BY **WINSTON HUFF, CPD, LEED AP**

Plumbing Versus Agriculture

When the water wars begin, will the poor and the environment be the first casualties?

I recently ate at a restaurant that had signs on the tables notifying customers that the restaurant no longer was providing water with meals because the city was running low on water reserves. The signs had facts relating how many gallons of water it takes to wash the glasses used for serving water. In contrast, flying into the city I noticed large tracts of land with canal and irrigation systems. Rice fields flooded with water were in an area that was once a desert. Later the same day I met with the architects building a large hospital campus, and we talked about water-efficient plumbing fixtures. I thought, *Why is agriculture getting all the water?*

It is important to say that the intent of this article is not to insult or compromise the modern farmer in any way. My family is only one generation away from the farm. Rather, the intent of this article is to enlighten and educate plumbing engineers on how to design plumbing systems that address the water concerns of the future.

THE WATER WARS

Scientists are warning us that a storm is brewing over water. Inefficient irrigation and decaying reservoirs and potable water systems are causing water shortages, crop failures, and shrinking natural water supplies in many developing countries. Plumbing engineers should be aware of these issues because some of us may find ourselves in the middle of this conflict. Here are some interesting facts about agriculture and water from the book *When the Rivers Run Dry: Water—The Defining Crisis of the Twenty-first Century* by Fred Pearce. It takes

- between 250 and 650 gallons of water to grow a pound of rice—more water than many households use in a week;
- 132 gallons of water to grow a pound of wheat and 66 gallons for a pound of potatoes;
- 3,000 gallons of water to grow the feed for enough meat to make a quarter-pound hamburger and between 500 and 1,000 gallons for the cow to fill its udders with a quart of milk;
- up to 400 gallons of water to produce a 1-pound box of sugar; and
- 2,650 gallons—a ton—of water to produce a 1-pound jar of coffee.

Photo credit: UNEP

Lake Mead dropped 18 meters (shown in white) between 2000 and 2004 during a drought.

It seems odd to me that the people in this city are looking for ways to save a few cups of water by washing their hands using water-efficient fixtures, while they can order rice at lunch that took hundreds of gallons of water to grow.

Some statistics being used in presentations and papers about water efficiency cause concern.

According to LEED for New Construction and Major Renovations (LEED-NC) Version 2.0, "In the United States, approximately 340 billion gallons of fresh water are withdrawn per day from rivers, streams, and reservoirs to support residential, commercial, industrial, agricultural, and recreational activities. This accounts for about one-fourth of the nation's total supply of renewable fresh water. Almost 65 percent of this water is discharged to rivers, streams, and other water bodies after use and, in some cases, treatment."

Statistics such as these are being used to promote water-efficient plumbing systems. However, I am concerned that these statistics do not differentiate among agriculture, recreational, and domestic uses of this water. In other words, if every plumbing fixture were an efficient fixture, would the statistics change?

SOME BASIC FACTS

Freshwater is limited, and much of this freshwater is used for domestic plumbing systems. Consider the following facts from Fred Pearce's book. For example, "Over three-quarters of the earth is covered with water, but only 1 percent of it is freshwater. Only one one-hundredth of that 1 percent is available for human use."

When compared to the rest of the world, Americans use large amounts of water. "In the United States, the average person uses 185 gallons of water a day. An average person in West Africa uses 7.6 gallons a day—that's one twenty-fifth of an American's daily use." However, we live in a developed country that is full of water and waste treatment facilities. A person can travel from Maine to California, drink from public drinking fountains along the way, and never think about the safety of the water supply.

Many parts of the world do not enjoy our access to potable water. "Over one billion people worldwide lack access to adequate clean water. Nearly 2.5 billion lack adequate sanitation.

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Some 80 percent of illness and disease across the globe involves contaminated water," according to Pearce's book.

Based on data from NASA, the World Health Organization, and other agencies, the United Nations Environment Programme (UNEP) finds the following:

- Severe water shortages affecting at least 400 million people today will affect 4 billion people around the world by 2050. Southwestern states such as Arizona will face other severe freshwater shortages by 2025.
- Adequate sanitation facilities are lacking for 2.4 billion people around the world, about 40 percent of humankind.
- Half of all coastal regions, where 1 billion people live, have degraded due to overdevelopment or pollution.

According to *Global Environment Outlook 3: Past, present and future perspectives,* a UNEP report, water-related diseases cause "about 4 billion cases of diarrhoea and 2.2 million deaths annually: this is the equivalent of 20 jumbo jets crashing every day."

It is a sobering thought that millions of people around the world could avoid death simply by having access to safe plumbing and water distribution systems. Unfortunately, poor countries suffer the most casualties. In contrast, most of the United States benefits from efficient plumbing systems and fixtures that deliver a consistently high quality of water for washing, consumption, fire protection, irrigation, and many other uses.

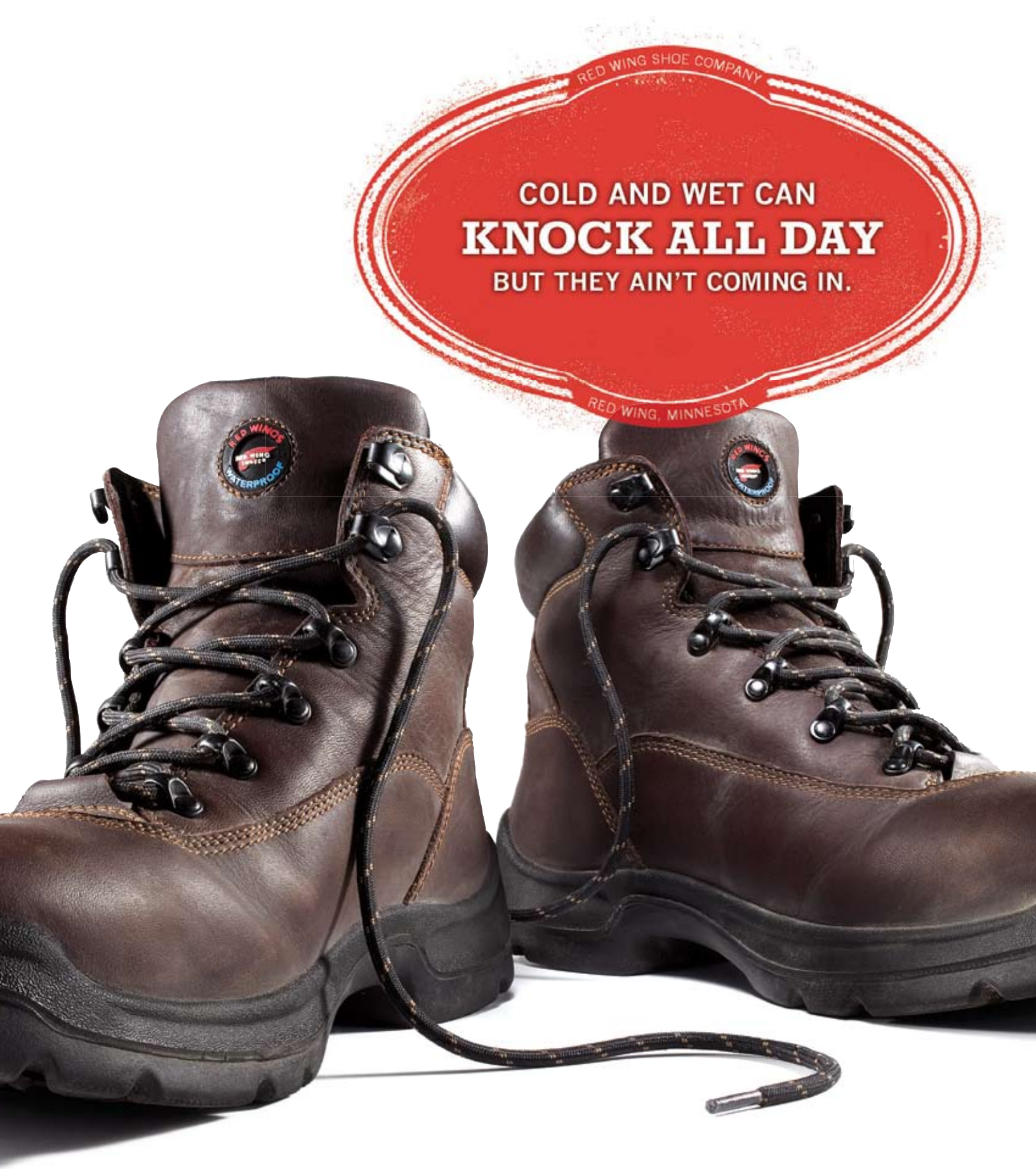
Ecosystems Need Water. Wildlife and ecosystems need water as well. During the water wars between plumbing and agriculture, the environment may be the second casualty.

"Water development projects during the 20th century have had significant impacts on freshwater ecosystems by eliminating marshes and wetlands, removing water for other uses, altering flows, and contaminating water with industrial and human wastes," according to *Global Environment Outlook 3.* "In many rivers and lakes, ecosystem functions have been lost or impaired. In some areas, growing water demand has led to reductions in the volume of large rivers, affecting riverine and adjacent coastal areas. Reproductive failures and death in various wildlife species, particularly at higher levels in the food chain, have been reported as a result of high withdrawals of water."

Agriculture Needs Water. Advanced agricultural methods have prevented severe food shortages in much of the United States. We enjoy a great variety of food from all around the world delivered to our neighborhoods in an efficient manner and at affordable prices.

But to maintain agricultural success, water becomes an issue. Agriculture accounts for 85 percent of freshwater consumption worldwide. In many developed countries, "most water shortfalls arise from politically popular but inefficient subsidies and protections of agriculture," according to "Water shortages will leave world in dire straits," a *USA Today* article by engineer and science policy analyst Dan Vergano.

Around the world, "Agriculture accounts for more than 70 percent of freshwater drawn from lakes, rivers, and underground sources," according to *Global Environment Outlook 3.* "Most is used for irrigation, which provides about 40 percent of world food production. Over the past 30 years, the area of land under



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irrigation has increased from less than 200 million ha (hecta acres) to more than 270 million ha. During the same period, global water withdrawals rose from about 2,500 km^3 to more than 3,500 km^3. Poor management has resulted in the salinization of about 20 percent of the world's irrigated land, with an additional 1.5 million ha affected annually."

DESIGNING PLUMBING SYSTEMS TO AVERT WATER WARS

In some extreme cases plumbing engineers are peacemakers. Plumbing engineers are the stewards of water inside and around buildings, and they can design efficient plumbing systems that reduce a building's negative impact on the people and environments inside and outside the building. To do this we need to know local water issues in the building environment.

Photo credit: UNEP

Human development is moving into water-sensitive wildlife areas of the Everglades in South Florida. In this area plumbing engineers will need to be familiar with efficient storm water systems more than water-efficient plumbing fixtures.

Sewer Systems. In the United States, a discussion of freshwater is not complete until the Great Lakes Basin is discussed. "The Great Lakes Basin is one of the Earth's largest freshwater systems, containing 18 percent of the world's fresh surface water," according to *Global Environment Outlook 3*.

Anyone who grew up in the 1960s and 1970s knows about the terrible condition of some of the Great Lakes. At one time Lake Erie was so polluted that a portion of it caught fire. "Over the years, the lakes have been subject to a polluting mix of effluents due to inadequate sewage treatment, fertilizer, and wastewater effluent," according to *Global Environment Outlook 3*. "By the early 1970s, beaches were smothered with algae, and water was unfit for drinking unless extensively purified. Lake Erie suffered from excess phosphorus, algal blooms, and serious declines in fish populations. Aboriginal communities were the most affected. Newspaper headlines in 1970 declared that 'Lake Erie is Dead.'"

Several groups worked with international, state, local, and agricultural efforts to develop ways to approach the problem. Plumbing engineers played an important part in this cause. Plumbing engineers were tasked with defining the problems and developing solutions. For example, concentrating on low-flow plumbing fixtures would not have addressed the problems. Rather, technology developments in water monitoring and sewer systems that contain waste effluent were needed. Plumbing engineers designed storm and sewer systems in buildings to reduce the amount of hazardous material that was released into the fresh waterways.

Three decades after Lake Erie was declared dead, municipal phosphorus loadings have been reduced by almost 80 percent, and the lake now has the world's largest walleye fishery, according to *Global Environment Outlook 3*.

While many problems still must be solved, the Great Lakes Basin is an example of how many different groups including plumbing engineers can work together to solve a problem.

Storm Water Ecosystems. The Everglades is an important part of South Florida's natural environment that is under compromise as urban sprawl encroaches into natural areas. Wetlands, or swamps as they were called in the early 1900s, were treated as areas to drain and fill for urban development. Today it is apparent that large-scale development has harmed the environment.

Today new types of storm water systems are being installed to protect these vital areas and to reduce the effect of urban development. Plumbing engineers are playing an important role in designing rainwater systems in buildings to reduce and clean the quality of runoff water from building sites.

Water Efficiency. The fastest growing metropolitan area in the United States is Las Vegas. In the early 1970s it was considered a small settlement, but currently the ever-increasing development is straining natural water systems. Lake Mead dropped 18 meters between 2000 and 2004, and severe water shortages are predicted in the next 20 years, according to UNEP.

In this situation, highly efficient plumbing fixtures are an appropriate solution. A community of 500,000 uses more than 1 million gallons of water a day just to flush water closets. Using 1.6-gallons-per-flush fixtures can cut that figure in half. This could be reduced even more with ultra-low-flow fixtures that use around 1 gallon of water per flush. As a result, the water consumption would decrease to approximately 300,000 gallons a day.

CONCLUSION

When conflicts over water heat up, plumbing engineers need to be aware of local water issues. Some aspects of plumbing design are universal, but with many elements of plumbing design a one-size-fits-all approach is not appropriate. The plumbing engineer must be aware of these plumbing design elements and know when and where they should be applied. By doing this, we can help protect the poor and the environment from becoming the first casualties of the water wars. PSD

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