elected officials.

Recommended Task Group Membership:

- Dr. George Tchobanoglous
  UC Davis, Civil Engineering Department (916) 752-1440
- Tom Schuler
  Center for Watershed Protection

- Michael Stenstrom
  UCLA, Stenstrom@seas.ucla.edu

- Dr. Benefield
  Auburn University, Alabama

- Southwest Florida Water Management District

- Amanda Rice
  Schroeder & Associates
  Hydrogeologists, management of wetlands for treatment of stormwater

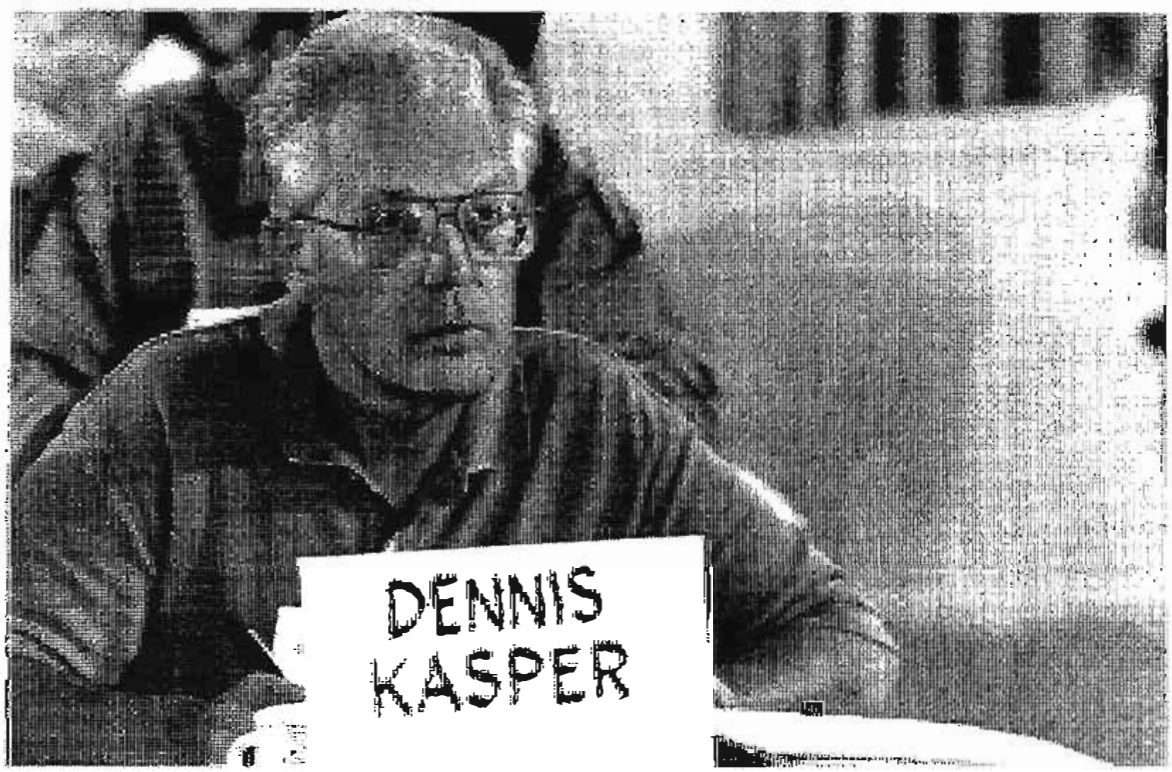
- Bob Earhart, Prof., Environmental Engineering
  Demonstration Marsh at Cal State Humboldt

- Eric Livingston,Treatment with Natural Systems
  Tallahassee, Florida Department of Environmental Regulations University

- University of Arizona, Urban Runoff Studies

Comments:

"Idea of assuming worst case may rule out small community systems? Maybe discuss matching treatment tier with intended use?" - Randal Ortoo



View Graphs Used in Working Group Presentation

Priority 5

Lack of Demonstrated Technically-Viable and Cost-Effective Treatment Systems for Intended End Uses

Priority 5
Importance

Without demonstrated successful systems, the public and elected officials will not fund stormwater harvesting.

Priority 5
Barriers

- "Stormwater" inherently pollutes (Public Health Risk)
- Treatment is required
- Lack of demonstrated, operating systems for some end uses ⇒
- Risk
- Lack of treatment systems
- Cost, relative to other water sources

Priority 5
Actions

- Define systems for alternative and uses
- R&D to identify more cost-effective systems
- Conduct demonstration projects
  -Public health risk
  -Technical viability
  -Economics
- Outreach to inform public and elected officials

View Graphs Used in Working Group Presentation

Priority 5

- Dr. George Tchobanoglous - UC Davis, Civil Engineering Dept.
- Tom Schuler - Center for Watershed Protection
- Michael Stenstrom - UCLA
- Dr. Benfield - Auburn University
- Southwest Florida Water Mgmt District
- Amanda Rice - Schroeder & Associates
- Bob Earhart - Demonstration Marsh at Humboldt State Univ.
- Eric Livingston - Treatment with Natural Systems
- University of Arizona

PRIORITY 6

Institutional Barriers to Integrated Water Resource Management to Include Stormwater Harvesting

WORKING GROUP MEMBERS:

Carnahan and Green

Barrier Description:

There is no single agency with authority to manage the multi-discipline issues associated with water resources. Water resource management must address the interrelationships between groundwater, surface water, reclaimed water, and stormwaters. The problem areas are not limited to quantity and quality of water but include environmental impacts on habitats and land use, as well as social and economic issues.

Existing agencies have singularly focused missions and do not address multi-discipline problems that may cross regional boundaries. These agencies are unable to integrate their efforts to solve technical, environmental, social, and economic problems. An agency that is able to address all the issues of a problem may be limited by geographical or administrative boundaries.

How to Overcome the Barrier:

An organization must be formed that has the authority to integrate multi-disciplinary activities across regional boundaries. This organization should have the authority to coordinate and direct the water resource activities within a watershed or water basin.

- Governance: This organization would have a board with representation comprising all stakeholders (members from the public, private, and special interest sectors). There would be an executive director and staff who are answerable to the board. The executive director and staff would be responsible for the management of the water basin and for compliance with regulatory policies of the state. Where potential problems between regulatory agencies occur, this Basin Board would have the authority to mediate a solution that is acceptable to all the stakeholders.

- Voluntary versus establishing another level or layer of government: There is tremendous resistance to forming new levels of government; however, a voluntary association has no clout. Success is dependent on stakeholder buy-in and willingness to cooperate. Models that have been tried include Joint Powers Authority, Resource Conservation Districts, the National Estuary Program, and the establishment of a non-profit organization.

- Leadership: There can be problems with one agency taking the lead based on suspicions of hidden agendas. It is important that the leadership include all stakeholders from the very beginning and ensure that everyone is respected and heard - avoid getting into personalities.

- Fundings: If stakeholders are convinced of the value of the cooperative effort, they will/should provide the necessary support for the executive director and staff. Foundation and government grants can be sought for special studies projects.

Recommended Task Group Members:

- Stan Ponce, BuRec, Director of Research
- Mark Farrell, Former Resource Director, Southwest Florida Water Mgt. District
- Dorothy Green, LA/SG Rivers Watershed Council
- Glenda Humiston, California Resource Conservation Association
- Kris Lindstrom, Consultant
- Robert Collacott, Woodward Clyde
- General Galloway, Army Corps of Engineers
- Jim Noyes, Los Angeles County Public Works
- Wildlife Management
- USEPA

Comments:

"Recommended Task Group Member: Mike Cook, Office of Wastewater Management, USEPA, Washington, DC." - Shari Goodwin

"Recommended Task Group Member: Manesh Padar, USEPA Policy; Bill Blomquist, Indiana University; Helen Ingram, University of California, Irvine." - Ron Linsky

"Recommended Task Group Member: Gerald Hansler, Delaware River Basin Commission." - Stephen Weisburg

"New title: Institutional Barriers to Integrated Water Resource Management. Recommended Task Group Member: Ann Riley, Urban Creeks Council in Oakland, California, and more, much more." - Dorothy Green

View Graphs Used in Working Group Presentation

Priority 6
Barrier Description

Water resources that must be integrated:
- groundwater
- surface water
- reclaimed water
- stormwater
- water quality/water quantity

Additional issues & concerns to integrate:
- Crossing regional/political boundaries
- Administrative boundaries
- Land use
- Environmental/habitat restoration
- Social
- Economic

Priority 6
How to Overcome Barriers

Form a watershed or water basin authority with the ability to coordinate resource management, representative of all stakeholders.

Priority 6
Stakeholders will include:

- Water resource agencies
- Regulatory agencies
- Land owners
- Community and environmental groups
- Business
- Academia
- Local elected officials

Priority 6
People for Task Group 6

Stan Ponce - BuRec, Director of Research

Mark Farrell - Former Resource Director Southwest Florida Water Mgmt District

Dorothy Green - LA/SG Rivers Watershed Council

Glenda Humiston - Calif. Resource Conservation Association

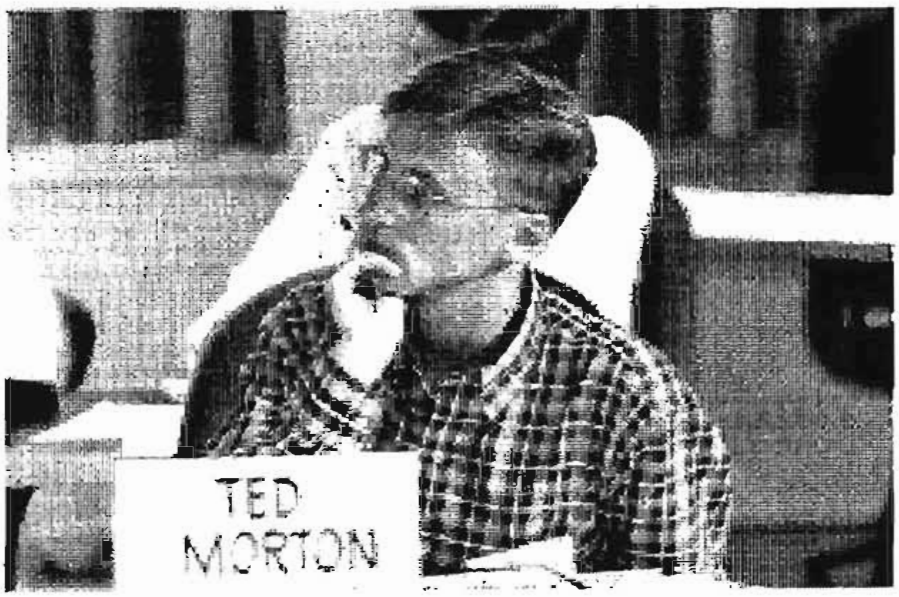
Kris Lindstrom - Consultant

Robert Collacott - Woodward Clyde

General Galloway - Army Corps of Engineers

Jim Noyes - Los Angeles County Public Works

Wildlife Management and EPA


TED
MORTON


XAVIER


STEPHEN
WEISBERG

PRIORITY 7

Lack of Public Trust that Harvested Waters are Safe for Use

WORKING GROUP MEMBERS:

Morton, Swamikannu, and Weisberg

Barrier Description:

Currently, public perceptions about stormwater pollution are negative. Public education efforts have successfully taught us about contaminants found in stormwater; the various impacts of stormwater pollution; and, our roles in the problem.

To develop the public support that government agencies need in order to pursue using harvested stormwater for water supply, it is critical to improve the public's perception and assure the public of its safety. Specifically, at least four areas should be considered to raise the public's trust:

- Quality of water: The public needs to be convinced that there are technological processes to clean the water for safe use.

- Quality of data: The public needs to be confident about the data used to establish the safety of water. There is a need to know that science is accurate and adequate.

- Motivations of those collecting and interpreting data: If the public believes a water district is pursuing this activity to save money at the potential risk of human health, it will be difficult to overcome the barrier.

- Accessibility to and participation in the decision-making process: The public should have access to information about treatment processes and compliance with water quality and health standards to build and maintain trust.

How to Overcome the Barrier:

A Proposed Path to Overcome the Barrier:

- Characterize the problem: Gather the data necessary to characterize present stormwater quality. This may take the form of aggregating existing data but will more likely require intensive site-specific measurements (consistent with Priority 9) to ensure that public perceptions about data quality and completeness are addressed. Once the characterization is

complete, place stormwater in perspective with other sources of water, such as wastewater entering a sewage treatment plant, Colorado River Reclamation Standards, aquifers, etc. While the public has been educated and has concerns about the quality of stormwater, they need to understand its relative quality. For the most part, stormwater has considerably lower concentrations of bacteria and pollutants than influent wastewater, yet people are willing to accept treatment and re-use of wastewater. These perspectives are important to achieving public acceptance.

- Community outreach: Get information out to the public in understandable terms. Include the involvement of wastewater treatment personnel. A broad cross section of the community should be included in outreach efforts.

- Conduct demonstrations projects to show the feasibility of harvesting and treating stormwaters to acceptable standards of water quality.

- Expand outreach programs to a larger community and political base after results of the demonstration projects are known.

Recommended Task Group Membership:

- Ken Schiff, Southern California Coastal Water Research Project
- Mike Cook, EPA Wastewater/Richard Fields - EPA ORD
- Mike Stenstrom, UCLA
- Robert Pitt, University of Alabama, Birmingham - Treatment Process Engineer
- Dr. Rick Linthurst, EPA ORD
- Municipal Water Supply Champion
- Paul Schwartz, Clean Water Action
- Doug Harrison, Municipal Storm Water
- Don Wolfe, L.A. County - Municipal Storm Water
- Experienced Public Outreach Coordinator
- Peter Lehner or Diane Cameron, NRDC

Comments:

"Need more involvement from environmental groups with experience in public education such as Heal the Bay." - Dorothy Green

"Recommended Task Group Member: Gary Robbins, Principal, Urban Alternatives, public outreach expert, 5 Tenaya Lane, Suite 203, Novato, CA 94947, (510) 527-7714." - Kris Lindstrom

"Contact Peter MacCaughnahan, who was recently with the San Diego County Water Authority and is now a private consultant. SDCWA did a large public outreach for public acceptance or reclaimed water. WateReuse is another organization with experience with public acceptance outreach efforts." - Randal Orton

"Possible addition to overcome barrier after pilot study possibly four Quality Control and Standardization of methods used for study. Recommended Task Group Member: National Sea Grant office representative, marine/water education." - Rachel Noble

View Graphs Used in Working Group Presentation

Priority 7

Lack of Public Trust that Harvested Waters are Safe for Use

Negative Public Perception about Stormwater Pollution Exist

1) Quality of water.

2) Quality of data.

3) Motivations of data collectors/interpretations.

4) Accessibility to add participation in decision making.

Priority 7

Lack of Public Trust that Harvested Waters are Safe for Use

Path to Overcome Barrier

1) Characterize the problem.

2) Community outreach

3) Pilot study

4) Expanded outreach

Priority 7

Lack of Public Trust that Harvested Waters are Safe for Use

Recommended Task Force

1) Ken Schiff - So. California
2) Mike Cook - USEPA Office of Wastewater
3) Richard Fields - EPA ORD
4) Peter Lehner - NRDC or Diane Cameron - NRDC
5) Dr. Richard Linthurst - USEPA Office of Research and Development

6) Paul Schwartz - Clean Water Action
7) Municipal Water Supply Champion
8) Mike Stenstrom - UCLA
9) Robert Pitt - University of Alabama at Birmingham
10) Doug Harrison
11) Don Wolfe - L.A. County
12) Experienced Outreach Coordinator

PRIORITY 8

Lack of Public Support, Motivation, Economic Rationale, and Resources for Strategic, Long-Term Planning

WORKING GROUP MEMBERS:

Drennan and Stenstrom

Barrier Description:

During wet periods, we ignore water consumption and recycling programs; during droughts, we rush to find solutions.

The public has not been adequately informed that the current methods of managing water are more costly than if sound, long-term planning efforts were to be funded.

How to Overcome the Barrier:

- Political: Provide stakeholders/community opinion leaders with information to justify the need for long-term planning and development of water resources.

- Economic: Develop sound economic data to demonstrate that long-term planning is the least expensive alternative to manage our water resources. Develop more realistic economic models to include traditionally-externalized costs. These economics will demonstrate how the current way of doing business (managing water resources) costs more than solutions based upon sound, long-term planning.

- Scientific and Technical: Utilize current scientific and technical data to support the proposed economic model.

- Political: Implement the recommendations of the assembled stakeholders and seek their support for funding long-term planning efforts.

Recommended Task Group Membership:

Political

- Public opinion leaders; both local and regional.
- Public relations/advertising expert (e.g., Tom Soto, P.S. Enterprises).
- Elected officials.

Economic

- Visionary economist (author of article in "Atlantic" Journal on revised GNP).
- Chief Administrative Officer (LA County) - Sharon Yanoshiro (responsible for drafting bond measures).

Technical/Scientific

- Water Resource Planner (Jim Noyes, L.A. County, DPW).
- Academia.
- Policy/Regulatory (Michael Drennan, P.E., MDA, Inc.).

Comments:

"Recommended Task Group Member: Ane Deister - Metropolitan Water District of Southern California, expert in IRP and an incredible facilitator." - Dorothy Green

"Recommended Task Group Member: Zack Wiley, NRDC, Economist." - Kris Lindstrom

"Connect valuing benefit costs. Recommended Task Group Member: Bill Blomquist, Indiana University; Sandra Archibald, University of Minnesota." - Ron Linsky

View Graphs Used in Working Group Presentation

Priority 8

Lack of Public Support, Motivation, Economic Rationale, and Resources for Strategic, Long-Term Planning

Priority 8

Barrier Description

- During wet periods we ignore water consumption and recycling programs; during droughts we rush to find solutions.

The public has not been adequately informed that the current way we manage water costs them more than if they were to find solutions based on sound, long-term planning efforts.

Priority 8
Overcoming the Barrier

Economic

- Develop economic model and analysis that will show the true cost of the alternatives.
- Perform an economic analysis which shows that solutions based upon long-term planning are more cost-effective.

Scientific/Technical

- Utilize current scientific and technical resources to support the economic analysis.

Political

- Assemble stakeholders/community opinion leaders and educate them about the economic analysis and ask them how best to educate the public.
- Build consensus to support harvesting programs based upon good science and long-term planning.

View Graphs Used in Working Group Presentation

Priority 8
Recommended Task
Group Membership

Political
- Public opinion leaders (local, regional, national)
- Public relations/advertising expert (e.g., Tom Soto, P.S. Enterprises)
- Elected officials

Economic
- Chief Administrative Officer (responsible for drafting)
- Holistic economist

Technical/Scientific
- Water resources planner
- Academia
- Policy/regulatory

PRIORITY 9

Optimum Harvesting Management Requires a Better Understanding of Runoff Water Quality

WORKING GROUP MEMBERS:

Lindstrom and Schiff

Barrier Description:

Pollutants co-mingled in stormwaters have been well documented on a nation-wide scale. Therefore, harvesting stormwaters will typically require some type of treatment as part of the water production system. Pollutant concentrations in these source stormwaters, however, are not constant and can vary widely within and between storm events, or within and between watersheds.

An understanding of variability in pollutant concentrations will be crucial for determining the most appropriate source waters for water supply enhancement. Knowledge of which key pollutants are of concern, and an understanding of how their concentrations change, will allow for the selection of appropriate treatment processes, locations of treatment facilities, and will target consumer needs. Alternatively, this will allow for the water production manager to capture all, or just portions, of any particular storm event, therefore reducing costs and increasing efficiency overall, while reducing the risk of regulatory non-attainment.

How to Overcome the Barrier:

- Scientifically: A monitoring program design for variability analysis will need at least two components including: (1) temporally-intensive sampling, and (2) correlative measures such as hydrologic process and water management practices, land use patterns, and source control measures.

- Technically: Temporally-intensive sampling will require some advanced monitoring methods for contaminants and pathogens. This may include real-time, continuous measurements of key indicators. In tandem, the application of this monitoring data should be used to develop a management program for treatment options.

- Economically: Funding for monitoring programs initially can be costly, but cost savings will be realized over time in effective water resource planning. Also, funding for research and development of new monitoring technology may be incurred.

- Politically: This will be a new approach to monitoring stormwaters. Traditional monitoring has been forced, compliance-based, and many times ineffective. This new monitoring approach should be considered pro-active and focused for planning efforts.

Recommended Task Group Membership:

- Bob Collacott, WCC
- Don Schroeder, CDM
- Shari Goodwin, SAIC
- Mike Stenstrom, UCLA
- Roger James, Water Res. Management
- Gayle Boyd, WCC
- Richard Boone, County of Orange
- Ken Schiff, SCCWRP
- Randal Orton, Las Virgenes MWD
- Peter Seligman, NRAD

Comments:

"Initiate formal data collection effort of existing available characterization data and/or monitoring data required under NPDES or state permits." - Shari Goodwin

"Change philosophy towards runoff monitoring: refocus from receiving water driven (current NPDES) permit approach) to end-use driven (e.g., what is most important to the use as a drinking water supply)." - Don Schroeder

View Graphs Used in Working Group Presentation

Priority 9

Optimum Harvesting Management Requires a Better Understanding of Runoff Water Quality

Priority 9
Importance of Barrier

- Pollutant concentrations vary widely in stormwater
  - -within & between events
  - -within & between watersheds
  - -changes not well understood
- Knowledge of pollutant concentrations in sourcewater is crucial for production
  - -which stormwaters need treatment
  - -information for treatment process managers
  - -which stormwaters should not be harvested

Priority 9
Overcoming the Barrier

- Change philosophy towards runoff monitoring
  - -pro-active, planning
  - -reactive, permit-driven compliance
- Fund monitoring programs
  - -research and development
- Intensive monitoring to characterize sourcewater
  - -correlative measure

- Develop real-time, continuous measure
- Relate changes in water quality to watershed characteristics for optimizing harvest
  - -hydrological processes
  - -water management
  - -land use
  - -source control

View Graphs Used in Working Group Presentation

Priority 9
Recommended Task
Group Membership

Ken Schiff, SCCWRP
Randal Orton, Las Virgenes MWD
Don Schroeder, CDM
Gayle Boyd, WCC
Bob Collacott WCC
Shari Goodwin, SAIC
Mike Stenstrom, UCLA
Peter Seligman, NRAD
Richard Boone, Co. of Orange
Roger James, Water Res. Mgmt

PRIORITY 10

Developing Regulations Based on Defined Technical Protocols for Monitoring and Implementation of Stormwater Harvesting

WORKING GROUP MEMBERS:

Taylor and Younos

Barrier Description:

Stormwater may contain constituents that are presently unknown, or unregulated, that may be harmful to public health or long-term aquifer viability. Further, water suppliers require specific protocols for analysis and monitoring of product water for domestic use that are comprehensive and protective of public health. Maximum containment levels (MCL's) may not be suitable for the protection of aquifers recharged by stormwater, and the variability of stormwater quality presents special challenges for both characterization (monitoring) and treatment. Monitoring and regulations must be implementable on an economical basis for both large- and small-water purveyors. Regulations and technical protocols must be flexible enough to allow for variation in requirements based on the source of the stormwater runoff and the expected contaminants, while still providing for protection of public health.

How to Overcome the Barrier:

In order to meet regulatory requirements and not compromise public health, development of comprehensive monitoring programs is needed to create protocols for biological, chemical, and physical testing. In the case of stormwater recharge to aquifers, a detailed analysis must be conducted of the chemical, and physical composition of the runoff, the existing aquifer water, and the aquifer soils. The design of the monitoring systems will require an evaluation of existing water quality standards, identifying gaps in specific monitoring protocols, and initiating research to develop new monitoring protocols in response to the identified gaps. Specific recommendations include:

- Support research efforts to develop monitoring protocols.
- Determine gaps in existing potable water standards relative to stormwater harvest.

- Organize proponents to lobby for funds for applied research into real-time monitoring of pathogens, organic pollutants, and "non-conventional pollutants," identified as uncharacterized organic compounds.

- Craft regulations to allow flexibility to support both large and small projects recognizing the variability of source water from various land uses.

Task Group Recommendations:

- Dr. Michael Barrett
  Center for Research in Water Resources
  Balcones Research Center
  The University of Texas at Austin
  Austin, Texas 78712

- Dr. Fred Lee
  G. Fred Lee and Associates
  27298 El Macero Drive
  El Macero, CA 95618-1005

- Thomas Schuller
  Center for Watershed Protection
  Bethesda, Maryland

- Dr. David Kibler
  Professor Civil Engineering
  Virginia Technical Institute

- Dr. Alex Horne
  University of California, Berkeley

Comments:

"Recommended Task Group Member: Dr. Heather Trim - Los Angeles Regional Water Quality Control Board." - Randal Orton

"Recommended Task Group Member: Eugene Bromely - USEPA, Tom Mumley - CA State Water Resources Control Board, San Francisco Region; Tom Mumley - USEPA?" - Ken Schiff

"Recommended Task Group Member: Ben Urbanas, Urban Drainage & Flood Control District, 2480 W. 26th Ave, Suite 156B, Denver, CO 80211, (303) 455-6277, (303) 455-7880 fax." - Scott Tucker

View Graphs Used in Working Group Presentation

Developing Regulations Based on Defined Technical Protocols for Monitoring and Implementation of Stormwater Harvesting

Priority 10

Barrier 32

Group Members:
T. Younos
S. Taylor

Barrier Description:

- Stormwater contains unknown/unregulated constituents
- Water suppliers require specific testing/monitoring protocols to protect public health and for operational viability

- Variability of stormwater quality presents challenges for monitoring/treatment
- Regulation must be flexible enough to consider source of stormwater runoff

Importance of Barrier:

- Surface waters contain unidentified and uncharacterized compounds

- Water suppliers and the public must be protected with proper regulation

How to Overcome the Barrier:

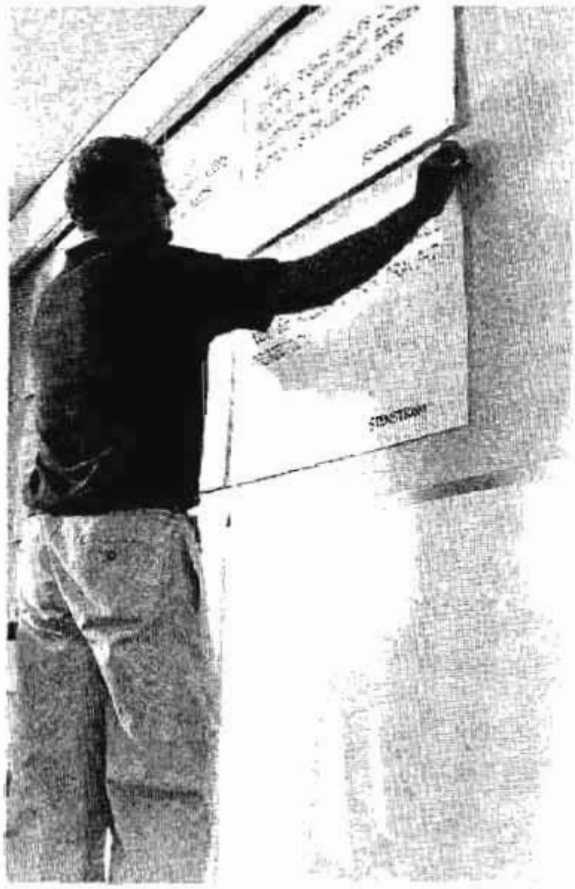
- Determine gaps in existing potable water standards relative to stormwater harvest

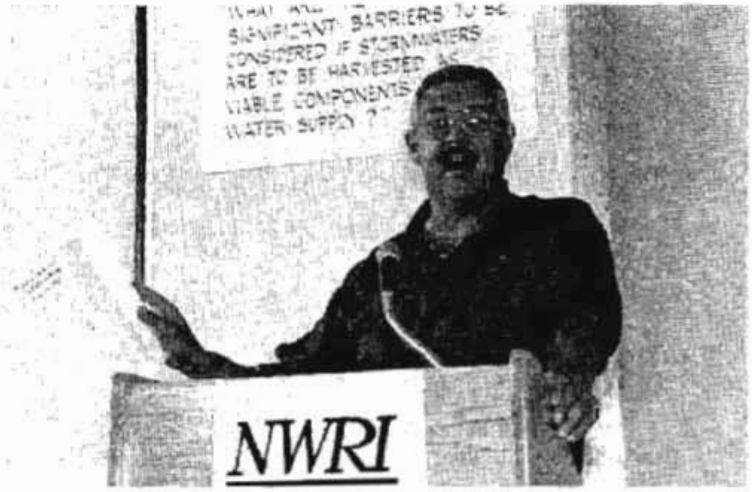
View Graphs Used in Working Group Presentation

- Support research efforts to develop monitoring protocols
- Organize proponents to lobby for funds for applied research into real-time monitoring.
- Craft regulations to allow flexibility to support both large and small projects

PART 2

NGT Workshop




NWRI


NWRI

THE NOMINAL GROUP TECHNIQUE (NGT) PROCESS

The Nominal Group Technique (NGT) process was developed by Professors Delbecq and Van de Ven[1] in the late 1960s at the University of Wisconsin. Their goal was to design a process that would allow a group of individuals to meet and quickly come to consensus, without the usual delays that result from each taking time to establish his or her own credentials in the eyes of the group, or the dominance of the meeting by a particularly vocal individual(s). The technique allows a group of individuals to address efficiently a question that could not be resolved satisfactorily by a single individual. This technique has been improved and refined for NWRI by Dr. William S. Gaither who chaired this workshop.

Twenty-five individuals with expertise in the many issues of stormwater, (e.g., planning, research, engineering, management, and conservation) accepted the NWRI's invitation to participate in a workshop to respond to the question: ***What are the most significant barriers to be considered if stormwaters are to harvested as viable components of the water supply?***

The venue for the workshop was the Kellogg West Conference Center & Lodge located on the campus of California State Polytechnic University in Pomona, California

The workshop comprised four distinct phases:

- Barrier identification.
- Consolidation of barriers into major groups.
- Individual ranking of the ten highest priority barriers.
- Refinement of Working Group Reports.

The workshop began promptly at 8:00 a.m on the first day of the workshop. During the first phase, the participants identified 85 barriers and presented them to the other participants. Titles of these barriers were posted on the walls of the workroom. In the afternoon, participants were guided through a systematic discussion to consolidate those 85 individual barriers to 20 major barrier groups. Every effort was made to ensure that each major barrier group represented a distinct philosophic thrust that was unambiguous. Each participant then completed a Priority Ranking form indicating his or her top ten barriers.

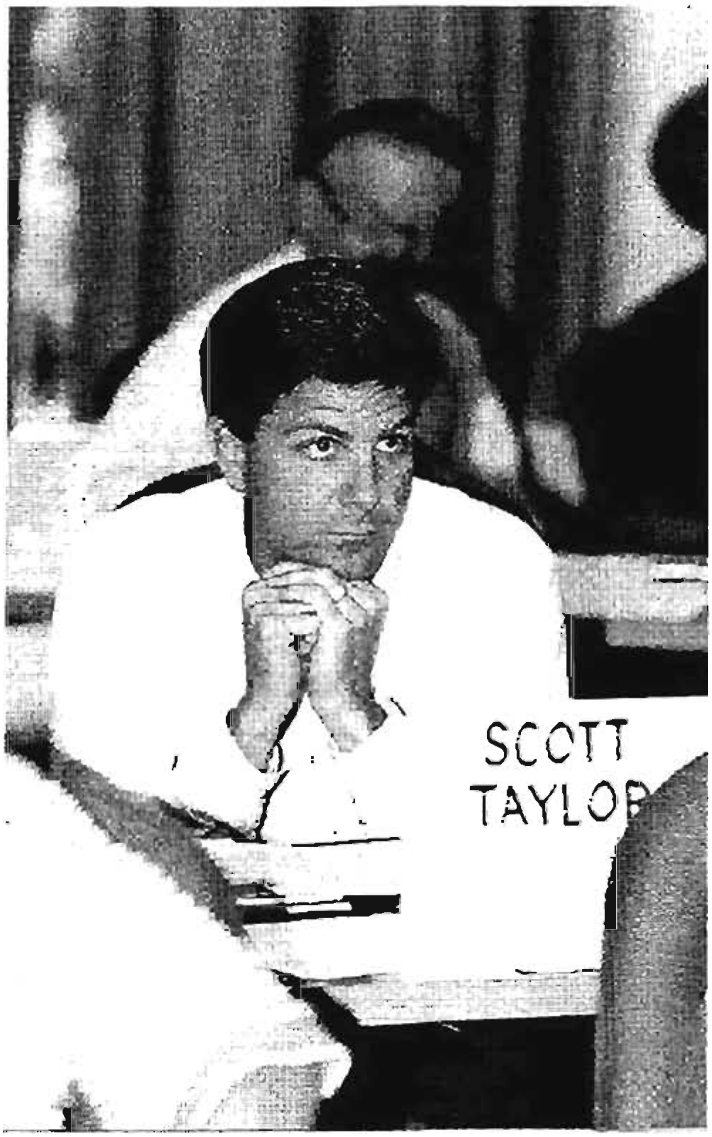
Working Groups, comprising two or three participants, were appointed to develop a consolidated and refined version of each of the top ten major barrier areas identified in the NGT Workshop. Each group had the authority to revise their priority barrier title. Thus, while the ten highest

[1] Delbecq, Andre L., A.H. Van de Ven, and D.H. Gustafson, *Group Techniques for Program Planning - a guide to nominal group and delphi processes*, Green Briar Press, 6612 Green Briar Road, Middleton, Wisconsin 53562, 1975: 174p.

priority summary barriers presented in Part 1 of this report correspond, one-for-one, to the ten highest priority major barrier areas listed in Part 2, the titles may have changed in the refinement process. Each group worked as long as necessary prepare their reports for presentation on the following morning.

The second day began with each of the ten Working Groups presenting their refined reports to their workshop colleagues. These presentations prompted discussion, feedback, and advice for improvements. By noon, all working group reports were presented, and all participants' comments were recorded and collected. Editorial approval was given by each author before departing. The reports of the working groups are presented, in descending order of priority established in the NGT Workshop, in Part 1 of this report.

Priority Ranking of Barriers


SCOTT
TAYLOR


ROBERT
CARNAHAN

PRIORITY RANK 1

Capability to Capture, Store, Treat, and Use Stormwater for Designated End Uses While Maintaining Essential System Hydrology, Hydraulics, and Services

ORIGINATORS:

Harrison on behalf of himself, Carnahan, Goodwin, Lackner, Lindstrom, Moore, Salgaonkar, Schroeder, Taylor, and Tucker

The following barriers were subsumed under the above title:

Barrier Title: **Physical Capacity to Capture, Store, and Treat Significant Portion of Peak Runoff Flow**

Originator: Harrison

Barrier description:

Stormwater flows are characterized by episodic large volume, short duration peak flows. Capturing a significant portion of such flows requires substantial diversion and storage facilities. Making the water useable requires transportation to and availability of appropriate treatment and distribution facilities. Retrofitting such facilities into existing urban communities will produce substantial cost and dislocation.

Importance:

A community must be willing to pay the price in both cost and urban-form impact to accomplish the capture and use of stormwater.

How to overcome the barrier:

- Obtain community consensus on the value of the resource and the acceptability of the cost.
- Modify/adopt relevant land use/utility plans to incorporate the capture, storage, treatment, and distribution systems.
- Create the funding mechanisms.
- Implement.

Barrier Title: **Land Use Limits the Use of Stormwater as a Water Supply**

Originator: Carnahan

Barrier description:

Local zoning and land use legislation dictate the type and the rate at which lands may be used. This impacts directly on the quantity and the quality of stormwater discharged from this land.

The use of land determines the hydrological discharge and the water quality of the runoff. For example, urban runoff will occur quickly due to the imperviousness of the area, and the runoff will contain higher concentrations of heavy metals than the same rainfall events occurring in a rural area. Rural runoff will contain higher concentrations of nutrients than urban runoff caused by a similar rain event.

Importance:

The rates of discharge from a given land area will determine the way the quantity of water may be managed. The rate of discharge will certainly determine the methods used to retain the stormwater. It is impracticable to retain flows resulting from intense storms in urban areas. The time of concentration is too short, and the quantity of water is too great.

There is some question as to whether the first-inch of runoff from an area contains the majority of the pollutants. If the entering volume of runoff is retained, then the treatment of this water becomes complex. In Florida, if aquifer storage is used as a retention process, any water that is injected into the aquifer must be pretreated to remove potential pollutants. Water quality is a serious problem that becomes more complex without consistent land management.

How to overcome the barrier:

Effective planning and rational legislation are the first elements in overcoming this barrier. Better technologies need to be developed to treat and cope with the massive problems of retention and treatment of stormwater.

Barrier Title: **Methods of Stormwater Collection**

Originator: Goodwin

Barrier description:

Stormwater may be collected directly from a precipitation event or from a point source discharge (outfall). If collecting prior to runoff, a large land area may need to be dedicated to catchment. This may not be feasible in many areas because it is also difficult to predict the timing and quantity of events. If collecting from the point source, there may need to be created catchments prior to discharge to receiving water or to retrofit existing storm sewer systems; these may cause environmental impacts.

Importance:

This is the first step in successfully harvesting stormwater.

How to overcome the barrier:

- Encourage integrated planning with all jurisdictions involved; use "landscape ecology" in planning efforts.
- Conduct feasibility analysis on a site-by-site basis, e.g., at municipal levels or lower, as needed.
- Conduct pilot tests.
- Collect data on effectiveness (e.g., amounts of water collected and cost).

Barrier Title: **Lack of Stormwater Treatment and Storage Facilities**

Originator: Lackner

Barrier description:

Currently, in this country, urban stormwater runoff is not used in the water supply and is not generally treated to a degree where it would be safe for water supply. Designing, planning, funding, and developing such facilities will be time-consuming, difficult, and costly.

Importance:

If treatment facilities do not exist, stormwater cannot be successfully harvested.

How to overcome the barrier:

Education is required to convince the public of the need for supporting and funding such facilities. Additionally, research will be needed into the most functional and economical designs for facilities and to determine what levels of effort will be needed to treat stormwater to water supply standards.

Barrier Title: **Developing Seasonal Storage Needs in an Urban Environment**

Originator: Lindstrom

Barrier description:

The lack of storage facilities is a barrier to utilizing stormwater in the coastal areas of California. There is a need to develop community storage reservoirs or cisterns for capturing stormwater for landscaping or other exterior on-site uses.

Importance:

Storage facilities limit the ability to capture stormwater in areas that lack reservoirs, adequate groundwater aquifer storage, or imported supply facilities.

How to overcome the barrier:

Storage reservoirs (above and below ground) can be constructed in existing parks, golf courses, and via cisterns in new construction and in urban redevelopment projects. Airports and other major paved areas (parking lots) may be candidate sites for underground storage. Tax incentives may be necessary to stimulate the creation of such urban storage reservoirs. Necessity may be a

driving force in some areas of the central coast of California. Creating regulatory and economic incentives may be necessary in the future.

Barrier Title: **Maintenance of the Level of Flood Protection Provided by the Stormwater Conveyance Systems**

Originator: Moore

Barrier description:

The primary purpose of the storm drain system is flood control.

Importance:

Public safety should not be compromised by stormwater harvesting.

How to overcome the barrier:

Design the diversion or retention systems so that the level of flood protection is maintained or enhanced. Coordinate channel improvements by the Flood Control Agency with construction of stormwater harvesting facilities by the water purveyor.

Barrier Title: **Cost-Effective Storage Technologies/Options**

Originator: Salgaonkar

Barrier description:

- Above ground: no land available in urban areas.
- Underground: will need expensive treatment or risk contamination of existing water.
- Ocean: long-term effects of sediment accumulation; effect on ocean life.

Importance:

Without storage, demand and supply cannot be matched, making harvesting difficult.

How to overcome the barrier:

- Better watershed planning to minimize pollution at source.
- Regulations to reduce/eliminate use of pesticides, hazardous materials that typically run off.
- Better research
- Change land use planning requirements.

Barrier Title: **Developing Adequate Storage**

Originator: Schroeder

Barrier description:

Stormwater hydrology is highly variable. Substantial storage (e.g., surface reservoirs, detention/recharge basins) is typically required to temporarily detain larger storm events before diverting to the water supply at a greater rate than can be accommodated. Storage generally is land intensive, and development of new storage/retention is either limited because of the lack of available land and/or significant environmental impacts associated with development.

Importance:

Currently, significant stormwater is already captured in either surface reservoirs or recharge/detention basins. However, much greater quantities are available during above-average rainfall periods and higher flow storms. This water is not captured due to lack of storage/detention opportunities.

How to overcome the barrier:

- Conduct regional investigations of potential storage opportunities in areas of critical water supply shortage.
- Involve multiple interests (water supply, stormwater, and land use jurisdiction).
- Do a first-level screening based on technical, economic, institutional, and environmental concerns.
- Identify most promising opportunities for further study.
- Investigate innovative, multi-use opportunities, where possible.

Barrier Title: **Limited Available Storage for Stormwater Runoff**

Originator: Taylor

Barrier description:

Most viable dam sites (and many non-viable dam sites) are currently in use or have been studied extensively (Corps of Engineers, Bureau of Reclamation). Harvest of stormwater will require large storage volumes to be filled in a relatively short period of time (i.e., no pumping or small sites would be feasible).

Importance:

The lack of the remaining viable storage locations hinders the use of stormwater as a significant portion of the water supply.

How to overcome the barrier:

- Direct stormwater to aquifer forebay areas where it may be recharged to aquifers.
- Create new opportunities for recharge in urban areas.

Barrier Title: **Cost and Disruptiveness of Construction of Large Facilities in Urban Areas**

Originator: Tucker

Barrier description:

Large facilities will be needed for collection, storage, and treatment of stormwater. In dense urban areas, it will be expensive and disruptive to construct such facilities.

Importance:

Cost is always an issue. If costs are too high, stormwater harvesting will not be cost effective. The construction of large facilities can be disruptive in terms of transportation, other utilities, access to businesses, and public inconvenience which could result in a lack of public support, and/or organized opposition.

How to overcome the barrier:

- Underground construction.
- Public education and outreach programs.
- Use of existing infrastructure to maximum extent possible.

Barrier Title: **Elevation Differences Between Point of Collection and Point of Distribution**

Originator: Tucker

Barrier description:

Stormwater will tend to be collected at lower elevations in the urban area. Water supply systems tend to treat and distribute from as high an elevation as possible. This will tend to make energy consumption and pumping costs higher.

Importance:

Elevation differences may contribute to cost ineffectiveness or to limitations as to where harvested stormwater may be used.

How to overcome the barrier:

- Collect stormwater as high in a basin as possible.
- Distribute harvested stormwater to an area that can be served with as little pumping as possible.

PRIORITY RANK 2

Inability to Demonstrate to the Consumer/Public that Expenditures for Stormwater Harvesting are Appropriate Public Policy and Need to Start Now

ORIGINATORS:

Noyes on behalf of himself, Birdzell, Drennan, Harrison, Salgaonkar, Schroeder, and Weisberg

The following barriers were subsumed under the above title:

Barrier Title: **Infrastructure Financing**

Originator: Noyes

Barrier description:

Developing additional facilities will be expensive due to treatment requirements, storage, and distribution.

Importance:

Water is cheap to the consumer. Water rates will need to rise to pay for this infrastructure.

How to overcome the barrier:

Public education.

Barrier Title: **Funding Incentives**

Originator: Birdzell

Barrier description:

Unless there is a practical reason for changing the way stormwater is currently handled, the local political bodies will not be interested in projects using stormwater.

Importance:

Incentives, in the form of funding sources, will create an interest in utilizing stormwater by focusing "Political Will" and reducing the economic burden on local taxpayers.

How to overcome the barrier:

To create such incentives will require a combination of political and economic considerations. A formula of economic incentives (i.e., 10% of the project costs) will be needed to attain the maximum benefit of the total incentive dollars.

The political solutions would revolve around priorities for project selection. I would propose a three-tier priority system based on:

- Demonstrated need for additional water supply.
- Demonstration that the normal rainfall can meet a significant percentage of supply needs.
- Demonstrated local ability to support a defined percentage of a project's cost (both initial and life costs).

Barrier Title: **Accurate Cost-Accounting of Alternatives to Include Traditionally-Externalized Costs such as Environmental Impacts, Government Subsidies, Quality of Life Impacts**

Originator: Drennan

Barrier description:

Comparing the costs of alternatives may be similar to comparing apples and oranges. The costs of water often times do not include many costs that are externalized, such as environmental impacts, government subsidies, etc. These out-dated economic models prevent environmentally-responsible alternatives from competing.

Importance:

Most social decisions include some form of economic analysis.

How to overcome the barrier:

Develop acceptable economic models which include costs that have typically been externalized and which allow more realistic comparison of alternatives.

Barrier Title: **Overcome Public's Low Prioritization of the Funding of Stormwater Systems; Participatory Decision Making**

Originator: Harrison

Barrier description:

People are constantly pressed to pay taxes, fees, and assessments to finance urban services. Among the demands for urban revenue, stormwater management is always, or nearly always, last. Unless the public agrees with the need for harvesting stormwater, they will not fund it.

Importance:

It remains the local taxpayers who ultimately underwrite public policy and urban service systems. Unless they agree with the need and value of harvesting stormwater, the funding will not be available. If "harvesting" is simply imposed as a new mandate, it will be resisted.

How to overcome the barrier:

Let the true public influence the decision process; avoid the traditional dominance of such "environmental policy" decisions by vocal interest groups or increasingly independent regulatory interests. Move from mandates to participatory decision making.

Barrier Title: **Consumers' Willingness to Pay a Premium for Harvested Stormwater**

Originator: Salgaonkar

Barrier description:

Harvested stormwater cost ≅ $1,500 to $2,500/AF. Compare that cost to local groundwater at $200/AF, imported water at $450/AF, and ocean desalination at $1,200/AF. There are no monetary incentives to harvest stormwater.

Importance:

Without public support, politicians and bureaucrats may not be willing to initiate harvesting.

How to overcome the barrier:

- Subsidize the cost of harvesting (federal/state grants, etc.).
- Increase cost of competing resource (make imported water expensive).
- Mandate use of harvested stormwater.

Barrier Title: **Lack of Common Economic Models Between Water Supply and Stormwater Planning**

Originator: Schroeder

Barrier description:

Water supply planning traditionally seeks the least-cost water supply alternative. Conversely, stormwater management typically focuses on minimizing the cost of flood control and meeting NPDES discharge requirements. These two planning activities frequently are conducted separately using different economic criteria and models to minimize the cost of each function, thus potentially missing lower-cost overall-solutions.

Importance:

Lower-cost total-solutions may be available to address joint water supply and stormwater solutions.

How to overcome the barrier:

- Encourage joint planning of projects.
- Develop economic models that can commonly account for costs and benefits of both water supply and stormwater management.

Barrier Title: **Getting Started in the Development Process**

Originator: Weisberg

Barrier description:

The initial cost of stormwater harvesting will exceed the cost of existing supplies. Only if we look out many years will the economic value of beginning research and pilot project efforts be realized. The urgency for undertaking the large investment is lacking. Short-term incentives are necessary to begin the development process.

Importance:

Even pilot project efforts will require large investments.

How to overcome the barrier:

Develop a funding source or funding incentive to start the process of addressing technology development needs. Perhaps funding incentives will follow only after a consolidating event such as a drought.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PRIORITY RANK 3

Environmental and Community Impacts of Stormwater Harvesting

ORIGINATORS:

Collacott on behalf of himself, Goodwin, Noble, Noyes, Orton, Schiff, Tucker, and Weisberg

The following barriers were subsumed under the above title:

Barrier Title: **Environmental Impacts of Stormwater Harvesting**

Originator: Collacott

Barrier description:

Diversion of stormwater for storage/use may disrupt natural hydrologic and fluvial processes and ecosystems.

Importance:

- Physical impacts on natural stream courses.
- Impact on beach sand replenishments, if dams are constructed.
- Rising groundwater levels may impact existing developed areas.
- Diversion may impact natural riparian habitat and wetlands.

How to overcome the barrier:

- Off-stream storage/infiltration of stormwater.
- Design for high-flow sediment transport.
- Maintain low flows to preserve riparian and wetland habitats.
- Conjunctive use of groundwater basins and inter-basin transfers.

Barrier Title: **Potential Effects/Impacts to Endangered/Threatened Species Resulting from Stormwater Harvesting**

Originator: Goodwin

Barrier description:

Many species depend on specific water quantities to provide habitat.

Importance:

Reductions in water flow due to harvesting may alter or destroy a species habitat, potentially resulting in the loss of the species. This may lead to conflicts with the Endangered Species Act requirements which may impede growth and development in an area.

How to overcome the barrier:

Work with state and federal agencies to ensure that species habitat needs are met well in advance of harvesting stormwater.

Barrier Title: **Need for Program Development/Implementation/Enforcement Guidance Concerning Water Harvesting**

Originator: Goodwin

Barrier description:

Currently, there is no national program or guidance to address stormwater harvest concerns.

Importance:

There is a need for national guidance for program development and implementation. National standards are also needed. How does a municipality get started in evaluating a need for a stormwater harvest program?

How to overcome the barrier:

- Coordinate with existing state/federal programs (e.g., NPDES Stormwater Program, CSO program, watershed programs).

- Evaluate existing regulatory language for potential modification.

- Establish a pilot test program.

Barrier Title: **Loss of Wetlands Areas**

Originator: Noble

Barrier Description:

The loss of wetlands is occurring rapidly due to development and is a barrier to increasing the harvest of stormwater.

Importance:

Wetlands areas are being lost in the Los Angeles region with the threatened loss of both Ballona Wetlands and Bolsa Chica. This is a common theme throughout the United States. We need to advance our knowledge on how to protect wetlands from detrimental effects while at the same time determine how to use the wetlands for beneficial aspects of stormwater harvest.

How to overcome the barrier:

- Save the area from development.
- Invest in research:

  - Continue work which incorporates use of wetlands as a preserved habitat, understanding of species life cycles, detrimental effects of stormwater contaminants while performing research on natural filtration and remineralization of nutrients, bioremediation of heavy metals, etc.

  - Determine pretreatment which may be necessary to avoid the true detrimental effects to wetlands.

Barrier Title: **Achieving a Balance Between Water Supply Needs and Environmental Needs**

Originator: Noyes

Barrier description:

Belief by adherents that all stormwater should be devoted to either water supply or the environment, and neither side is willing to compromise.

Importance:

This condition creates conflict between the parties and prevents or delays beneficial projects.

How to overcome the barrier:

Realization that each goal is good public policy, and that the resource (stormwater) should be shared. This takes dialogue among the parties and a willingness to compromise.

Barrier Title: **Impacts of Stormwater Harvesting on Local Streams, Coastal Wetlands, and Estuaries**

Originator: Orton

Barrier description:

Streams, wetlands, and estuaries, and their biota, are adapted to a natural hydrology that includes winter storm runoff. Legal challenges can be expected from fish and wildlife agencies under the Endangered Species Act and other statutory wildlife protections. Environmental groups may also challenge stormwater harvest since it will promote urban growth. Community resistance can be expected if projects result in dry urban streams.

Importance:

Legal challenges and scientific uncertainties over impacts to native wildlife have stalled or blocked recycling efforts with several parallels to stormwater harvesting concepts.

How to overcome the barrier:

- Storage.
- Regional, not local, discussions.
- Early communication with local regulators, communities.
- Support for scientific research into relationship between stormwater runoff and coastal wetlands and estuary ecology.

Barrier Title: **How Do We Replace the Lost Resources to the Ocean?**

Originator: Schiff

Barrier description:

Harvesting stormwaters will reduce pollutant loads to receiving waters but will also inhibit the delivery of natural resources that are needed by ecosystems in near-coastal waters.

Importance:

Stormwaters are a natural part of ecosystem function. Loss of runoff to receiving waters and the important nutrients (for plankton and algal growth) or sediments (for beach replenishment) which are associated with these discharges may limit ecosystem function.

How to overcome the barrier:

A better understanding of ecosystem interactions in the ocean environment and river discharges will be needed. This will allow for secondary enhancement, if needed.

Barrier Title: **Removal of Stormwater as an Urban Stream Resource**

Originator: Tucker

Barrier description:

In all cases, urban streams will derive all or a portion of their flows from stormwaters. Stormwaters that are harvested would be removed from the urban stream system, and in some cases this could adversely impact the urban stream.

Importance:

Concern for urban stream environments may be a source of opposition and should be a consideration if it is a problem.

How to overcome the barrier:

Analyze urban stream hydrology and hydraulics and determine if there is a problem. Harvesting systems could be designed to pass certain flows, if necessary. Most urban stormwater events cause too much water too fast, and water harvesting systems could help to retard large storm events and to sustain base flows in urban streams.

Barrier Title: **Natural Resource Habitat Protection**

Originator: Weisberg

Barrier description:

Stormwater helps form essential estuarine habitats for many birds and fishes. Stormwater harvest could detrimentally affect this habitat.

Importance:

Habitat protection laws may prevent stormwater harvest.

How to overcome the barrier:

More studies are required to better define habitat needs of estuarine biota.

PRIORITY RANK 4

Conflicts Between and Constraints from Federal, State, and Local Regulations may Limit or Prevent Project Implementation

ORIGINATORS:

Tucker on behalf of himself, Harrison, Lackner, Schroeder, and Watson

The following barriers were subsumed under the above title:

Barrier Title: **Federal and State Regulatory Constraints**

Originator: Tucker

Barrier description:

There are several federal and state permits that will be required for any water development project. For example, a 404 permit from COE with USEPA and Fish & Wildlife Service approval, preservation of endangered species, historical site presentation, state 401 certification, SDWA requirements, and approval from state Fish and Game interests, to mention a few.

Importance:

If a 404 permit is not granted, for example, there will be no project. Also, mitigation of impacts in order to obtain a permit can add significantly to the cost. Another example is when the destruction of an endangered species habitat can stop a project.

How to overcome the barrier:

- Work with regulators in order to develop projects that meet regulatory requirements.
- Factor in regulatory considerations at the beginning of the project planning process.

Barrier Title: **Regulatory Limits on the Movement of Untreated Stormwater**

Originator: Harrison

Barrier description:

Federal and state regulations governing the "discharge" of stormwater could adversely limit the ability to move captured stormwater from the place of capture to the place of treatment.

Importance:

If the movement of stormwater is considered a discharge and prohibited without meeting water quality standards, the place of - and opportunity for - economical treatment may be so impacted as to make stormwater an infeasible source, even after capture.

How to overcome the barrier:

- Analyze federal/state regulatory structures for possible impacts on post-capture stormwater movement.
- Amend regulatory structures to facilitate stormwater capture and conveyance to treatment/use facilities, where necessary.

Barrier Title: **Possible Legal Barriers**

Originator: Lackner

Barrier description:

There may be communities or areas which have specific laws against the re-use of stormwaters for water supply. Specific public health concerns may precipitate such laws. The Safe Drinking Water Act may make it impossible to use stormwater as water supply due to the contaminants it contains.

Importance:

Laws prohibiting re-use of stormwater for water supply, or even laws containing maximum contaminant levels for water supply, could effectively make it illegal to harvest stormwater.

How to overcome the barrier:

Politicians would need to be lobbied and convinced to repeal or modify such laws. To this end, it would be helpful to have concrete scientific data and research establishing true levels of concern. Overcoming this barrier would also require technology which could cost-effectively treat stormwater.

Barrier Title: **Disconnected Regulatory Programs Discourage Coordinated Solutions**

Originator: Schroeder

Barrier description:

Local, state, and federal regulatory programs focus on "single issue" concerns: Clean Water Act (receiving water quality protection and discharge permitting); SDWA (potable water quality); ESA (habitat protection); flood protection; and, therefore projects/programs may hinder.

Importance:

Any project to harvest stormwater must pass all regulatory approvals, and these often may be conflicting when applied to a specific process.

How to overcome the barrier:

- Encourage watershed-based approach.
- Educate/influence legislators and legislative process toward more integrated and streamlined law/regulatory structure.

Barrier Title: **Inappropriate Regulation**

Originator: Watson

Barrier description:

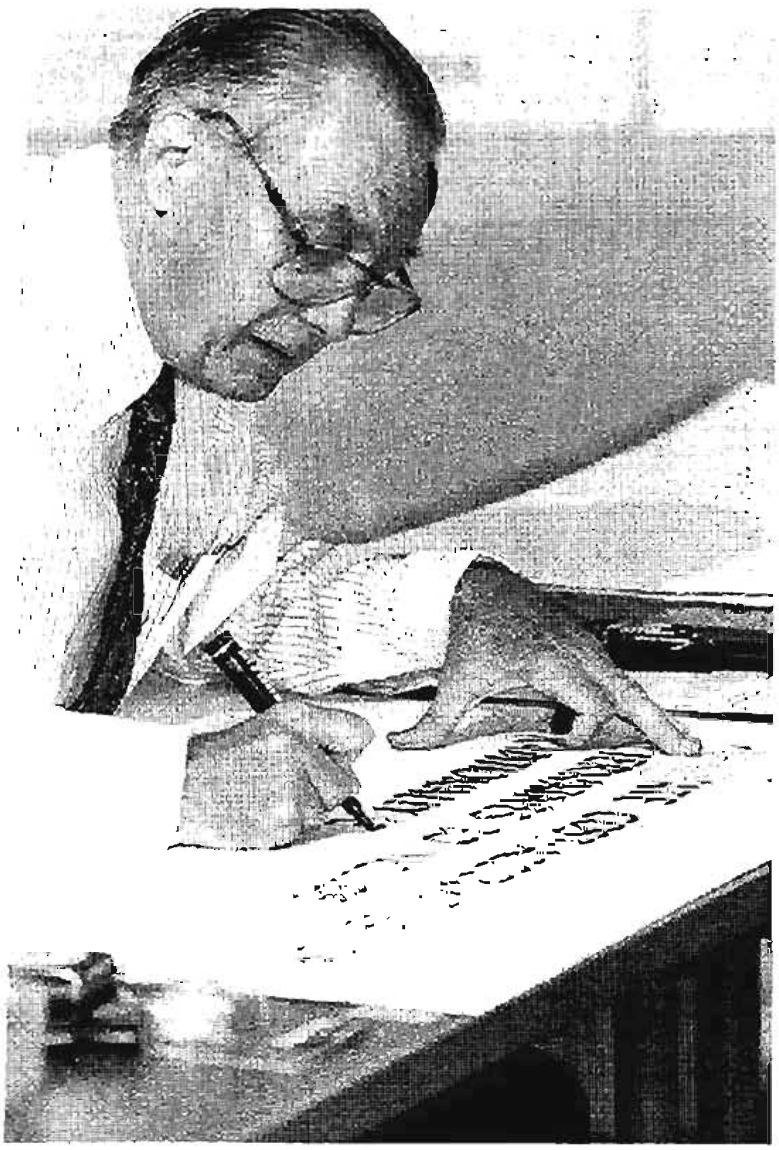
The Clean Water Act and the regulations implementing it have been written to emphasize procedure and data collection rather than to emphasize solutions to high priority problems. Furthermore, a major source of potential pollutants, namely agriculture, is exempted.

Importance:

A great deal of money is spent crossing "t's" and dotting "i's" and on litigation resulting from missing some "t's" and "i's" rather than on addressing real problems.

How to overcome the barrier:

The Clean Water Act needs to be amended to focus on priority water quality problems, and the regulations need to be re-written to encourage cooperation and innovation.



PRIORITY RANK 5

Need to Determine the Extent of Stormwater Contamination to Design Appropriate Treatment Processes for Intended End Use

ORIGINATORS:

Noyes on behalf of himself, Goodwin, Kasper, Lackner, and Noble

The following barriers were subsumed under the above title:

Barrier Title: **The Perception of Adverse Water Quality on Creating Additional Supplies**

Originator: Noyes

Barrier description:

There is a prevalent misconception that stormwater is too polluted to be used in any other fashion. Hence, plans to develop it as a water supply source are prematurely rejected.

Importance:

Water quality issues are very important to the public. If the public thinks that stormwaters should not be integrated into the public water supply, it becomes difficult and expensive to overcome that perception.

How to overcome the barrier:

Utilize a three-pronged approach:

- Use science/technology to prove that stormwater can be used in the water supply without causing adverse health effects.
- Educate elected officials and policy-makers that stormwater can be beneficial. Get them on your side.
- Develop a public relations campaign using the above points to overcome public opposition.

Barrier Title: **Determining End Use of Stormwater Harvest to Ensure Appropriate Treatment**

Originator: Goodwin

Barrier description:

Stormwater needs to be treated prior to most uses. Runoff has been shown to carry various pollutant levels depending on drainage basin land uses. End use of harvest should be determined prior to identifying treatment. Treatment costs may be significant depending on end use. Location of treatment needs to be determined, e.g., at end of pipe, at publicly-owned treatment works, or at drinking water treatment plant.

Importance:

Runoff has been shown to contain varying pollutants, metals, bacteria, oil and grease, sediment, etc. Treatment will depend on intended use of harvest.

How to overcome the barrier:

- Natural treatment should be used as much as possible, e.g., grassed swales, wetlands.
- Retrofit of existing municipal infrastructure may be needed to pump collected stormwater to treatment system.
- Integrated planning is needed.

Barrier Title: **Lack of Cost-Effective Treatment Processes Suitable for Stormwater Management**

Originator: Kasper

Barrier description:

Treatment processes generally perform most efficiently at constant flow rates. Stormwater flows and compositions vary greatly over relatively short periods. The majority of existing processes cannot respond to these large variations. The large flow variation results in relatively short operational periods for many systems. The low "use factor" significantly increases the costs of water harvesting.

Importance:

- For most uses, stormwater requires treatment.
- Lack of effective processes increases costs.
- Lack of suitable processes results in poor quality harvested water.
- Lack of reliable effective processes increases costly water monitoring requirements.

How to overcome the barrier:

- Development of processes.
- Demonstration project.

Barrier Title: **Lack of Stormwater Treatment and Storage Facilities**

Originator: Lackner

Barrier description:

Currently, in this country, urban stormwater runoff is not used in the water supply and is not generally treated to a degree where it would be safe for water supply. Designing, planning, funding, and developing such facilities will be time-consuming, difficult, and costly.

Importance:

If treatment facilities do not exist, stormwater cannot be successfully harvested.

How to overcome the barrier:

Education is required to convince the public of the need for supporting and funding such facilities. Additionally, research will be needed into the most functional and economical designs for facilities and to determine what level of effort will be needed to treat stormwater to water supply standards.

Barrier Title: **Reduction of Microbial Pathogens - Examination of Public Health Risks**

Originator: Noble

Barrier description:

Stormwater has the potential to contain a wide variety of microbiological contaminants by its non-point source nature. Testing for microorganisms must be cost-effective, yet widely applicable. As of now, there is little cross-over research which investigates both direct and indirect public health risks.

Importance:

Microorganisms contaminating stormwater supply can be defined as human pathogenic, dangerous to livestock, or detrimental to mineral cycling processes depending upon the purpose intended for the reused/recycled stormwater. Unfortunately for us, these pathogens can often times cross barriers and become vectors which pose public health risks, e. g., shellfish poisoning, and Creutzfeldt-Jakob's Disease (thought to originate from mad cow disease in certain instances).

How to overcome the barrier:

Determine in advance the specific use for the harvested stormwater. Design cost-effective measures to pretest and post-test water for specific microorganisms or indicator microorganisms. Research needs to be concerned with all transport of water since pathogens can be found in living tissues of all organisms which utilize the water.

PRIORITY RANK 6

Institutional Barriers to Stormwater Harvesting

ORIGINATORS:

Collacott on behalf of himself, Carnahan, Green, and Noyes

The following barriers were subsumed under the above title:

Barrier Title: **Institutional Barriers**

Originator: Collacott

Barrier description:

Jurisdictional, legal, regulatory and political limitations of involved agencies require extensive inter-agency cooperation for implementation.

Importance:

Jurisdictional and political boundaries and authorities are generally not established to maximize stormwater storage.

How to overcome the barrier:

Establish Regional Joint Powers authorities for stormwater harvesting.

Barrier Title: **Lack of Private Sector Participation in Use of Urban Runoff as a Water Supply**

Originator: Carnahan

Barrier description:

Stormwater runoff from densely developed areas represents a threat of flooding and damage to the private sector. The private sector does not receive any tax rebate for implementing a storage or retention program. The private sector relies on the local government for control and protection.

Importance:

Stormwater may be recovered from malls, parking lots, and streets if pervious pavements, cisterns, and curbings are used. This will reduce the peak of the hydrograph and will extend retention time. The use of pervious pavement will permit recharge of the groundwater.

How to overcome the barrier:

Provide a reward or rebate program to the private sector.

Barrier Title: **Groundwater Management for Conjunctive Use**

Originator: Green

Barrier description:

The agricultural community refuses to manage its groundwater so wet year surpluses can be stored underground against dry year need.

Importance:

Using aquifers for storage is less costly than dams and reservoirs above ground; there are no losses from evaporation; and, valuable land is not taken out of use.

How to overcome the barrier:

Farmers must be persuaded that it is within their best self-interest to manage the ground water. Failing that, it must be legislated and enforced.

Barrier Title: **Change the Approach to Flood Control**

Originator: Green

Barrier description:

Institutional - Flood control managers fear and resist sharing authority involved in developing multi-purpose projects as well as the loss of control associated with a dispersed rather than a central system.

Importance:

With a multi-purpose approach to managing stormwater, wetlands and habitat could be restored while recharge proceeds, and recreational and educational opportunities would be provided to the public.

How to overcome the barrier:

Apply political pressure on governing bodies as well as on the bureaucracy.

Barrier Title: **Institutional Arrangements that Hinder Water Supply Development**

Originator: Noyes

Barrier description:

There are single purpose agencies that do not cover the spectrum of water resources and multiple uses. Too much time and resources are spent in protecting turf. Some politicians take a short-term view.

Importance:

A perception exists that no one is in charge. It takes too long to get decisions made and projects implemented.

How to overcome the barrier:

Dialogue among agencies and stakeholders should be voluntary and based on a spirit of compromise. Some laws will need to be changed.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PRIORITY RANK 7

Lack of Public Trust that Harvested Waters are Safe for Use

ORIGINATORS:

Morton on behalf of himself, Birdzell, Carnahan, Moore, Orton, Salgaonkar, Swamikannu, and Weisberg

The following barriers were subsumed under the above title:

Barrier Title: **Developing Public Trust that Harvested Waters are Safe for Use**

Originator: Morton

Barrier description:

Members of the public will want assurances that harmful contaminants (e.g., pesticides, heavy metals) are neutralized before being put into the water supply, especially into the drinking water supply. Several communities are already losing faith in their drinking water systems, and learning that a potential source of their drinking water is harvested stormwater might cause greater alarm.

Importance:

A community needs the support of the public to pay for the treatment and distribution of stormwater and to be satisfied consumers.

How to overcome the barrier:

- Public education.
- Public access to information about treatment processes and compliance with appropriate water quality or health protection measures.

Barrier Title: **Convincing the Public that the Body of Science Supporting the Use of Stormwater is Accurate and Adequate**

Originator: Birdzell

Barrier description:

The trust of the public in the ability of the scientific and engineering communities to properly evaluate actions has eroded over the last four decades. The public is very sensitive to issues surrounding possible health issues.

Importance:

Public influence will have a direct impact on the acceptance of stormwater as a source of water supply.

How to overcome the barrier:

Public education and product marketing institute an aggressive education program describing the benefits and safety of stormwater.

Barrier Title: **Valuing Stormwater as a Part of the Water Supply**

Originator: Carnahan

Barrier description:

The public views stormwater as a wastewater with no value. However, the cost of managing stormwater is an expense to the tax payer. The public has no concept of the value of water, whether it is groundwater, surface water, or stormwater.

Importance:

Although stormwater is polluted, it does have a value as a resource. The use of natural systems to treat this water would provide a useable resource (water supply) and prevent pollution. The economic benefits to the public would be an augmented water supply and a reduction in pollution.

How to overcome the barrier:

Inform the public of the economic value of investing in treatment and retention of stormwater.

Barrier Title: **Negative Public Perception of the Driving Forces Behind the Program**

Originator: Moore

Barrier description:

The ordinary citizen may perceive this process as an attempt to force contaminated or poor-quality water onto the consumer just to save money for the water districts.

Importance:

A negative public perception can undermine a project. Example: A local water district was looking for alternative methods of wastewater disposal during periods of low demand for reclaimed water. The method proposed would involve tertiary treatment, nutrient removal by a wetland system, and final discharge to a creek which is the primary tributary to an estuary. The estuary had been identified on several federal lists as being impacted by eutrophication. In order to facilitate the EIR and permit approval process, the project was proposed as a Wetlands Water Supply Project. The path taken by this local water district was perceived as underhanded by local environmental groups. Any benefits which may arise from this project will be over shadowed by the negative perception of the initial action.

How to overcome the barrier:

Enlist the services of a public relations expert prior to the start of the project. Outline the steps for proposal, approval, and implementation of the project. Have the expert evaluate each step with respect to the possible impacts to public perception. Modify, as necessary, to eliminate or reduce the negative impacts.

Barrier Title: **Avoid the Potential to Backtrack on Efforts to Prevent and Control Pollution at the Source**

Originator: Morton

Barrier description:

Stormwater treatment and harvesting should not lead to a de-emphasis on pollution prevention efforts, use of best management practices, and efforts to make non-point sources more accountable for controlling their runoff. If members of the public believe their runoff will eventually receive treatment, they could become less willing to initiate personal actions to prevent and manage stormwater pollution.

Importance:

- There is a need to protect surface waters and habitats in areas "upstream" of the beginning of the community's collection and treatment system.

- It is also important that significant sources of pollution are not allowed to pass the costs of their pollution onto others. Pollution prevention efforts are cost-effective approaches to protecting water quality.

- Avoid "resting on our laurels."

How to overcome the barrier:

Include stormwater treatment and harvesting as elements of a larger, integrated strategy to manage stormwater pollution.

Barrier Title: **Need a Leader/Champion For Stormwater Harvesting**

Originator: Orton

Barrier description:

Without someone who really wants to do it, who can envision it and make it fun...it will not happen, or it will happen poorly.

Importance:

Any new idea for public works needs a champion. Otherwise, the concept submerges and is overwhelmed by opposing views and minutiae.

How to overcome the barrier:

- Identify who stands to gain the most from stormwater harvesting.

- Fund the person so they can devote their best energies to promoting the idea.

- Provide them with contacts such as the mailing list for this workshop.

Barrier Title: **Dry Weather vs. Wet Weather Urban Runoff Reclamation**

Originator: Salgaonkar

Barrier description:

Capturing wet weather is a complex issue and may seem intimidating to some. People may lose patience and give up or lose motivation – a definite barrier to successful harvesting.

Importance:

Use dry weather runoff reclamation projects as a pilot project to set an example for how treatment/collection will work and how costs can be addressed. Show the benefits of pollution reductions in the bay as well as an alternative source of supply to build public trust and confidence.

How to overcome the barrier:

- Incentives to recycle dry weather urban runoff.
- Take small steps with small projects and build confidence.

Barrier Title: **Public Perceptions on Potability**

Originator: Swamikannu

Barrier description:

Public perceptions on contaminated sources of potable water may hinder reuse when alternative sources are available.

Importance:

Public perceptions influence political acceptance and commercial viability.

How to overcome the barrier:

Public perceptions can be changed through demonstration projects, outreach and education programs.

Barrier Title: **Public Perception of Water Quality**

Originator: Weisberg

Barrier description:

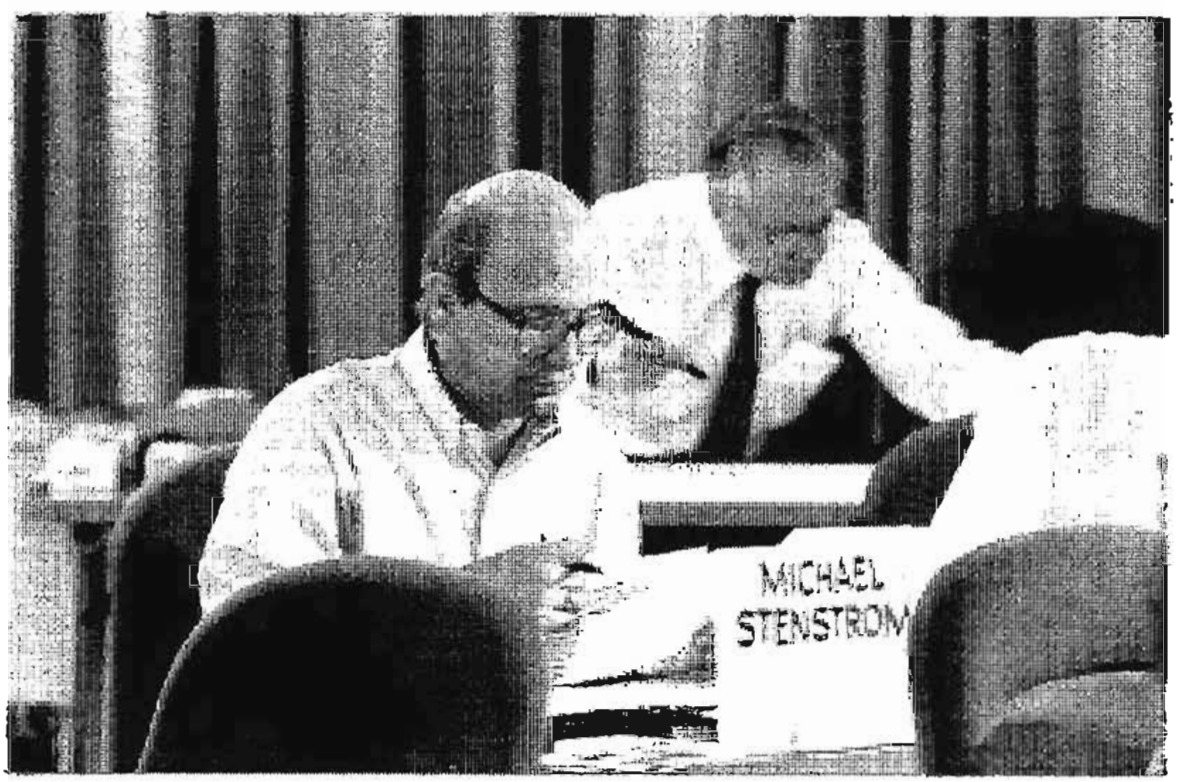
In southern California, the public has been well educated not to swim near storm drains because of organic pollution and bacterial contamination. They may have difficulty accepting re-use of the same water.

Importance:

Stormwater harvest will require considerable capital expenditures in both dollars and land-use allocation. The public's will to undertake these expenditures must be enhanced.

How to overcome the barrier:

- Public education.
- Proof of concept tests.



PRIORITY RANK 8

Lack of Motivation, Economic Rationale, and Resources for Strategic, Long-Term Planning

ORIGINATORS:

Drennan on behalf of himself, Lackner, Stenstrom, Taylor, and Watson

The following barriers were subsumed under the above title:

Barrier Title: **Short-Term Thinking**

Originator: Drennan

Barrier description:

Solutions such as developing water supplies to carry us through droughts require a long-term vision (over the next 20-50 years). However, the public and elected officials want to see immediate results and experience instant gratification.

Importance:

Changes in water supply policy to land use policy require long-term planning. The lack of changes in our water supply and land use policies will continue to result in the negative impacts we are already aware of.

How to overcome the barrier:

Need to educate ourselves and the public about the long-term benefits of solutions as well as the long-term impacts if we do nothing.

Barrier Title: **Lack of Need**

Originator: Lackner

Barrier description:

Harvesting of stormwaters will require significant public buy-in, either in the form of changing habits or accepting taxes/fees to build treatment facilities. In areas of the country where there is no lack of water supply, people will not accept the need to change habits or fund facilities.

Importance:

Without public acceptance of the need to harvest stormwater, there will be no funding for such a project and no support for politicians in favor of it.

How to overcome the barrier:

Education of the public as to the need for stormwater harvesting. This would include education on the approach and methods to be used in harvesting.

Barrier Title: **When You Have It, You Need It the Least**

Originator: Stenstrom

Barrier description:

During rains, stormwater exists in abundance but can rarely be directly used; it must be stored. The problem also exists over seasons and droughts. During wet periods, we ignore water consumption and recycling programs. During droughts, we rush to find solutions. We need to sustain our effort across wet and dry periods.

Importance:

Technical problems - need large areas for reservoirs.

How to overcome the barrier:

Need to change public perception of drought.

Barrier Title: **Let's Keep History in Mind**

Originator: Taylor

Barrier description:

There have been a lot of water supply (harvest) projects constructed in the United States that are of debatable value (e.g., Central Arizona Project). These projects should be viewed as sunk costs and re-evaluated, as appropriate, to determine their ability to serve the public.

Importance:

Stormwater is a finite resource. As pointed out (by J. Salgaonkar), to maximize our efficiency of the use of this resource will tend to minimize associated problems.

How to overcome the barrier:

Charge the government to look at the efficiency and value of the huge harvest infrastructures currently in place (e.g., Bureau of Reclamation, Tennessee Valley Authority).

Barrier Title: **The Twin Scourges of Myopic Vision and Mutual Distrust**

Originator: Watson

Barrier description:

Individuals and groups often focus so strongly on particular issues that they cannot or will not recognize the validity of other perspectives. This is magnified by the tendency to distrust individuals and particularly organizations with other points of view.

Importance:

This barrier is important because individuals and groups will tend to look at increased harvesting of stormwater from limited perspectives, to distrust proponents, and to automatically react in opposition to such harvesting.

How to overcome the barrier:

Conduct more gatherings, such as this one, to bring people with different perspectives together. Proponents will need to listen and actually address the concerns of others.


NWRI


NWRI

PRIORITY RANK 9

Variability of Runoff Water Quality is Poorly Understood

ORIGINATORS:

Schiff on behalf of himself and Orton

The following barriers were subsumed under the above title:

Barrier Title: **Variability of Runoff Water Quality is Poorly Understood**

Originator: Schiff

Barrier description:

Water quality in stormwater runoff (at least in southern California) is tremendously variable, often changing concentrations one order of magnitude within and among storm events in a single channel.

Importance:

If treatment is required for harvested stormwaters, then an understanding of when and where the poorest (or best) water quality occurs will help to reduce costs for re-use.

How to overcome the barrier:

Substantial temporal frequency in sampling stormwaters would be required to understand when and where significant water quality changes occur. Alternatively, on-line real-time monitoring would be required.

Barrier Title: **Inadequate Tools for Real-Time, Broad-Spectrum Water Quality Monitors; Institutional Resistance to Same**

Originators: Orton

Barrier description:

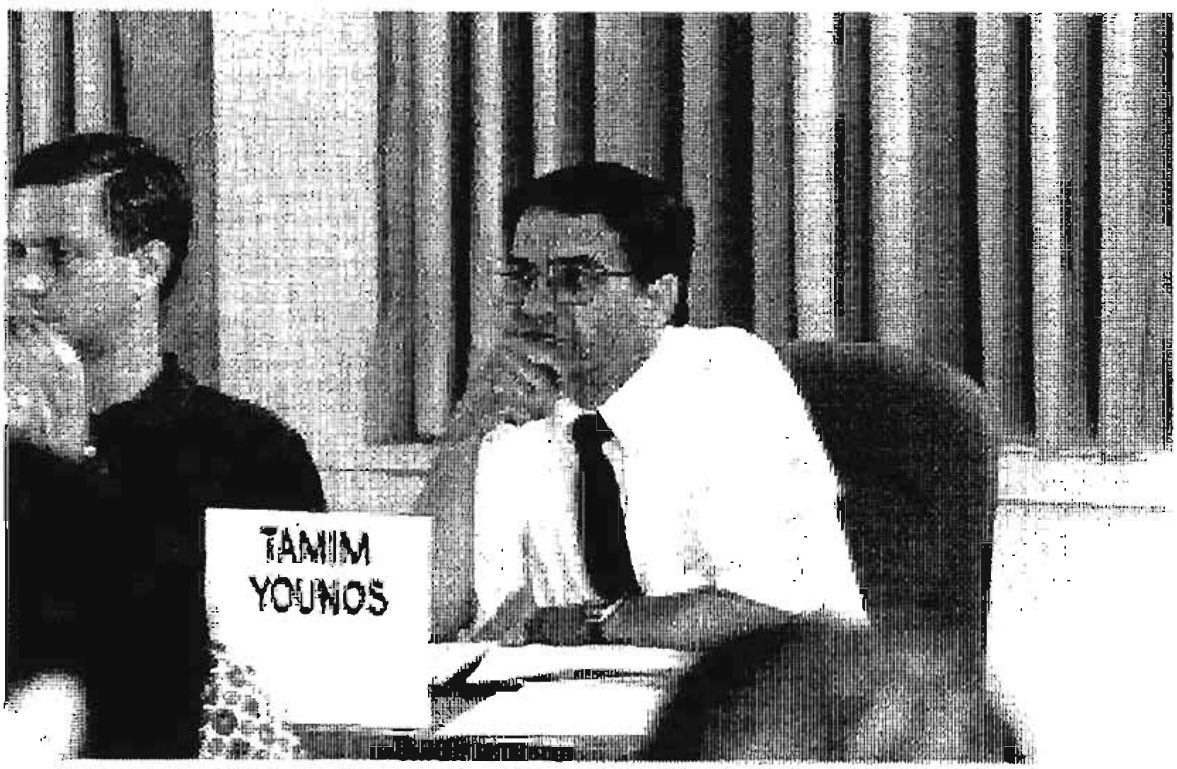
Variability of stormwater quality and the fast time course of storm events demand that harvesters know what they are getting - quality wise. This will require advanced monitoring methods for pathogens and other contaminants. However, resistance to methods' improvement may come from the regulated community, since methods used for standards compliance must be accessible equally to all who must comply with standards. Poor communities may resist new methods.

Importance:

Both the ability to avoid very poor stormwater and public/regulatory acceptance of treated stormwater depend on knowing what is in it.

How to overcome the barrier:

Organize proponents to lobby for funds for applied and basic research into real-time monitoring of pathogens and organic pollutants.



PRIORITY RANK 10

Developing Regulations Based on Defined Technical Protocols for Implementation of Stormwater Harvesting

ORIGINATORS:

Kasper on behalf of himself, Orton, Taylor, and Younos

The following barriers were subsumed under the above title:

Barrier Title: **Lack of Regulatory and Technical Protocols Defining Harvested Water Quality**

Originator: Kasper

Barrier description:

Water suppliers require specific protocols for analyses of harvested water prior to use in potable systems. Through the application of such protocols, water purveyors reduce their potential liability to acceptable levels. The existing potable water maximum contaminant loads (MCLs) do not address all the contaminants potentially in stormwater runoff. Analytical protocols (sampling frequencies, detection limits, etc.) need to be defined.

Importance:

- Water suppliers will not harvest water unless its quality meets regulatory requirements, thereby minimizing potential liabilities.
- Source control effectiveness cannot guarantee absence of contaminants.

How to overcome the barrier:

- Recognize the lack of specific protocols as barriers.
- Support research efforts to develop monitoring protocols.
- Determine if existing potable water standards are adequate for harvested stormwaters.

Barrier Title: **Inadequate Tools for Real-Time, Broad-Spectrum Water Quality Monitors; Institutional Resistance to Same**

Originator: Orton

Barrier description:

Variability of stormwater quality and the fast time course of storm events demand that harvesters know what they are getting - quality wise. This will require advanced monitoring methods for pathogens and other contaminants. However, resistance to methods' improvement may come from the regulated community, since methods used for standards compliance must be accessible equally to all who must comply with standards. Poor communities may resist new methods.

Importance:

Both the ability to avoid very poor stormwater and public/regulatory acceptance of treated stormwater depend on knowing what is in it.

How to overcome the barrier:

Organize proponents to lobby for funds for applied and basic research into real-time monitoring of pathogens and organic pollutants.

Barrier Title: **Ensuring Public Health and Long-term Viability of Stormwater Recharge to Aquifers**

Originator: Taylor

Barrier description:

There is a relatively poor understanding of the chemical, physical and biological reactions, and transport of chemical contaminants in aquifers. There may be a significant number of chemical contaminants introduced by stormwater recharge that are not tracked by current monitoring programs or for which there are no drinking water standards. Recharge now tends to take place until a problem is discovered.

Importance:

Surface waters contain unknown contaminates that may render an aquifer unusable, impact public health, and require remediation of the aquifer. Groundwater cleanup is very difficult, to nearly impossible, in some cases. Long-term build-up of contaminants in the unsaturated zone of the aquifer may require a future cleanup effort; or, in the worst case, the aquifer may have to be abandoned.

How to overcome the barrier:

Biological testing should be carried out on the recharge and recovered water. All recharge projects should include testing/monitoring prior to recharge and during recharge operations over the life of the project.

Barrier Title: **Integrating Technological Know-How into Regulatory Requirements to Enhance Feasibility of Cost-Effective Rainfall Harvesting in Rural Areas**

Originator: Younos

Barrier description:

Economy of scale is a problem. Rainfall harvesting would not be economically feasible for a community water system mainly because of required treatment and delivery (pumping) costs. It would be feasible for individual households where water treatment is not regulated, and pumping costs could be insignificant.

Importance:

Any system design should be economically feasible. Unless the cost is subsidized, consumers in a small community would not be able to afford the system.

How to overcome the barrier:

The operation and maintenance of small systems and individual household water supplies should be integrated within the operation of larger systems (someone should take the responsibility). To reduce the treatment costs for rainfall harvesting, less stringent water quality standards (without compromising the consumer health) may be necessary. For larger communities, a water treatment system, in conjunction with a constructed wetland (as a pretreatment unit), should be given consideration.

Barrier Title: **Lack of Design Parameters that Hinder Integrating Constructed Wetlands into Rainfall Harvesting Design**

Originator: Younos

Barrier description:

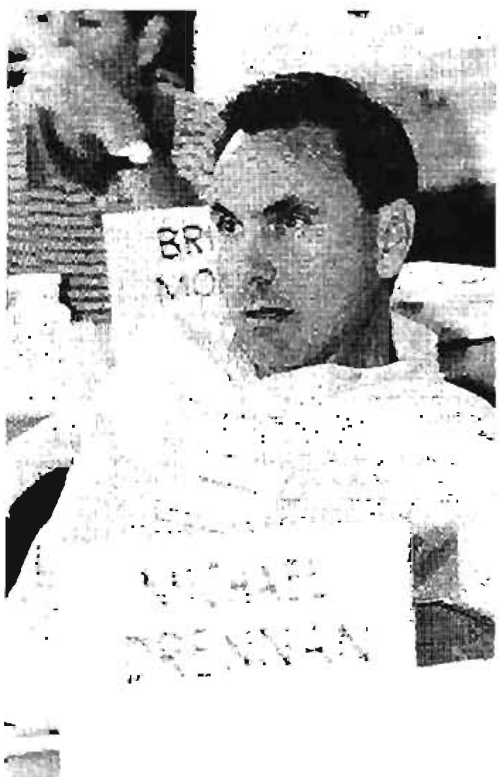
Water quality and treatment costs.

Importance:

Improved water quality; reduced costs.

How to overcome the barrier:

More research is needed to determine design parameters for various runoff waters and geographic locations.



PRIORITY RANK 11

Reaching Agreement Among Multiple Stakeholders/Users About Equitable Solutions

ORIGINATORS:

Drennan on behalf of himself, Noble, and Watson

The following barriers were subsumed under the above title:

Barrier Title: **Reaching Agreement Among Multiple Stakeholders About Equitable Solutions**

Originator: Drennan

Barrier description:

Solutions must be crafted in such a way as to assure all stakeholders that their issues have been addressed. Often, a lack of trust among traditionally-opposing parties prevents progress towards even an interim solution, because all sides feel it is safer to stick to their idealistic position than it is to make some concessions.

Importance:

There are multiple issues/needs/objectives involved in harvesting stormwater. Multi-purpose solutions are therefore the only ones which will work.

How to overcome the barrier:

- Build trust among traditionally-opposing parties.
- Recognize concessions do not need to imply a lack of integrity with your ideals.
- Build consensus by identifying benefits to all stakeholders.

Barrier Title: **Multiple Uses - Stormwater Harvesting Conflicts**

Originator: Noble

Barrier description:

Stormwaters harvested for multiple uses (e.g., agricultural, public water supply, etc.) will inherently involve conflicting interests of treatment methods, costs involved, and advancement of technologies. Stormwater systems in nature are not easily delineated by origin, ownership, or travel path.

Importance:

Re-use of stormwater will depend upon the public's acceptance and investment in treatment costs, planning, development, etc. Multiple uses of stormwater make it difficult to appeal to the public if uses will not benefit all. How multiple uses of stormwater are determined in relation to public health risk will be important for public acceptance. Planning will determine the efficiency of multiple uses for stormwater. Regulations regarding who stormwater "belongs" to will need to be addressed, as well as modification of existing regulations.

How to overcome the barrier:

- Development of stormwater harvest methods with multiple uses and the conflicts inherent to these uses in mind.

- Technological advances in containment; examination of aspect of storage problems for certain uses; and, cost-effective measures to treat stormwater so that it is available for multiple uses.

- Public acceptance of multiple uses which may not directly benefit all of the general public.

Barrier Title: **The Twin Scourges of Myopic Vision and Mutual Distrust**

Originator: Watson

Barrier description:

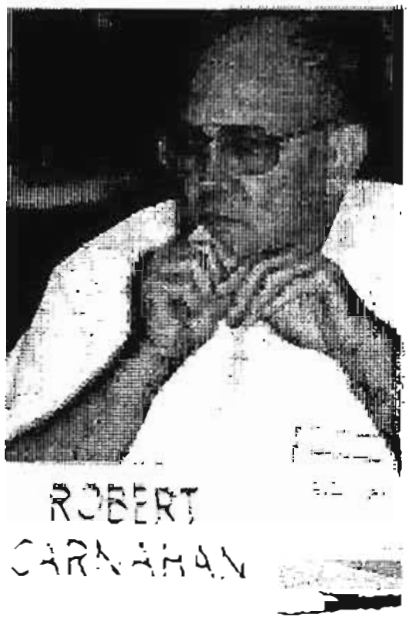
Individuals and groups often focus so strongly on particular issues that they cannot or will not recognize the validity of other perspectives. This is magnified by the tendency to distrust individuals and particularly organizations with other points of view.

Importance:

This barrier is important because individuals and groups will tend to look at increased harvesting of stormwater from limited perspectives, to distrust proponents, and to automatically react in opposition to such harvesting.

How to overcome the barrier:

Conduct more gatherings, such as this one, to bring people with different perspectives together. Proponents will need to listen and actually address the concerns of others.


ROBERT
CARNAHAN


KEN
GINNY
LACKNER

PRIORITY RANK 12

Elevated Contaminant Concentrations in Stormwater which Result from Land-Use Patterns and Lack of National Manufacturing Standards Limit Use as a Resource

ORIGINATORS:

Swamikannu on behalf of himself, Carnahan, Lackner, and Lindstrom

The following barriers were subsumed under the above title:

Barrier Title: **Contaminant Concentrations in Stormwater Limit Use as Drinking Water Source**

Originator: Swamikannu

Barrier description:

Concentrations of pathogenic indicators, as well as toxic and conventional pollutants found in stormwater, commonly exceed drinking water standards.

Importance:

Pollutant concentrations in stormwaters affect the cost of satisfactory treatment to render it potable.

How to overcome the barrier:

- Pollutant concentrations can be lowered using improved technology.
- Public behavioral changes can be effected through education.

Barrier Title: **Land Use Limits the Use of Stormwater as a Water Supply**

Originator: Carnahan

Barrier description:

Local zoning and land use legislation dictate the type and the rate at which lands may be used. This impacts directly on the quantity and the quality of stormwater discharged from this land.

The use of land determines the hydrological discharge and the water quality of the runoff. For example, urban runoff will occur quickly due to the imperviousness of the area, and the runoff will contain higher concentrations of heavy metals than the same rainfall events occurring in a rural area. Rural runoff will contain higher concentrations of nutrients than urban runoff caused by a similar rain event.

Importance:

The rates of discharge from a given land area will determine the way the quantity of water may be managed. The rate of discharge will certainly determine the methods used to retain the stormwater. It is impracticable to retain flows resulting from intense storms in urban areas. The time of concentration is too short, and the quantity of water is too great.

There is some question as to whether the first-inch of runoff from an area contains the majority of the pollutants. If the entering volume of runoff is retained, then the treatment of this water becomes complex. In Florida, if aquifer storage is used as a retention process, any water that is injected into the aquifer must be pretreated to remove potential pollutants. Water quality is a serious problem that becomes more complex without consistent land management.

How to overcome the barrier:

Effective planning and rational legislation are the first elements in overcoming this barrier. Better technologies need to be developed to treat and cope with the massive problems of retention and treatment of stormwater.

Barrier Title: **Contamination through Surface Contact**

Originator: Lackner

Barrier description:

Stormwater runs off streets and highways contaminated with oil and grease; off lawns, gardens, and agricultural areas with pesticides; and, off hundreds of other surfaces that have accumulated contaminants. Many contaminants in the air pollute stormwater.

Importance:

Many contaminants make stormwater unfit for human consumption.

How to overcome the barrier:

Attempts have been made to keep surfaces cleaner and prevent contamination of surface runoff; however, even assuming that the public can be educated not to unnecessarily pollute in urban areas, it may never be feasible to have surfaces clean enough so that stormwater can be used as a part of the water supply. The only way to overcome this barrier will be by instituting stormwater treatment.

BARRIER TITLE: **National Pollution Prevention Standards for Transportation and Manufacturing to Reduce Contamination of Stormwater**

ORIGINATOR: Lindstrom

Barrier description:

The automobile and other transportation modes (trucks, airplanes, etc.) contribute significantly to the release of environmental contaminants. Changing the design, manufacturing, and basic nature of some of these components is a significant technological, social, economic and institutional barrier.

Importance:

Release of copper, lead, chromium, oils and grease, and numerous other contaminants to roadways pollute stormwater. These pollutants are expensive and difficult to remove and will contaminate soils upon percolation.

How to overcome the barrier:

- Scientific research needed on new components (paints, chromium, brakes, tires, lubricant seals).
- Technical: design standard for components (sealed lubrication, paints, cleaners, coatings, wax, etc.).
- Economic: how it affects manufacturing and consumer costs.
- Political: public acceptance/safety standards, etc.

PRIORITY RANK 13

Public Perception that Existing Water Resources Should be Used More Efficiently (Maximize Value) Before Developing New Water Supply Sources

ORIGINATORS:

Salgaonkar on behalf of himself, Green, and Taylor

The following barriers were subsumed under the above title:

Barrier Title: **Maximizing Value of Existing Resources Before Developing New Sources**

Originator: Salgaonkar

Barrier description:

Current water resources are not being appropriately used for their highest value - agricultural users pay $10 to $20/AF and grow crops. Can that water be directed to southern California and increase its value to $400/AF? Can some crops be grown elsewhere (out of state or out of the country) so that the displaced water can be used in other areas and its value maximized?

Importance:

Until we have inexpensive sources of water, it will be difficult to implement new methods/resources.

Urban Use	- 20%	- Provide 75% value (economic)
Agriculture Use	- 75%	- Provide 25% value (economic)
Environmental Use	- 05%	- Provide ? value (economic)

How to overcome the barrier:

- Subsidies to not grow low-value products.
- Legislation.
- Economic incentives.
- Consensus process similar to Bay-Delta.

Barrier Title: **Use What Supplies We Have More Efficiently; Demand-Side Management**

Originator: Green

Barrier Description:

Growth of population and demands on our limited water supply from all sectors: agriculture, urban, and the environment.

Importance:

Rigorous demand-side management would greatly reduce our need to harvest additional stormwater.

How to Overcome the Barrier:

- Economics incentives - increasing block rates.
- Changes in water rights law - no more "use it or lose it."
- Political will to discipline ourselves to be efficient, especially in the agricultural community.
- Mandatory demand-side management.

Barrier Title: **Let's Keep History in Mind**

Originator: Taylor

Barrier description:

There have been a lot of water supply (harvest) projects constructed in the United States that are of debatable value (e.g., Central Arizona Project). These projects should be viewed as sunk costs and re-evaluated, as appropriate, to determine their ability to serve the public.

Importance:

Stormwater is a finite resource. As pointed out (by J. Salgaonkar), to maximize our efficiency of the use of this resource will tend to minimize associated problems.

How to overcome the barrier:

Charge the government to look at the efficiency and value of the huge harvest infrastructures currently in place (e.g., Bureau of Reclamation, Tennessee Valley Authority).

PRIORITY RANK 14

Water Rights Issues Can Become a Significant Barrier if Additional Stormwater Supply is Developed

ORIGINATORS:

Tucker on behalf of himself, Noble, and Schroeder

The following barriers were subsumed under the above title:

Barrier Title: : **Water Rights**

Originator: Tucker

Barrier description:

In most western states, water is appropriated and is a form of property right. Stormwaters may already be taken by downstream users or be appropriated by others. If that is the case, the stormwater could not be harvested.

Importance:

A potential water harvester may not have a "right" to use the water if such water is "owned" or has been appropriated by others.

How to overcome the barrier:

Define water rights for the basin in question to see if it is a problem. If it is a problem, there may be a possibility of acquiring the water rights or effecting trades. If stormwaters have not been appropriated by others, then filings could be made to protect the proposed use.

Barrier Title: **Possession of Stormwater: Regulation, Examination, and Modification**

Originator: Noble

Barrier description:

Who owns the stormwater before/after harvesting? Upstream rainfall flows through areas picking up more and more contaminants. In rural areas, the accumulation of contaminants may not be as great. How do we regulate the possession of stormwater? Should we have different regulations based upon different parameters?

Importance:

Loss of stormwater due to downstream flow must be either controlled or estimated to equally distribute the benefits of the end-point stormwater-harvest product. Regulations may need to be tailor-made for different areas based upon a few key factors (not exhaustive):

- Residential vs. Urban.
- Land use.
- Population density.
- Use of harvested water.

How to overcome the barrier:

- Model economic impacts and benefits, incorporating public expenses such as tax revenues.
- Model flow of stormwater through the system in question.
- Determine the effects of stormwater harvesting upstream, midstream, and downstream versus single-point harvest in downstream location. (Flow rate and contaminant levels are higher downstream at certain times, but stormwater flow is more consistent which may make year-round harvesting a more efficient option.)

Barrier Title: **Water Rights Issues Can Become a Significant Barrier if Additional Stormwater Supply is Developed**

Originator: Schroeder

Barrier description:

Water rights, especially in western states, must be considered when planning to develop additional water sources. Water rights have frequently been allocated by prior agreements, adjudications, or other legal procedures. Capturing and using additional stormwater above, and beyond historic diversions that have been legally allocated, sets up potential conflicts over the rights to the additional water. Also, "environmental" water rights have become important concerns that might limit diversions (e.g., Sacramento/San Joaquin Delta).

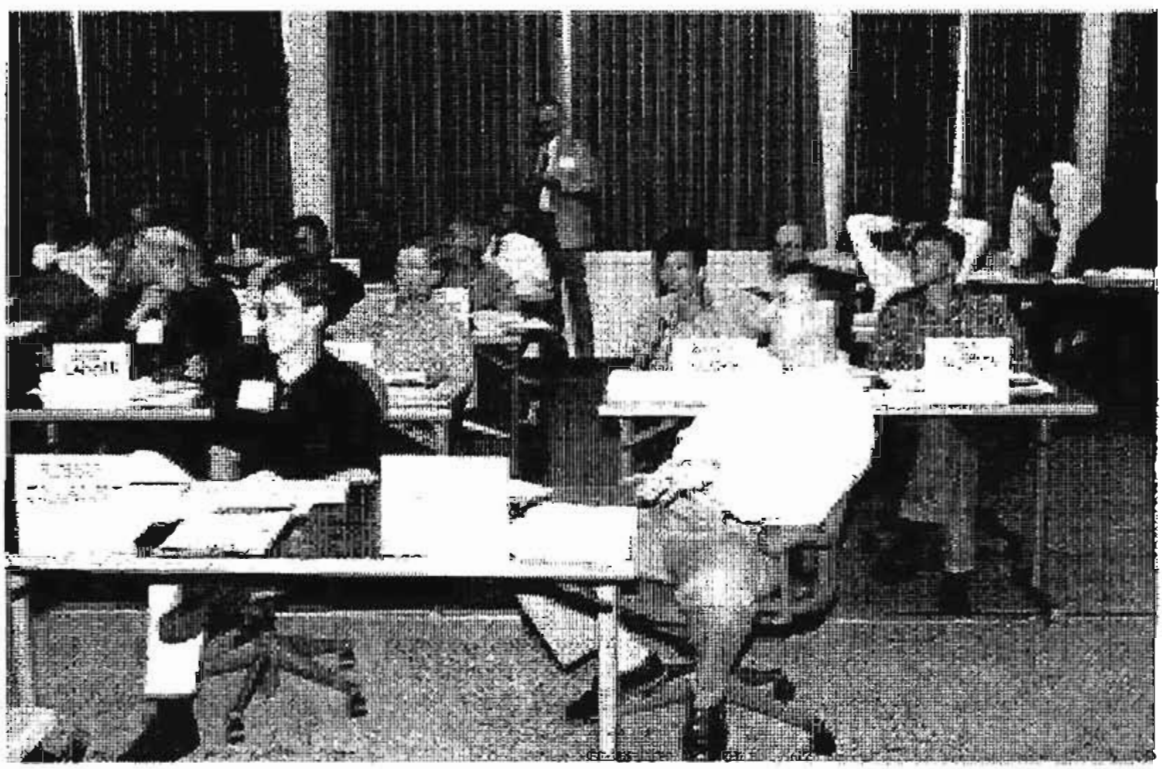
Importance:

Water rights confrontations can often create political, institutional and legal barriers to project implementation even if technical and economic conditions are favorable when the project is evaluated on its own merits.

How to overcome the barrier:

- Identify all interests early that could potentially have a stake in water rights, and seek solutions that could mutually benefit all parties.

Review water rights law to determine if there are opportunities to change laws to better accommodate the capture of excess storm flow.



PRIORITY RANK 15

Legal Barriers and Preoccupation with the Risk of Litigation

ORIGINATORS:

Watson on behalf of himself, Lackner, and Swamikannu

Barrier description:

There may be states and communities with specific laws and ordinances against the re-use of stormwater for their water supply. Potential legal liability for adverse affects resulting from the re-use of stormwater and the risks from potential litigation may be barriers to the development of increased stormwater harvesting.

Importance:

The potential for legal liability, the existence of local ordinances or state laws restricting the re-use of stormwater, and the risks of litigation could limit the implementation of increased stormwater harvesting for water supply.

How to overcome the barrier:

The Clean Water Act and other related laws need to be amended to limit legal liability and decrease the emphasis on litigation. State and local laws may also require amendments to remove specific barriers to the implementation of increased stormwater harvesting.

The following barriers were subsumed under the above title:

Barrier Title: **Possible Legal Barriers**

Originator: Lackner

Barrier description:

There may be communities or areas which have specific laws against the re-use of stormwaters for water supply. Specific public health concerns may precipitate such laws. The Safe Drinking Water Act may make it impossible to use stormwater as water supply due to the contaminants it contains.

Importance:

Laws prohibiting re-use of stormwater for water supply, or even laws containing maximum contaminant levels for water supply, could effectively make it illegal to harvest stormwater.

How to overcome the barrier:

Politicians would need to be lobbied and convinced to repeal or modify such laws. To this end, it would be helpful to have concrete scientific data and research establishing true levels of concern. Overcoming this barrier would also require technology which could cost-effectively treat stormwater.

Barrier Title: **Legal Liability Derivatives from Potential Adverse Human Health Impacts**

Originator: Swamikannu

Barrier description:

Legal liability if claims of adverse health impacts cannot be convincingly and factually dispelled.

Importance:

Failure to address legal liability will chill commercial and public distribution/utilization.

How to overcome the barrier:

Legal liability can be limited through legislation.

Barrier Title: **The Preoccupation with and the Cost of Litigation**

Originator: Watson

Barrier description:

Our society, and implementation of the Clean Water Act in particular, has become preoccupied with litigation as a tool and a threat.

Importance:

Resources that could be used to address real problems are spent on litigation.

How to overcome the barrier:

The Clean Water Act and other key pieces of legislation need to be amended to decrease the emphasis on litigation. This could include the use of arbitration as a means of settling disputes.


PATRICIA
LINSKY

PRIORITY RANK 16

Community Impacts of Construction and Operating Facilities: Minimization of Cost, Disruption, and Rebuilding

ORIGINATORS:

Morton on behalf of himself, Noble, and Tucker

The following barriers were subsumed under the above title:

Barrier Title: **Community Impacts of Constructing and Operating Facilities**

Originator: Morton

Barrier description:

Many projects are sited in urbanized sectors with large populations of low-income residents usually because of lower land values and diminished political power.

Importance:

Quality of life in these communities: Often, low-income neighborhoods are disproportionately affected by siting discussions and operations. The residents need to be part of decisions that impact that quality of life in these neighborhoods.

How to overcome the barrier:

- Early in the design and planning of large projects, incorporate the concerns of a broad cross-section of the community.
- Be inclusive.
- Consider potential adverse impacts of construction and maintenance to localized communities.

Barrier Title: **Add to Urban Development: Minimization of Rebuilding Structures Necessary for Effective Harvest**

Originator: Noble

Barrier description:

Planning and development should proceed with an effort to save public dollars and also should incorporate "smart" use of existing structures for stormwater retention.

Importance:

- Improves public perception of benefits incurred without extra investment and community disruption.
- Recycles key resources.
- Saves space in urban environments.
- Allows focus on harvest process - advancement of technologies.

How to overcome the barrier:

- Knowledgeable development and planning in urban areas (are crucial steps in taking advantage of resources which are already in existence).
- Examinations of historical rainfall, storm drain function, flow rate data, and effectiveness of structure designs (such as retention ponds) will allow the functioning stormwater harvesting plant to run at the highest efficacy and efficiency.

Barrier Title: **Cost and Disruptiveness of Construction of Large Facilities in Urban Areas**

Originator: Tucker

Barrier description:

Large facilities will be needed for collection, storage, and treatment of stormwater. In dense urban areas, it will be expensive and disruptive to construct such facilities.

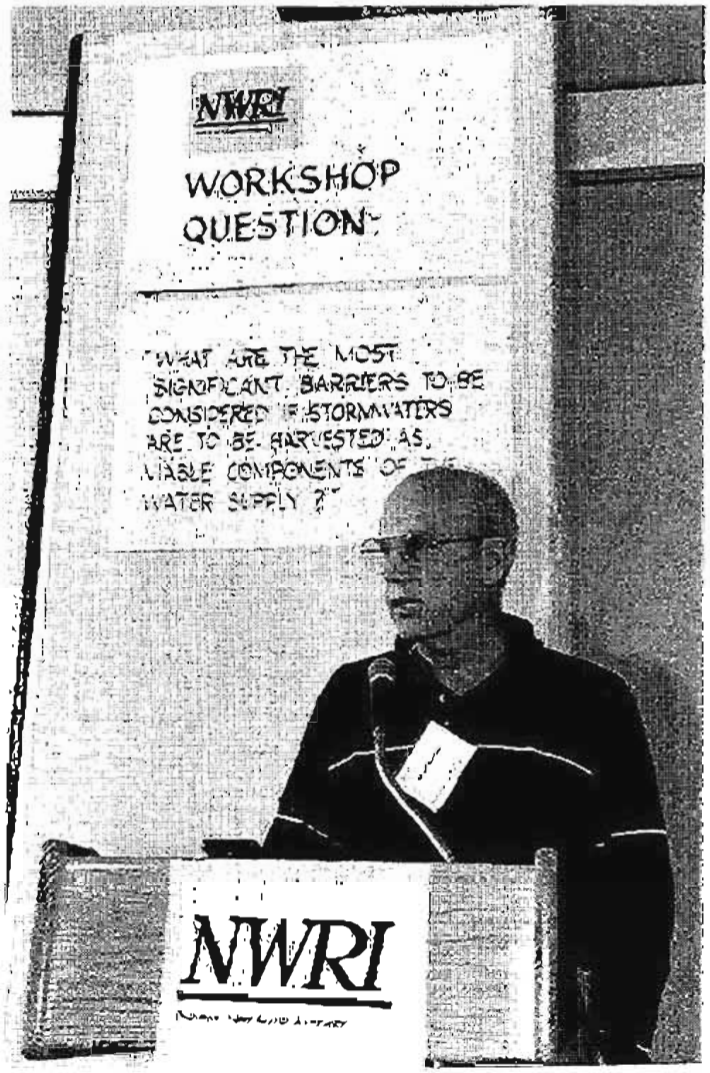
Importance:

Cost is always an issue. If costs are too high, stormwater harvesting will not be cost effective. The construction of large facilities can be disruptive in terms of transportation, other utilities, access to businesses and public inconvenience which could result in a lack of public support, and/or organized opposition.

How to overcome the barrier:

- Underground construction.
- Public education and outreach programs.

Use of existing infrastructure to maximum extent possible.


NWRI
WORKSHOP
QUESTION:
WHAT ARE THE MOST
SIGNIFICANT BARRIERS TO BE
CONSIDERED IF STORMWATERS
ARE TO BE HARVESTED AS
VIABLE COMPONENTS OF
WATER SUPPLY ?
NWRI

PRIORITY RANK 17

Training and Education Needs for Rainfall Harvesting Technologies

ORIGINATOR:

Younos on behalf of himself

The following barriers were subsumed under the above title:

Barrier Title: **Revise Environmental Engineering and Water Resources Management Curricula to Include Rainfall Harvesting**

Originator: Younos

Barrier description:

Ancient courses.

Importance:

Educate a new breed of engineers and scientists in a multi-disciplinary fashion; integrate policy and technology.

How to overcome the barrier:

- Design new courses.
- Provide incentives to revise or develop new courses.

Barrier Title: **Institutionalizing Rainfall Harvesting for Drinking Water and Other Purposes**

Originator: Younos

Barrier description:

Lack of interest in state or local agencies in rainfall harvesting as a viable option.

Importance:

Need to proceed in an organized fashion with governmental support for research development and project implementation.

How to overcome the barrier:

Conduct workshops/symposia for state and local agency personnel to describe the technical feasibility and advantages of a rainfall harvesting system.

PRIORITY RANK 18

Fear of Unintended Consequences

ORIGINATORS:

Watson on behalf of himself, Morton, Orton, and Stenstrom

Barrier description:

Individuals and organizations will oppose increased harvesting of stormwaters to augment the water supply because of concerns that proponents will not adequately consider the risks and potential adverse impacts of doing so. Specific concerns may include the side effects of stormwater treatment and the potential to back track on efforts to prevent or control pollution at the source.

Importance:

This barrier is critical because our society increasingly makes public policy decisions on the basis of emotion, rather than thought. Also, there may be serious side effects of some treatment processes that could result in adverse impacts to the receiving water. Furthermore, pollution prevention and protection of upstream water could be de-emphasized.

How to overcome the barrier:

Proponents of increased stormwater harvesting must work closely with various interest groups to consider the potential benefits, the potential adverse impacts, and the costs of increased stormwater harvesting. Stormwater treatment and harvesting should be considered within the context of all overall stormwater management program. Representatives of the media will also need to be educated.

The following barriers were subsumed under the above title:

Barrier Title: **Avoid the Potential to Backtrack on Efforts to Prevent and Control Pollution at the Source**

Originator: Morton

Barrier description:

Stormwater treatment and harvesting should not lead to a de-emphasis on pollution prevention efforts, use of best management practices, and efforts to make non-point sources more accountable for controlling their runoff. If members of the public believe their runoff will eventually receive treatment, they could become less willing to initiate personal actions to prevent and manage stormwater pollution.

Importance:

- There is a need to protect surface waters and habitats in areas "upstream" of the beginning of the community's collection and treatment system.

- It is also important that significant sources of pollution are not allowed to pass the costs of their pollution onto others. Pollution prevention efforts are cost-effective approaches to protecting water quality.

- Avoid "resting on our laurels."

How to overcome the barrier:

Include stormwater treatment and harvesting as elements of a larger, integrated strategy to manage stormwater pollution.

Barrier Title: **Stormwater Treatment Side Effects (e.g., solids, DBPs)**

Originator: Orton

Barrier description:

Most treatment methods have their own impacts that emerge only after "feasibility" studies are over. For example, removing phosphorus from stormwater will generate more solids. Disinfection of stormwater with chlorine will yield disinfection by-products (DBPs), such as trihalomethane (THM), due to high concentrations of humic materials in stormwater.

Importance:

Due to the poorer quality of stormwater, the potential for treatment-related side effects is greater. Some side effects are economic (higher treatment costs).

How to overcome the barrier:

Study existing treatment plants to assess how they respond to higher concentrations and/or sporadic loading of solids and contaminants.

Barrier Title: **Stormwater Resources Will Not Be Adequate for Drought Protection**

Originator: Stenstrom

Barrier description:

The availability of stormwater depends upon rainfall. When it rains, droughts do not exist. We may increase short-term water availability and promote growth, creating larger demands for water. During a three- to five-year drought, stormwater resources will also disappear. We may create a worse problem during droughts.

Importance:

Solution: Long-term storage, 3 - 5 years.

How to overcome the barrier:

We must store and budget some of the stormwater harvest to be used during long-term droughts.

Barrier Title: **Fear of Unintended Consequences**

Originator: Watson

Barrier description:

Individuals and organizations will oppose increased harvesting of stormwaters to augment the water supply because of concerns that proponents will not adequately consider the risks and potential adverse impacts of doing so.

Importance:

This barrier is critical because our society increasingly makes public policy decisions on the basis of emotion rather than thought.

How to overcome the barrier:

Proponents of increased stormwater harvesting must work closely with various interest groups to consider the potential benefits, the potential adverse impacts, and the costs of increased stormwater harvesting. Representatives of the media will also need to be educated.

PRIORITY RANK 19

Urban Stormwater Capture is Limited, Expensive, and Involves the Loss of Habitat and Recreation. However, it is Cleanest and Involves the Private Sector in Retrofit

ORIGINATORS:

Green on behalf of herself, Carnahan, and Schiff

The following barriers were subsumed under the above title:

Barrier Title: **Capturing Water On-Site in Urban Areas Minimizes Problems of Contamination**

Originator: Green

Barrier description:

Cisterns installed on residential or industrial sites in urban areas to capture stormwater would entail major retro costs. However, stormwater captured and held in cisterns could be used for either aquifer recharge or applied directly on landscaping. Catchment surfaces that feed cisterns should be impermeable. Areas not used for cistern catchments should be paved with permeable materials so that at least some of the stormwater could percolate directly into the aquifer below.

Importance:

Water is least contaminated as it falls.

How to overcome the barrier:

Public acceptance and willingness to invest.

Barrier Title: **Lack of Private Sector Participation in Use of Urban Runoff as a Water Supply**

Originator: Carnahan

Barrier description:

Stormwater runoff from densely developed areas represents a threat of flooding and damage to the private sector. The private sector does not receive any tax rebate for implementing a storage or retention program. The private sector relies on the local government for control and protection.

Importance:

Stormwater may be recovered from malls, parking lots, and streets if pervious pavements, cisterns, and curbings are used. This will reduce the peak of the hydrograph and will extend retention time. The use of pervious pavement will permit recharge of the groundwater.

How to overcome the barrier:

Provide a reward or rebate program to the private sector.

Barrier Title: **Natural Groundwater Recharge is Compromised**

Originator: Green

Barrier description:

- Urban areas are paved over.
- Streams and creeks are channeled, thereby preventing meanders and causing streams to undercut their normal channel.
- Riparian habitat and wetlands are destroyed.

Importance:

Aquifers are depleted causing subsidence or seawater intrusion or other problems that further compromise our ability to use our underground aquifers to best advantage.

How to overcome the barrier:

- Require each urban parcel to retain some rain water on site.
- Change our approach to stormwater management.
- Restore wetlands and riparian habitat, wherever possible.

Barrier Title: **Cost and Contamination of Urban Lands Along Water Courses**

Originator: Green

Barrier description:

The land near our rivers and streams has been heavily industrialized. As a result, the land is highly contaminated in many places that might be appropriate for recharge facilities.

Importance:

Clean soil is needed to percolate water for recharge.

How to overcome the barrier:

There seems to be great interest in cleaning up brown fields for reuse. Costs and technology for clean up sufficient for spreading grounds are unknown.

Barrier Title: **Combining Stormwater Harvesting with Other Potential Beneficial Uses**

Originator: Schiff

Barrier description:

Initial and on-going costs of stormwater harvesting may be extreme (i.e., start-up/ collection, storage, treatment, delivery).

Importance:

If an alternative beneficial use can be realized by harvesting stormwater, then this resource will become more attractive to the public and incentivize private industry.

How to overcome the barrier:

Combining other beneficial uses with re-use will be inherent with stormwater harvesting (i.e., wetlands creation for treatment, new treatment technology, reduced pollution), but other beneficial uses outside of stormwater reclamation may include energy production generated from dry or wet weather flows, creation of more open space, and recreational uses, while maintaining flood protection.

PRIORITY RANK 20

Impact on Recreational Opportunities Resulting from Stormwater Harvesting

ORIGINATOR:

Morton

Barrier description:

Reducing the quantity of stream flows and alteration of habitat could potentially limit opportunities for personal recreation (e.g., swimming, kayaking, fishing, bird watching, etc.).

Importance:

- Could be a significant source of local revenue.
- Public support.

How to overcome the barrier:

Examine the potential impacts of stormwater harvest on recreational opportunities.

STRENGTH OF FEELING OF PARTICIPANTS AND SUBGROUP ANALYSIS

The following tables provide a quantitative sense of the degree of agreement (or lack of agreement) regarding barrier priorities between the 25 participants as well as between participants in each of the four subgroups: consultants, researchers, public agencies, and environmental advocates.

The strength of feeling tables show the number of times each barrier was chosen by a participant, as well as the total number of points it received. A priority rank of one (highest) gives ten points to that particular barrier, and a priority rank of ten (lowest on the ranking sheet) gives one point to the barrier. The strength of feeling expressed as a percentage assigns a numerical "grade" to the group's unanimity (or lack of unanimity) for each barrier they ranked. For example, if every participant selected the same barrier as his or her highest priority, then that barrier's strength of feeling will be 100%. If no one selected the barrier, then its strength of feeling will be zero. Intermediate strengths-of-feeling are computed by dividing the total number of points a barrier received on all the ranking sheets by the total number it could have possibly received (times 100) if each participant had selected it as his or her top priority.

TABLE 1

Barriers Ranked by All Participants (25)

Rank	Title	Times Picked/Pts.	Strength of Feeling
1.	Capability to Capture, Store, Treat, and Use Stormwater for Designated End Uses While Maintaining Essential System Hydrology, Hydraulics, and Services	23/154	61.6%
2.	Inability to Demonstrate to the Consumer/Public that Expenditures for Stormwater Harvesting are Appropriate Public Policy and Should Start Now	18/199	47.6%
3.	Environmental and Community Impacts of Stormwater Harvesting	15/112	44.8%
4.	Conflicts Between and Constraints from Federal, State, and Local Regulations may Limit or Prevent Project Implementation	19/112	44.8%
5.	Need to Determine the Extent of Stormwater Contamination to Design Appropriate Treatment Processes for Intended End Use	19/112	44.0%
6.	Institutional Barriers to Stormwater Harvesting	16/97	38.8%
7.	Lack of Public Trust that Harvested Waters are Safe for Use	14/96	38.4%
8.	Lack of Motivation, Economic Rationale, and Resources for Strategic Long-Term Planning	15/82	32.8%
9.	Variability of Runoff Water Quality is Poorly Understood	13/78	31.2%
10.	Developing Regulations Based on Defined Technical Protocols for Implementation of Stormwater Harvesting	12/73	29.2%
11.	Reaching Agreement Among Multiple Stakeholders/Users About Equitable Solutions	15/68	27.2%
12.	Elevated Contaminant Concentrations in Stormwater which Result from Land-Use Patterns and Lack of National Manufacturing Standards Limit Use as a Resource	11/59	23.6%
13.	Public Perception that Existing Water Resources Should be Used More Efficiently (Maximize Value) Before Developing New Water Supply Sources	9/52	20.8%

14.	Water Rights Issues Can Become a Significant Barrier if Additional Stormwater Supply is Developed	12/47	18.8%
15.	Legal Barriers and Preoccupation with the Risk of Litigation	11/30	12.0%
16.	Community Impacts of Construction and Operating Facilities: Minimization of Cost, Disruption, and Rebuilding	10/28	11.2%
17.	Training and Education Needs for Rainfall Harvesting Technologies	7/24	9.6%
18.	Fear of Unintended Consequences	8/22	8.8%
19.	Urban Stormwater Capture is Limited, Expensive, and Involves the Loss of Habitat and Recreation. However, it is Cleanest and Involves the Private Sector in Retrofit.	3/12	4.8%
20.	Impact on Recreational Opportunities Resulting From Stormwater Harvesting	0/0	0.0%

TABLE 2

Barriers Ranked by Consultant Participants (9)

Rank	Title	Times Picked/Pts.	Strength of Feeling
1.	Capability to Capture, Store, Treat, and Use Stormwater for Designated End Uses While Maintaining Essential System Hydrology, Hydraulics, and Services	9/65	72.2%
2.	Conflicts Between and Constraints from Federal, State, and Local Regulations may Limit or Prevent Project Implementation	8/50	55.6%
3.	Need to Determine the Extent of Stormwater Contamination to Design Appropriate Treatment Processes for Intended End Use	7/48	53.3%
4.	Inability to Demonstrate to the Consumer/Public that Expenditures for Stormwater Harvesting are Appropriate Public Policy and Should Start Now	7/46	51.1%
5.	Institutional Barriers to Stormwater Harvesting	6/35	38.9%
6.	Environmental and Community Impacts of Stormwater Harvesting	5/34	37.8%
7.	Lack of Motivation, Economic Rationale, and Resources for Strategic, Long-Term Planning	6/32	35.6%
8.	Developing Regulations Based on Defined Technical Protocols for Implementation of Stormwater Harvesting	4/29	32.2%
9.	Lack of Public Trust that Harvested Waters are Safe for Use	4/24	26.7%
10.	Variability of Runoff Water Quality is Poorly Understood	5/21	23.3%
11.	Elevated Contaminant Concentrations in Stormwater which Result from Land-Use Patterns and Lack of National Manufacturing Standards Limit Use as a Resource	4/19	21.1%
12.	Legal Barriers and Preoccupation with the Risk of Litigation	6/19	21.1%
13.	Reaching Agreement Among Multiple Stakeholders/Users About Equitable Solutions	4/18	20.0%
14.	Public Perception that Existing Water Resources Should be Used More Efficiently (Maximize Value) Before Developing New Water Supply Sources	3/18	20.0%

15.	Water Rights Issues Can Become a Significant Barrier if Additional Stormwater Supply is Developed	4/13	14.4%
16.	Fear of Unintended Consequences	3/9	10.0%
17.	Community Impacts of Construction and Operating Facilities: Minimization of Costs, Disruption, and Rebuilding	3/9	10.0%
18.	Urban Stormwater Capture is Limited, Expensive, and Involves the Loss of Habitat and Recreation. However, it is Cleanest and Involves the Private Sector in Retrofit	1/3	3.3%
19.	Training and Education Needs for Rainfall Harvesting Technologies	1/3	3.3%

TABLE 3

Barriers Ranked by Public Agency Participants (7)

Rank	Title	Times Picked/Pts.	Strength of Feeling
1.	Conflicts Between and Constraints from Federal, State, and Local Regulations may Limit or Prevent Project Implementation Conflicts	7/44	62.9%
2.	Institutional Barriers to Stormwater Harvesting	6/41	58.6%
3.	Capability to Capture, Store, Treat, and Use Stormwater for Designated End Uses While Maintaining Essential System Hydrology, Hydraulics, and Services	6/37	52.9%
4.	Inability to Demonstrate to the Consumer/Public that Expenditures for Stormwater Harvesting are Appropriate Public Policy and Should Start Now	5/36	51.4%
5.	Environmental and Community Impacts of Stormwater Harvesting	4/32	45.7%
6.	Lack of Public Trust that Harvested Waters are Safe for Use	4/28	40.0%
7.	Elevated Contaminant Concentrations in Stormwater which Result from Land-Use Patterns and Lack of National Manufacturing Standards Limit Use as a Resource	3/25	35.7%
8.	Need to Determine the Extent of Stormwater Contamination to Design Appropriate Treatment Processes for Intended End Use	6/24	34.3%
9.	Developing Regulations Based on Defined Technical Protocols for Implementation of Stormwater Harvesting	4/20	28.6%
10.	Variability of Runoff Water Quality is Poorly Understood	3/18	25.7%
11.	Water Rights Issues Can Become a Significant Barrier if Additional Stormwater Supply is Developed	3/17	24.3%
12.	Reaching Agreement Among Multiple Stakeholders/Users About Equitable Solutions	4/16	22.9%
13.	Community Impacts of Construction and Operating Facilities: Minimization of Costs, Disruption, and Rebuilding	4/13	18.6%
14.	Lack of Motivation, Economic Rationale, and Resources for Strategic, Long-Term Planning	3/9	12.9%

15.	Fear of Unintended Consequences	2/8	11.4%
16.	Public Perception that Existing Water Resources Should be Used More Efficiently (Maximize Value) Before Developing New Water Supply Sources	1/6	8.6%
17.	Training and Education Needs for Rainfall Harvesting Technologies	3/6	8.6%
18.	Legal Barriers and Preoccupation with the Risk of Litigation	2/5	7.1%

TABLE 4

Barriers Ranked by Research Participants (7)

Rank	Title	Times Picked/Pts.	Strength of Feeling
1.	Capability to Capture, Store, Treat, and Use Stormwater for Designated End Uses While Maintaining Essential System Hydrology, Hydraulics, and Services	6/44	62.9%
2.	Variability of Runoff Water Quality is Poorly Understood	5/39	55.7%
3.	Need to Determine the Extent of Stormwater Contamination to Design Appropriate Treatment Processes for Intended End Use	6/38	54.3%
4.	Environmental and Community Impacts of Stormwater Harvesting	5/37	52.9%
5.	Lack of Public Trust that Harvested Waters are Safe for Use	5/34	48.6%
6.	Inability to Demonstrate to the Consumer/Public that Expenditures for Stormwater Harvesting are Appropriate Public Policy and Should Start Now	5/28	40.0%
7.	Lack of Motivation, Economic Rationale, and Resources for Strategic, Long-Term Planning	4/26	37.1%
8.	Reaching Agreement Among Multiple Stakeholders/Users About Equitable Solutions	5/23	32.9%
9.	Developing Regulations Based on Defined Technical Protocols for Implementation of Stormwater Harvesting	3/20	28.6%
10.	Conflicts Between and Constraints from Federal, State, and Local Regulations may Limit or Prevent Project Implementation	3/17	24.3%
11.	Training and Education Needs for Rainfall Harvesting Technologies	3/15	21.4%
12.	Institutional Barriers to Stormwater Harvesting	2/14	20.0%
13.	Public Perception that Existing Water Resources Should be Used More Efficiently (Maximize Value) Before Developing New Water Supply Sources	3/13	18.6%
14.	Water Rights Issues Can Become a Significant Barrier if Additional Stormwater Supply is Developed	4/12	17.1%

15.	Elevated Contaminant Concentrations in Stormwater which Result from Land-Use Patterns and Lack of National Manufacturing Standards Limit Use as a Resource	3/11	15.7%
16.	Legal Barriers and Preoccupations with the Risk of Litigation	3/6	8.6%
17.	Community Impacts of Construction and Operating Facilities: Minimization of Cost, Disruption, and Rebuilding	2/4	5.7%
18.	Fear of Unintended Consequences	2/2	2.9%
19.	Urban Stormwater Capture is Limited, Expensive, and Involves the Loss of Habitat and Recreation. However, it is Cleanest and Involves the Private Sector in Retrofit	1/2	2.9%

TABLE 5

Barriers Ranked by Environmental Advocate Participants (2)

Rank	Title	Times Picked/Pts.	Strength of Feeling
1.	Public Perception that Existing Water Resources Should be Used More Efficiently (Maximize Value) Before Developing New Water Supply Sources	2/15	75.0%
2.	Lack of Motivation, Economic Rationale, and Resources for Strategic, Long-Term Planning	2/15	75.0%
3.	Reaching Agreement Among Multiple Stakeholders/Users About Equitable Solutions	2/11	55.0%
4.	Lack of Public Trust that Harvested Waters are Safe for Use	1/10	50.0%
5.	Environmental and Community Impacts of Stormwater Harvesting	1/9	45.0%
6.	Inability to Demonstrate to the Consumer/Public that Expenditures for Stormwater Harvesting are Appropriate Public Policy and Should Start Now	1/9	45.0%
7.	Capability to Capture, Store, Treat, and Use Stormwater for Designated End Uses While Maintaining Essential System Hydrology, Hydraulics, and Services	2/8	40.0%
8.	Institutional Barriers to Stormwater Harvesting	2/7	35.0%
9.	Urban Stormwater Capture is Limited, Expensive, and Involves the Loss of Habitat and Recreation. However, it is Cleanest and Involves the Private Sector in Retrofit	1/7	35.0%
10.	Water Rights Issues Can Become a Significant Barrier if Additional Stormwater Supply is Developed	1/5	25.0%
11.	Elevated Contaminant Concentrations in Stormwater which Result from Land-Use Patterns and Lack of National Manufacturing Standards Limit Use as a Resource	1/4	20.0%
12.	Developing Regulations Based on Defined Technical Protocols for Implementation of Stormwater Harvesting	1/4	20.0%
13.	Fear of Unintended Consequences	1/3	15.5%

14.	Community Impacts of Construction and Operating Facilities: Minimization of Cost, Disruption, and Rebuilding	1/2	10.0%
15.	Conflicts Between and Constraints from Federal, State, and Local Regulations may Limit or Prevent Project Implementation	1/1	5.0%

APPENDICES

APPENDIX A

GLOSSARY OF ABBREVIATIONS AND ACRONYMS

BMP	Best Management Practices
COE	Corps of Engineers
CSO	Combined Sewer Overflow
DBP	Disinfection By-Product
DWR	Department of Water Resources
EIR	Environmental Impact Report
ESA	Endangered Species Act
IRP	Integrated Resources Planning
LACDPW	Los Angeles County Department of Public Works
LARWQCB	Los Angeles Regional Water Quality Control Board
MCL	Maximum Containment Level
NPDES	National Pollutant Discharge Elimination System
NWRI	National Water Research Institute
SCCWRP	Southern California Coastal Water Research Project
SDWA	Safe Drinking Water Act
SWTR	Surface Water Treatment Rule
THM	Trihalomethane
TVA	Tennessee Valley Authority
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service

APPENDIX B

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