Alliance Environmental LLC

**TESTIMONY**

**Subcommittee Hearing**
**Subcommittee on**
**Government Programs and Oversight**
**Subject: Conserving Natural Resources and Examining Related Emerging Technologies**
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**Prepared Testimony**
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## I Water - Humanity's Waste Dump

It is fascinating that humans, the most advanced life form on earth, choose to use one of life's most precious resources, water, as a means of transporting waste. Many lower mammalian life forms protect their water supply by defecating into or on the soil, away from the water they drink.

Our water resources are very limited. Less than two percent of the earth's water is fresh water and only one percent is fit to drink, yet the vast majority of the people are not well connected to the subject of water resources. Even in the modernized, well educated industrialized countries, it is not easy for people to see the impact they have on water quality because intricate and massive infrastructure masks this impact. Without water, a person could not live for more than seven days, but still, because water falls from the sky, we treat it with little respect. It is abundant and free! At least that is how it appears. However, our relationship with water quickly changes as soon as there is a draught and water stops falling from the sky. Mankind has been on a very slow learning curve with regard to water quality matters. The Romans began to understand the value of clean water and pioneered the aqueducts in 200 to 100 BC.

After the fall of the Roman Empire, there were no further advancements regarding water quality until the mid 1800s. Following the plague of 1832, Napoleon III built a sewer pipe system for Paris that was the pride of the World's Fair in 1850 and marked a dramatic awakening toward the value of sanitation. Paris, previously a mud hole of filth and disease, now became one of the world's cleanest and best planned cities.

Between 1900 and 1950, the science behind water and wastewater treatment began to evolve with more consistency. There were numerous inventions and discoveries during this time that helped the water supply and wastewater disposal industry develop into disciplines centered on mechanical, biological and chemical processes.

As one would expect, the evolution of water and wastewater facilities was much more advanced for the urban centers than it was in the rural areas because the need was much greater where the population density was highest. The sparsely populated countryside had a much greater assimilative capacity for waste contaminants than did the densely populated cities and simple cesspools and wells provided adequate service. By 1950, most major urban areas now had public water and sewer systems and at least primary wastewater treatment and secondary biological treatment was becoming common. Because our larger cities were built near our larger rivers and water bodies, dilution of wastes remained a principal means of achieving adequate water quality. Primary wastewater treatment provided very little health protection, and in each city the water treatment plant intake pipe was placed upstream of the wastewater treatment plant outfall pipe. However, as metropolitan areas grew along these river bodies, this series of water intake pipes and wastewater outfall pipes became what we now call ***unplanned indirect reuse*****.**

Today, people indirectly, and mostly unknowingly, reuse a significant quantity of wastewater without thinking too greatly about the consequences. Several of the USA's largest cities (Philadelphia, Cincinnati and New Orleans) obtain their water supplies from rivers (Delaware, Ohio and Mississippi) that are heavily contaminated by upstream wastewater discharges. There are currently more than two dozen potable water supply systems in the USA, serving populations from 25,000 to 2,000,000 people, deriving their water supply from surface waters made up of more than 50 percent wastewater discharge during low stream flow conditions. If it were not for the powerful disinfection capability of chlorine, the widespread, unplanned indirect reuse that currently exists would be creating unacceptable health risks. Therefore, the discovery and implementation of chlorine as a disinfectant is one of the most significant public health advancements of the 20th century. As we build more cities with public sewers and water supply systems and more people spread out across the earth, this unplanned indirect reuse phenomenon is growing rapidly. We are seeing the true meaning of the phrase "we all live downstream".

In the rural areas, water and wastewater systems evolved quite differently. In 1950, rural areas depended upon individual wells for water supply and cesspools for wastewater disposal. The use of the septic tank was common, but design standards had not yet been adopted. The cesspool can be described as an outhouse with indoor plumbing. The cesspool provides no treatment to the wastewater contaminants prior to contact with the soil or groundwater and it basically served as a way to get the dirty wastewater back into the ground. It was during the 1950s that waste disposal rules became common and controls began to emerge almost entirely on a local level. The rural water and wastewater system, therefore, relied totally on the soil and groundwater to provide dilution, treatment and acceptable controls of contaminants, whereas the urban systems utilized surface water and chlorine disinfectants. Because the population in the rural areas was very limited, this model was acceptable and problems only were evident in compact rural villages.

In the last 50 years of the 20th century, there has been dramatic and significant changes to all aspect of our water use patterns. These changes can be grouped into three categories:

1. Suburban Development/Sprawl - People moved away from the cities and into the rural areas.
2. Science and Regulation - The formation of the EPA and enactment of numerous regulations has yielded a tremendous improvement in pollution control and clearer understanding of our impact upon water quality.
3. Technology - Major advancements in water quality technology give us the ability to provide new alternatives and better water resource protection.

**Suburban Development**

One very significant change in water use and pollution patterns is that people moved away from the urban areas in the last half of the 20th century and into the countryside that lacked public water and wastewater infrastructure. By 1990, it was determined that in the

USA, 25% of all housing units (25 million in total) utilized on-site wastewater systems. It is estimated that new construction with on-site water and wastewater systems since 1990 has been occurring at a rate of 37%. Now the use of rudimentary septic systems has become an extremely significant factor in protecting our groundwater resources. Yet, there still has been no national effort to monitor or manage this matter. Regulations for on-site water and wastewater systems are now mostly set at a state and local level. The regulations vary widely and there is limited scientific research to support the decision making process. Most regulations that exist today focus on the proper design of septic systems so that the natural purification processes provided by the soil and microbiology are maximized. Now, on-site wells and septic systems have become another very significant factor creating more **unplanned indirect reuse** of water resources.

The movement into suburban America has created several other related and important problems that impact water quality. Suburban development with large lots (sprawl) causes significant increases in land coverage with impervious surfaces such as roads, parking lots, sidewalks and roofs. The increase in impervious surfaces results in a significant decrease in the recharge of our groundwater aquifers. The ultimate effect of this increased runoff is reduced groundwater quantity, reduced base flow to streams (therefore the streams dry up quickly during drought periods), and increased runoff of surface pollutants. Additionally, the suburban areas that are not converted into impervious surfaces are generally maintained as lawns that require increased applications of fertilizers, pesticides and herbicides, all of which further degrades the groundwater and surface water.

## Science and Regulation

Another very significant change in the USA in the past 50 years has been our concerted effort to clean up surface water bodies. The passage of the Clean Water Act and the expenditure of $60 billion of federal grant money resulted in tremendous improvements. Now, almost all of our major urban centers have provided (or are about to provide) secondary wastewater treatment systems and disinfected water supply systems. Additionally, recent revisions to the Safe Drinking Water Act now require filtration systems for potable water supplies that utilize surface water. As a result, there has been, and will continue to be, measurable diminished impact to our surface water bodies and to our potable water supplies from point source discharges (outfall pipes from wastewater treatment facilities). Unfortunately, new problems are always being discovered and the job is never done.

Over the past 30 years we have recognized that protection of groundwater quality is of equal importance to protection of surface water. The original Clean Water Act did not focus on groundwater quality originally. In the late 1970s and early 1980s, it became clear that leaking underground storage tanks, chemical spills, illegal disposal of toxic wastes, etc., were significant factors contributing to groundwater contamination and major efforts have been made to correct these conditions. During this era, numerous laws were enacted to establish responsibility and cleanup criteria for contaminated industrial sites but these all focused on industrial uses where concentrated contamination was most likely.

- RCRA (Resource Conservation and Recovery Act) -- 1976 -- cradle to grave regulation of hazardous waste that later led to superfund and hazardous and solid waste provisions via SARA and HSWA.
- CERCLA (Comprehensive Environmental Response, Compensation and Liability Act) -- 1980 -- established the policy and procedures to identify and clean up contaminated sites.

Nonpoint source pollution, by definition, is the pollution that results from sources other than discharge pipes. Phenomenon such as stormwater runoff, erosion, contamination of groundwater flows are examples of nonpoint source pollution. The causes of nonpoint source pollution are numerous and very varied. Septic systems, over application of fertilizer, use of pesticides and herbicides, spills, etc., are all examples of nonpoint source pollution. All of them relate to controlling the methods and types of land uses.

Nonpoint source pollution is clearly the next major regulatory hurdle. We are only beginning to address the related topics of agricultural pollution and storm water runoff. No one is yet tackling the issue of septic systems on a national basis and the scientific research surrounding this subject needs much attention.

### Technology Changes In the Past 50 Years

There have been tremendous advancements in water quality technology over the past 50 years, most of which occurred since 1985. In the past 15 years, the alternatives available for water purification have changed dramatically with the advent of new processes such as membrane filtration and UV (ultraviolet light) disinfection.

The improvements in technology are too numerous to mention and they involve all aspects of treatment processes, analytical methods and automation of operations and management. The water purification industry is entering the new millennium with the same level of intensive change as the computer, communication, pharmaceutical, manufacturing and all other modern age technology driven industries. Now we have the technology to directly reuse our water and dramatically shift our relationship toward water resources.

## II Water - A Reusable Resource

Applied Water Management, Inc. (AWM) has developed a network of small decentralized water and wastewater systems that provide wastewater recycling and reuse through a combination of **Planned Direct Reuse** and **Planned Indirect Reuse** methods. Referred to as **Community On-site Wastewater Systems** and **Community On-site Water Systems**, they are known as **COWS**. Beginning in 1987 with a single recycling system in Princeton, New Jersey, the network now consists of 22 systems that span five states: New Jersey, New York, Pennsylvania, Connecticut and Massachusetts. There will be four systems added in the year 2000.

This achievement is significant because it directly demonstrates that there are economically viable methods of providing water and wastewater systems that treat water as a reusable resource. It is also significant that this has been occurring for over ten years and that it has been done in a manner that exactly mimics large regional public water and wastewater services. The customers of AWM are reusing water without any personal inconvenience or involvement. COWS address a number of water quality issues in a new and intelligent manner. There are several key benefits to this alternative:

1. Water Conservation - Via reuse and recycling, the water supply required for any use is dramatically reduced, thereby conserving the resource. This benefit is particularly evident in arid regions where water supply is very limited, but it has now been demonstrated that there are huge benefits from an environmental impact and public health standpoint in areas where rainfall is abundant. It is interesting that AWM is based in the northeast, where rainfall is more than adequate.
2. Reduced Infrastructure - Solving the problem at the source eliminates the need to run thousands of miles of underground pipes to bring the wastewater to the treatment plant and to bring the treated water back to the consumer. By building COWS, the source is kept close to the consumer. The utility is

now "decentralized". This shifts the allocation of capital and maintenance resources significantly.

3. Creative Planning for Rural Areas - With the use of COWS, residential and commercial development can both be conceived in a more sensitive manner. More open space can be preserved and the need for large land masses to dilute discharge of pollutants is eliminated. Now, planners can keep the development confined to smaller areas.
4. Increased Groundwater Recharge - By directly recharging treated wastewater and by allowing more compact development, the groundwater impact is significantly reduced. Creative planning of new development will now demand less impervious coverage and thereby keep groundwater recharge maximized.

Both items 3 and 4 of the above list directly impact the uses of land that must be addressed to help resolve the nonpoint source pollution issue.

**III The Technology of Water Reuse**

Technology plays an important role in the successful implementation of community water and wastewater systems and is one of the most significant advancements that have occurred in this field. Indirect recycling of potable water and direct recycling of non-potable water are now readily achieved by the employment of advanced technologies. Some of the more notable recent achievements are:

A) <u>Membrane Filtration</u>

The separation of solids and liquids down to molecular size is now readily achievable and routinely accomplished with the use of membrane filters. These systems have been in use for over 10 years and are well proven. Recent advancements have lowered the installation and operating costs such that they are comparable to other conventional treatment systems. This technology is advancing rapidly and it offers the future possibility of total recycling for potable consumption.

B) <u>Automation</u>

Programmable controller technology has now been advanced to the point of off-the-shelf applicability to water and wastewater systems. Computerized programmable controllers allow remote monitoring and remote controlling of systems thereby reducing labor requirements and improving troubleshooting and emergency response capabilities. Without this advancement, the use of decentralized systems would have a very high labor cost.

C) <u>Groundwater Recharge Systems</u>

The use of drip irrigation, infiltration percolation ponds and improved hydrogeologic modeling allows solutions to problems associated with hydraulically restrictive soils and space limitations. These alternatives allow more flexibility with system implementation on difficult sites and allow more options for use of open space associated with system operation.

With the ability to provide automated systems that dependably produce high quality water, even on difficult sites, the future application possibilities are enormous. As the modern technology becomes more affordable over time, COWS are becoming more efficient and more cost effective. Eventually, decentralized community systems will be the more common and preferred alternative for rural and suburban areas that lack regional infrastructure.

## IV The Changing Utility Business

All utilities have been experiencing dramatic changes in the past several years. All are affected by new technology and new business strategies. Electric, gas, telecommunications and cable TV are good examples of the effects of rapid modernization upon utilities. Deregulation, alternative supplies, new delivery systems and globalization have all had a significant impact over a very short time span.

The same potential for change holds true for the water and wastewater utility business. However, the dramatic effects are not yet completely evident. Privatization is well established as a significant factor, but modernization is relatively slow in this industry. Much of the infrastructure is publicly owned and change is greatly delayed by that fact. Most significant advancements will take place in privately owned systems (public utilities) and industrial systems. New construction creates opportunities for implementation of new alternatives and it is in this area that the change seems to be most evident. Applied Water Management, Inc. has established a decentralized water and wastewater utility network in the northeast that demonstrates the application of all of these facets of modernization. Developed over the past ten years, this network consists of 16 direct reuse, non-potable water recycling systems that serve an array of commercial and public facilities combined with 7 indirect reuse groundwater recharge systems that serve residential communities.

The 16 wastewater recycling systems employ direct reuse of non-potable water for toilet flushing in combination with indirect recycling via groundwater recharge. The direct recycling makes up a range of 55% to 93% of the water consumption, depending on the specific application. Applications that are predominantly black water (toilet water) oriented, such as grammar schools, movie theaters, warehouses, etc., have a higher percentage of recycling than other applications that utilize more potable water, such as shopping malls, food stores, etc.

The 7 residential systems do not employ direct reuse of non-potable water because domestic uses are predominantly potable water oriented. In the home, only 30% of the water use is consumed for non-potable purposes. In these cases, the treated wastewater is returned to the water supply aquifer via indirect recharge. Depending on the specific site, some of this water mixes with the aquifer and supplements well water supplies while some flows with the groundwater into local streams, rivers and lakes.

In essence, all these systems maximize the recycling capability of each specific customer or community and create a unique and modern network of water/wastewater systems. Whereas other utilities are now dabbling with similar applications, this represents the largest network of this nature anywhere. It is interesting to note that this network began as a result of nonexistent centralized wastewater and water infrastructure and a predominance of environmental constraints. It was not created out of a pressing need to conserve water.

Networking these systems together is critical to the viability of this concept. As stand-alone facilities, the costs and control mechanisms are too cumbersome and the systems become impractical and unaffordable. As a utility network, AWM shares all management and overhead between many systems. Under the networked model, operations is centralized and automated to the greatest extent possible and common costs, such as sludge disposal, billing, reporting, accounting, insurance, etc., are divided between all the customers. This provides for the management efficiencies of a centralized utility while the actual infrastructure is decentralized and constructed on a community basis.

## V The Economics

Affordability is key to continued growth and success of this COWS community based approach to water and wastewater. Construction costs and operation costs are of equal importance. If COWS were more costly than other traditional alternatives, their use would be limited. To address this issue, AWM established one regional rate structure for water and wastewater services that fit in with the cost of living criteria for the service region. Other cost models would be appropriate in other regions.

To have a uniform rate, any deficit in capital funds are made up through *contributions in aid of construction* paid for by developers. The term "*contributions in aid of construction*" is widely accepted in the utility business to mean capital that is paid in to the utility from outside sources. This contribution concept is not offensive to developers because under any development model, there is a cost for the water and wastewater system. This applies whether it be an on-site well and septic system, a regional municipal utility, or COWS. The same cost variability that applies to construction also applies to operations. In different regions, the cost of labor and power have significant impacts on the operating costs as well and the cost model must be adjusted accordingly. The costs presented below are applicable to New Jersey, where the COWS utility network originated.

> Wastewater User Fee: $904/year per equivalent dwelling unit (300 GPD)
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> Potable Water User Fee: $100/year + $3.54/1,000 gallons consumed
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> Developer Contribution: 0% for project of 1,000 units (rough estimate only) 100% for project less than 50 units

It is most logical to have the utility rate structure follow the jurisdictional boundaries of the utility regulatory authority. In this case, the rates apply to the entire State of New Jersey because the New Jersey Board of Public Utilities regulates all utilities. In other states, the rate structure may follow a different jurisdictional boundary.

In certain areas there is no utility fee authority in place for water and/or wastewater. In these situations, the rate model would be the subject of a site specific negotiated contract, or the local government body would play a role in rate setting and possibly in ownership of the system. Recently, there have been numerous examples of public-private partnerships in the water and wastewater industry. The same networked COWS utility model would be possible under these scenarios as well. However, the user rate model would follow different regulatory guidelines.

Attached as Tables 1 and 2 are summaries of the use and cost structure for 16 non-potable direct reuse projects and six indirect reuse systems. The construction costs and operating costs are comparable to regional municipal systems that serve these same rural/suburban areas. The costs for similar services in older urban areas would be less due to lower capital costs and larger customer bases.

**VI Future Regulations**

Potable water supply is regulated under the Safe Drinking Water Act and discharge of treated wastewater effluent is regulated under the Clean Water Act. Both of these federal regulations provide extensive controls and protections and both are constantly being updated to reflect new understandings resulting from recent research efforts. Strict interpretation of these regulations would allow for the direct potable reuse of wastewater effluent in potable water supplies; however, philosophical and engineering issues need to be resolved. The regulations are not clear about specific safeguards and any projects that are currently being considered are done so on a pilot scale or supplemental supply basis.

The Committee to Evaluate the Viability of Augmenting Potable Water Supplies With Reclaimed Water published a book entitled Issues In Potable Reuse, National Academy of Sciences, 1998, that outlines all of the current issues and research relative to this subject. The Committee was commissioned by the National Research Council, recognizing that water supply sources are continually becoming more contaminated and that unplanned indirect reuse is a significant issue.

Most states have separate regulations that supplement the federal rules. Water reuse rules are not common, however, and where existent, mostly look at unplanned cross connections of wastewater and water systems. Back flow prevention regulations and safeguards for cross connection in plumbing codes do not address the legal and planned reuse issues. This matter is obviously a new subject and is not well regulated.

All of the AWM COWS systems utilize groundwater recharge as a means of planned indirect reuse. These discharges are regulated under the NPDES (National Pollution Discharge Elimination System) program. All of the AWM direct reuse systems recycle only non-potable water and permits were obtained via the local and state health and plumbing codes. Most facilities have multiple permits, with the NPDES permit being the primary regulatory mechanism from a treatment perspective and other local permits regulating the facility use and plumbing.

Considering the fact that much of our contaminated water is discharged without permits (i.e., septic systems and storm water basins), and that there is widespread use of chemicals such as fertilizers, pesticides and herbicides, the threat of contamination of potable water supplies is significant. Unplanned and unpermitted wastewater discharge is occurring everywhere and it is significantly impacting our water resources. Planned and fully permitted water reuse systems represent a more intelligent, environmentally sensitive and lower public health risk alternative. These options are available, they are practical, and they are currently in use. However, it would take a paradigm shift of human awareness for their use to become widespread. As a more realistic approach, through the adoption of regulations that restrict and penalize uses that destroy water resources, or via the creation of incentives for alternatives that provide conservation of water resources, society would quickly shift toward the more conservative alternatives. If we create a path of least resistance that favors water reuse alternatives, their use would quickly become the preferred option.

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