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ENVIRONMENTAL ENGINEER

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PRESERVE THE LEGACY – BUILD THE FUTURE

It has historically been engineers who have stepped up to the plate when the going gets tough. We must ask ourselves: "Where will the engineering leadership and talent come from to solve the problems in the wake of these trends?"

THE AMERICAN ACADEMY OF ENVIRONMENTAL ENGINEERS is celebrating its 50th year, and with this milestone has both a legacy to preserve and a future to build. The legacy is manifested in the safe drinking water that we know and expect, the quality of water in our rivers, estuaries and beaches, the litter-free roadsides that we enjoy, and many other manifestations of 50 years of hard work.

Unfortunately, we in America are too often a short-sighted society, and the public will soon forget the hard work and great accomplishments and leadership of our Diplomates (Board Certified Environmental Engineers) over the years.

There are real dangers ahead for our profession and for the legacy of a quality environment for the next generation. Let's look down the road at some of the ominous problem signs in our midst:

- Inadequate public funding to maintain the infrastructure that we have created, not to mention the new infrastructure needed for future growth in population.
- Major changes in how energy is used and managed are needed but not taking place at all levels of our society, from oversized family vehicles to energy-inefficient wastewater treatment facilities, to the organics that we send to landfill.
- Pollution of the near-shore coastal zones from such sources as storm-water runoff, agricultural over-use of fertilizers, and discharges from electrical power generation stations.
- Continued growth in the economic disparities between the rich and poor countries, increasing social pressures in the poorer countries for out-migration.
- The historical irrelevance of many of the environmental engineering solutions offered by the industrialized countries to the developing countries, leaving a legacy of non-functioning systems and debt burden where the need is greatest.

It has historically been engineers who have stepped up to the plate when the going gets tough. We must ask ourselves: "Where will the engineering leadership and talent come from to solve the problems in the wake of these trends?" The signs here are also ominous. Engineering enrollments are down as the bright young minds of America seek what they perceive to be more lucrative careers in other fields. Our next generation of engineers will likely have many immigrants in their ranks, good well-educated people from abroad, here to help build the future.

"Build the future." Strong words. As Board Certified Environmental Engineers, we at the Academy have strong expectations for a vital role in the future. Our organization is working in several areas to lay the foundation for building our future. These include building such bridges to the future as:

- Mentoring programs for young engineers.
- Outreach to the academic community to participate meaningfully in the academic formation of new engineers.
- Strengthening relationships with our Sponsor Organizations.
- Building linkages to our membership through our State and Regional organizations, so the officers can meet the more of the membership and better appreciate their perspectives.

We however can do only so much and desperately need your help in recruiting the new membership that will build our future. We need each of you to spend a few minutes each day identifying the engineering leaders of the future in your organization. We need each of you to recruit these individuals as the future of the Academy and of our profession, and to instill in them the utter importance of stepping forward to "Preserve the Legacy."

It will take unrelenting concerted effort on the part of each and every one of you to make it happen. Many of you have already started this vital work, and we appreciate it. Unfortunately, many haven't – it is never too late to get to work. We need your help to build the future now!

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SIGNIFICANT CHANGES IN ACADEMY MEMBERSHIP STRUCTURE MADE AT THE APRIL BOARD OF TRUSTEES MEETING

At the April 2005 meeting, the AAEE Board of Trustees enacted several major changes affecting the make-up and future of the Academy. The changes include expanding the membership categories of AAEE, the addition of a second specialty certification program (Board Certified Member) and the addition of Student Members.

First and foremost, the Officers and Trustees want to assure all Diplomates that no changes have been made to your Specialty Certification or the Diplomate category that will in any way devalue or lessen the credibility of your Diplomate Environmental Engineer certification. In fact, we believe the changes enacted at the April meeting will strengthen Specialty Certification by making it more sought after in the environmental engineering world.

Listed below are descriptions of the changes that were enacted at the Trustees meeting, along with the reasons that the Board believed they were necessary. Please note that all of the changes listed were enacted by unanimous votes of the Trustees.

Addition of Student Member Category: The AAEE will begin recruiting individual student members from those who are enrolled in Environmental (or similar) Engineering programs. *Reasoning:* The Board feels it is very important to encourage professionalism in the upcoming generations of environmental engineers. As student membership grows, it is our hope that more schools will form Environmental Engineering Student Societies and chapters of Tau Chi Alpha, the Environmental Engineering Honorary Society. Today's engineering students represent tomorrow's Academy members, and we need to bring them into the Academy family as soon as possible.

Board Certified Environmental Engineer: Beginning immediately, all Diplomates (DEEs) will have the option of using "Board Certified Environmental Engineer" or "BCEE" as part of their credential, or in place of the DEE designation. *Reasoning:* Many Diplomates have told us that the general population, especially those seeking the service of a qualified Environmental Engineering Specialist, does not understand the DEE designation and it requires explanation. Many Diplomates feel that it would be more to the point to refer to himself or herself as a Board Certified Environmental Engineer specialist. (for instance: John Doe, P.E., BCEE or John Doe, P.E., DEE, Board Certified Environmental Engineer.)

Changes in current classifications of membership: The Bylaws provisions for the Affiliate classes of Intern Environmental Engineer, Associate Environmental Engineer and Professor have been repealed. Instead, the people listed in those old categories will be designated in the new Member category. AAEE will begin recruiting Members out of the large pool of practicing Environmental Engineers who do not yet meet the requirements for Specialty Certification. Members will have full voting rights in AAEE, can serve on committees and also serve as Trustees and Officers. *Reasoning:* The Board believes that AAEE should be a home for all environmental engineers, nurturing them through their career path from college, right on through Specialty Certification, their advanced careers, and into retirement where they can mentor the next generation.

Addition of a Second Specialty Certification Program (Board Certified Member): Beginning in 2006, the Academy will offer a second Specialty Certification Program for graduate environmental engineers who do not have a P.E. License. Those achieving this certification will be referred to as a "Board Certified Member" or "BCM, AAEE". The requirements for applying for and testing to attain this certification will be very similar to the requirements for the Diplomate, or BCEE, exam and certification. *Reasoning:* Fewer graduate environmental engineers are encouraged to receive a P.E. license – especially those in industry, government and academia. The decline in the pool of licensed engineers has led, over time, to the membership in AAEE remaining relatively level. However, even though these men and women have not been encouraged to apply for state licensure, many of them are just as highly qualified and

❖ *Continued on 34* ❖

BY DAVID A. ASSELIN

"PROTECT OUR CHILDREN AND OUR FUTURE"

I'M A POLITICAL JUNKIE. I admit it. I watch American Politics the way some people watch college basketball – who's hot, who's struggling, who's injured, who's out of the game. So I usually take note when a well-known political figure passes away.

On July 3rd, former Wisconsin Governor and Senator Gaylord Nelson passed away at the age of 89. Senator Nelson was widely recognized as one of the world's foremost environmental leaders and a stalwart of the modern environmental movement. As governor of Wisconsin in the late 1950s, Nelson used a 1-cent per pack tax on cigarettes to allow the state to buy almost a million acres of parkland, wetlands and wildlife habitat for preservation. The Outdoor Recreation Act Program raised $50 million and became a model for other states to follow.

Senator Nelson is perhaps best known as the founder of Earth Day. In 1969, Nelson was speaking at a water conference in California and then visited the site of an oil spill off the coast of Santa Barbara. On his way back to Washington, he read an article about anti Vietnam War "teach-ins" on college campuses and decided to adapt the idea for the environment.

He hired a graduate student from Harvard to help organize the event, which was scheduled for April 22, 1970. Nelson had envisioned small local gatherings that would "appeal to Boy Scouts, mayors, college students and autoworkers" and was astounded when an estimated 20 million Americans joined in and spent that first earth day cleaning streams and rivers, recycling bottles and cans and learning about ecology and conservation.

Writing a decade later in 1980, Senator Nelson recalled, "My primary objective in planning Earth Day was to show the political leadership of the Nation that there was broad and deep support for the environmental movement. While I was confident that a nationwide peaceful demonstration of concern would be impressive, I was not quite prepared for the overwhelming response that occurred on that day."

To many, that first Earth Day was the beginning of the "decade of the environment." Throughout the 1970s, Senator Nelson had a hand in the crafting or passage of more than 20 major pieces of environmental legislation, including the National Environmental Policy Act, the Clean Air Act, the Water Quality Improvement Act, the Resource Conservation and Recovery Act, the Safe Drinking Water Act and the Water Pollution and Control Act Amendments.

These laws, while sometimes seen as controversial or anti-business, have had quite an effect on the environmental engineering profession. In 1970, there were a handful of colleges offering degrees specifically in environmental engineering; today there are over one hundred.

As a result of federal and state environmental laws and regulations, environmental engineering has experienced significant job growth in the last 30 years. And, even with economic slowdowns and changes in attitude among regulators, the United States Bureau of Labor Statistics (BLS) predicts that jobs in environmental engineering will increase 36 percent or more in the ten-year period between 2002 and 2012.

Now, of course we have to look forward. On April 22, 2005 – 35 years after the original - an estimated 500 million people worldwide celebrated this year's Earth Day whose theme was "Protect our children and our future."

Throughout the world, there are still many areas where clean, safe drinking water is virtually unknown, where landfills are teaming with health hazards for the local populations, where smog is so thick, people wear dust masks when they go outside. Board Certified Environmental Engineers have been leading the way to a healthier planet for the past fifty years and it will continue to be up to you to make sure things get better over the next fifty – and longer.

I leave you again with the words of Gaylord Nelson that he wrote in the EPA Journal in April, 1980, just before he left the Senate:

"So long as the human species inhabits the Earth, proper management of its resources will be the most fundamental issue we face. Our very survival will depend upon whether or not we are able to preserve, protect and defend our environment. We are not free to decide about whether or not our environment 'matters.' It does matter, apart from any political exigencies. We disregard the needs of our ecosystem at our mortal peril. That was the great lesson of Earth Day. It must never be forgotten." A

NEWS OF DIPLOMATES

WILLIAM C. ANDERSON, P.E., DEE, will be honored by Iowa State University College of Engineering with the Professional Achievement Citation in Engineering (PACE) award for 2005 in a ceremony to take place on October 21. Mr. Anderson was certified in 1977 in Water Suppy and Wastewater Engineering. He served as Executive Director of AAEE from 1985 to 2003 and is the current Executive Director of CESB.

STEPHEN R. GATES, P.E., DEE, joined R.W. Beck, Inc., as a Client Services Director for the Water and Waste Resources Practice. Mr. Gates has been certified since 1985 in Water Supply and Wastewater Engineering.

ALEX H. MAKLED, P.E., DEE, was honored by Florida Atlantic University, College of Engineering and Computer Science. Mr. Makled, Senior Vice President and Area Manager for CDM (South Florida Operations) earned his Master's Degree from FAU in Civil Engineering in 2000. Mr. Makled has been certified since 1998 in Solid Waste Management.

KYLE SCHILLING, P.E., DEE, was appointed EWRI Governing Board Official Nominee for the 2005 position of EWRI Vice President. His new position will commence on October 1, 2005. Mr. Schilling has been certified since 1995 in Water Supply and Wastewater Engineering.

RAO Y. SURAMPALLI, PH.D., P.E., DEE, was one of several experts sharing insight on the recent South Asia Tsunami at the 2005 EWRI Congress Special Plenary: Tsunami Impacts held May 16, 2005. Dr. Surampalli is currently the Environmental Engineering Director of the US Environmental Protection Agency. Dr. Surampalli has been certified since 1985 in Water Supply and Wastewater Engineering.

IN MEMORIAM

TERRENCE J. MCMANUS, P.E., DEE, passed away on January 31, 2005. Mr. McManus was an active member and was certified in 1989 in General Environmental Engineering.

JAMES C. PIERCE, JR., P.E., DEE, passed away on May 5, 2005. Mr. Pierce was a Life member and was certified in 1970 in Sanitary Engineering.

NICHOLAS L. PRESECAN, P.E., DEE, passed away on July 5, 2005. Mr. Presecan was certified in 1983 in Water Supply and Wastewater Engineering.

TAPPING INTO THE OCEAN FOR FRESH WATER

IN CARLSBAD, CALIFORNIA

SEAWATER DESALINATION IS PRODUCTION OF FRESH DRINKING WATER from saline source (seawater, bay or ocean water) via membrane separation or evaporation. Over the past thirty years, desalination technology has made great strides in many arid regions of the world such as the Middle East, Southern Europe and the Mediterranean. Today, desalination plants operate in more than 120 countries worldwide and some desert states, such as Saudi Arabia and the United Arab Emirates, rely on desalinated water for over 70 percent of their water supply. According to the 2004 desalination plant inventory report prepared by the International Desalination Association, at the end of 2003 worldwide there were over 17,000 desalination units with total installed treatment capacity of 37.8 million cubic meters per day (10 billion gallons per day).

By Nikolay S. Voutchkov, P.E., DEE

DESALINATION MAKING STRIDES IN SOUTHERN CALIFORNIA

To date, only a few small-size seawater desalination plants have been built along the West Coast of the United States primarily because the cost of desalination has been higher than that of available alternative sources of water supply – groundwater and interstate and out-of-state water transfers. Prolonged drought, dwindling traditional water sources such as Colorado River and Bay Delta water, and new more stringent regulatory requirements are driving the costs of conventional water supplies up and are bringing seawater desalination back into the limelight in California. Currently, there are five large projects in various stages of development in Southern California (*See Figure 1*).

Two of these projects, the Huntington Beach and the Carlsbad desalination plants, are being developed in a public-private partnership between Poseidon Resources and local municipalities and utilities. These desalination plants would be located at existing coastal electrical power generation sta-

Figure 1
Large Seawater Desalination Projects in Development in Southern California

By year 2016, Southern California is mandated to decrease its consumption of Colorado River water by more than 700 million gallons per day, which corresponds to a volume of water used by one million households per year.

tions. The Huntington Beach and Carlsbad desalination plants are projected to have product water capacity of 50 MGD and 25 MGD, respectively. The two projects are in a process of environmental feasibility review and permitting, and are planned to begin construction within two years.

The Metropolitan Water District of Southern California has been very supportive of the development of new local draught-proof potable water resources and has plans to subsidize the cost of water produced at most of the desalination facilities shown on Figure 1 with a $250/acre-foot ($0.77/1,000 gallons) credit. Compared to alternative water resources, the desalinated water planned to be produced at these facilities will be of lower salinity, and will have better overall water quality.

Most of the projects shown on Figure 1 are expected to be operational by 2010, and to cumulatively provide over 150 MGD of fresh water for Southern California. Although this amount is significant, it would be adequate to satisfy only a small portion of California commitment to reduce its use of Colorado River water and accommodate ever-growing water pressures. By year 2016, Southern California is mandated to decrease its consumption of Colorado River water by more than 700 million gallons per day, which corresponds to a volume of water used by one million households per year. In addition to seawater desalination, other alternative water sources which would be used to achieve this significant water use reduction are increased reliance on water reuse, conservation and development of new groundwater resources.

CARLSBAD SEAWATER DESALINATION DEMONSTRATION PLANT

To demonstrate the feasibility of coastal desalination and the benefits of co-location of large desalination plants with existing power plants in Southern California, Poseidon Resources assisted by a local specialty contractor (Enaqua) and Hydranautics, have constructed a 20 gpm desalination demonstration plant located at the Encina Power Plant in Carlsbad. This seawater desalination demonstration facility consists of raw water intake feed pump station; two pretreatment filtration systems configured to operate in parallel; filtered water transfer pumps; membrane system feed seawater storage tank; 5-micron cotton cartridge filter; 45 gpm high-pressure reverse osmosis (RO) feed pump; a single-stage RO system; permeate lime conditioning system; and UV disinfection system (*See Figure 2*).

The demonstration plant also has a potable water sampling station that allows visitors to taste the desalinated water. In addition, this facility is equipped with a number of ports for water quality sample collection. The demonstration plant is fully automated and is designed for remote monitoring and control via the internet. Pilot plant's state-of-the-art design, configu-

Figure 2
General View of the Carlsbad Seawater Desalination Demonstration Plant

ration and multifunctional use have been recognized by the San Diego Section of the American Planning Association, which granted this project the Year 2003 First Place Award in the Category of Innovative Use of Technology.

The source of feed seawater for the planned full-scale plant and for the demonstration facility is the warm cooling water of the Encina power plant. This once-through power generation station withdraws cooling water from the Pacific Ocean via the Agua Hedionda Lagoon. After passing through the power plant intake structure, trash racks and traveling screens, the cooling water is pumped through the condensers of the power plant generation units. The power plant has a total of five power generators and depending on the number of units in operation pumps between 200 MGD and 820 MGD of cooling water through the condensers. The warm cooling water from all condensers is directed to a common discharge tunnel and lagoon leading to the ocean. The full-scale desalination facility, is planned to tap to this discharge tunnel for both desalination plant feed water and for discharging high-salinity concentrate downstream of the intake area.

Figure 3
Granular Media Pretreatment System

The demonstration system intake withdraws warm water from a small lagoon which is located at the end of the power plant discharge tunnel. The power plant discharge cooling water is typically 5 to 10 degrees Fahrenheit warmer than the ocean seawater. Intake seawater's total dissolved solids (TDS) concentration varies between 33,000 milligrams per liter (mg/L) and 34,500 mg/L, and averages 33,500 mg/L. The demonstration plant's dry-weather intake water turbidity is usually between 1 and 4 nephelometric turbidity units (NTU). During wet-weather conditions, which are usually brief and occur mostly in the winter, raw seawater turbidity varies from 6 to 12 NTU, with occasional hourly spikes of up to 24 NTU.

Figure 4
Membrane Pretreatment System

The demonstration desalination plant has been in continuous 24-hours/day operation since August 2003.

The intake seawater is conveyed to a feed storage tank from where it is pumped to the demonstration plant pretreatment systems. Currently, the two pretreatment systems undergoing testing are Parkson's two-stage, continuous backwash granular media filtration system (*See Figure 3*) and Hydranautics' HydraSub© immersed microfiltration (MF) system (*See Figure 4*).

The granular-media pretreatment system includes two Parkson Dynasand© continuous backwash filters in series. The first filter has a coarse (0.9-mm) sand media bed. The second filter contains finer (0.5-mm) sand media. Both filters have instrumentation for continuous turbidity monitoring and data logging. The second-stage filter is also equipped with a particle counter.

The microfiltration system (Figure 4) consists of a test vessel which contains several immersed membrane modules and typically operates under less than 1 to 3 psi of vacuum. This system is also equipped with instrumentation for feed water and filtrate turbidity monitoring, and for automated data reporting and acquisition.

The two pretreatment systems are operated independently and typically produce between 40 and 45 gpm of filtered water each. The feed water to the granular media pretreatment system is conditioned using ferric sulfate. At this time, the MF system does not use chemicals for raw seawater conditioning and is tested at filter effluent production rates similar to these of the granular media system.

The reverse osmosis system consists of two 4-element pressure vessels in series (*See Figure 5*). This RO system configuration allows permeate to be collected from one or both ends of each vessel and to test different number of membrane elements. The tested seawater reverse osmosis membrane elements are 8-inch diameter, high salt-rejection units provided by Hydranautics. The RO system is designed to run in a range of 45 to 55 percent recovery and typically operates at 50 percent recovery. The effects of operation at higher and lower than 50 percent recovery on key system parameters such as permeate TDS concentration, feed pressure and other parameters are planned to be tested over the course of the demonstration study.

The demonstration desalination plant has been in continuous 24-hours/day operation since August 2003. The quality of the produced permeate is consistently high-TDS concentration of 200 and 300 mg/L at RO system feed pressure between 780 and 900 psi. The two pretreatment systems are performing well and the filtered seawater of these systems typically has silt density index (SDI) of less than 4 and turbidity below 0.1 NTU.

In both the demonstration scale and the planned full-scale desalination plants, the high-salinity concentrate, which is a side product of the desalination process, is

Figure 5
Reverse Osmosis System

Figure 6
Demonstration Plant Marine Aquarium

blended with the power plant cooling water discharge prior to discharge to the ocean. Chronic and acute whole effluent toxicity testing of a blend of demonstration plant concentrate and power plant cooling water in a ratio corresponding to a full-scale worst-case discharge conditions, indicates that the blended discharge is environmentally safe.

An additional confirmation of this conclusion is an ongoing marine aquarium test where aquatic organisms endogenous for the area of the power plant discharge are exposed to a blend of desalination plant concentrate and power plant cooling water discharge in a ratio reflective of the full-scale facility operations (*See Figure 6*). Seawater leaving the Encina power station's cooling system (33,500 mg/L of TDS) is combined in the aquarium with demonstration plant concentrate (67,000 mg/L of TDS) to maintain salinity concentration within the expected range of the combined power plant/desalination plant discharge (35,700 to 36,200 mg/L of TDS). The marine species in the aquarium such as the barred sand bass, the California halibut, the red sea urchin, the green abalone are representative of a diverse and healthy endogenous marine environment and most of them are of economic or recreational fishing significance.

The aquarium test is designed to assess the effect of prolonged exposure of the aquatic biota on the elevated salinity conditions and is conducted by a marine biologist with expertise and extensive knowledge of the aquatic life in the vicinity of the power plant intake and discharge. The marine species have adopted seamlessly and after over nine months of continuous exposure to the elevated salinity concentration are healthy and tolerate the new discharge conditions very well.

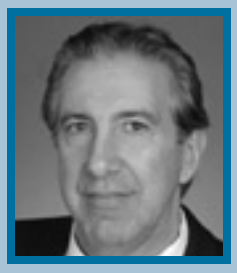
ABOUT THE AUTHOR

Nikolay S. Voutchkov, P.E., DEE is currently Senior Vice President of Technical Services with Poseidon Resources Corporation.

2006 ELECTION RESULTS

THE BALLOTS HAVE BEEN COUNTED. While the results will not be official until the Annual Meeting when the Teller's Report is confirmed by the Board, the following individuals have been elected. Current President-Elect, Alan H. Vicory, Jr., will succeed to the Office of the President; Stephen R. Kellog will be President-Elect; William P. Dee will become Vice President; Trustee-at-Large (*Existing Seat*) will be Robert C. Williams; and the three new Trustee-at-Large seats went to Sandra L. Tripp (*3-Year Seat*), John D. Booth (*2-Year Seat*), and James T. Canaday (*1-Year Seat*).

Alan H. Vicory, Jr.



Stephen R. Kellogg

William P. Dee

Robert C. Williams

Sandra L. Tripp

John D. Booth

James T. Canaday

Growth of Environmental and Infrastructure Markets Is Accelerating

By Alan L. Farkas

Washington, DC, June 27, 2005 — The economic recovery that began during the second half of 2003 led to a return to growth in the civil infrastructure and environmental engineering markets in 2004. After a 1-percent contraction in 2003 these markets bounced back with 5-percent growth last year, generating total revenues of $19.6 billion across four major sectors. (See Exhibit 1).

Civil infrastructure and environmental engineering firms should see an aggregate growth rate of 7 percent in 2005 year and could see double-digit growth in 2006.

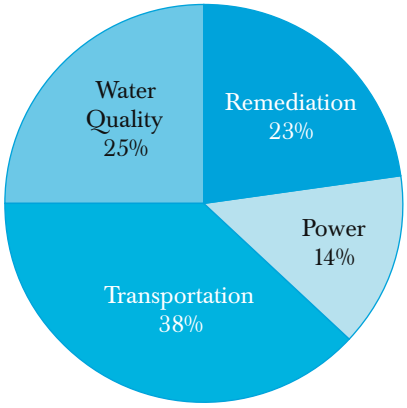
WATER QUALITY SERVICES AND EQUIPMENT

The U.S. water-quality engineering market remains strong, growing at a 13-percent rate to $4.82 billion in 2004 – the seventh consecutive year of double-digit growth (*See Exhibit 2*). The water-supply portion of the market continues to grow at a greater rate than the wastewater side. The water-supply portion of the market grew from 38 percent in 1997 to 51 percent in 2004. The top five firms in this sector are CH2M Hill, Tetra Tech, MWH, AECOM, and Earth Tech, collectively commanding one-third of the market.

The flow of opportunities in water-quality engineering is substantial, with overflow control work generating a number of large projects. Rehabilitation work, including both plant upgrades and underground infrastructure, will continue to contribute to this growing market.

Interestingly, a Delphi survey conducted by Malcolm Pirnie shows that deterioration of infrastructure ranks relatively low on the list of priorities for utility operators supporting the view that rehabilitation will occur very gradually. At the top of the utilities' list of critical issues are leadership, asset management, and an educated work force. As a result, engineering firms are increasingly providing management consulting services to their utility clients. Furthermore, the focus on improving the

EXHIBIT 1
Distribution of $19.6 Billion Market for Infrastructure and Environmental Engineering



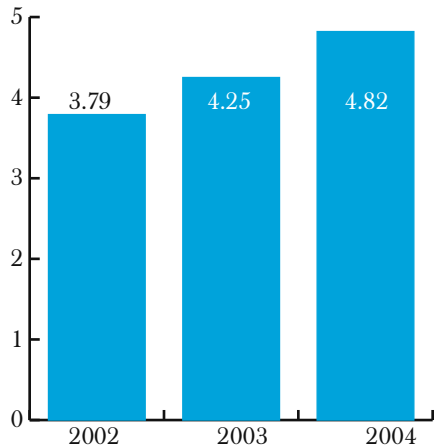
Based on *ENR* Top 500 Design Firm Survey for 2004
Source: Farkas Berkowitz & Company

efficiency of operations of treatment works seems to be changing. We now see a greater emphasis on helping utility executives figure out how to spend their scarce resources.

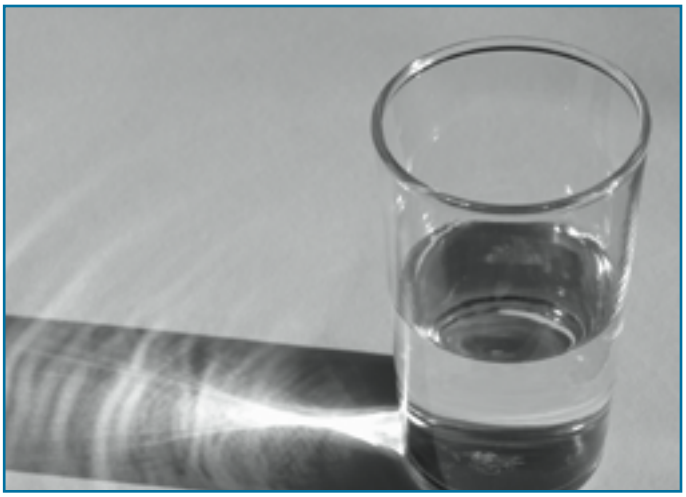
Also outpacing the overall engineering market in terms of opportunities is the water resources development segment. This segment principally involves the development of new sources of water in places where rapidly growing populations are putting extreme pressures on an already scarce resource. Several "mega-projects" exist in the water resources development arena, but only one project really generated good contracting opportunities last year. The Everglades project resulted in the award of $1.4 billion going to eight pre-selected contractors.

In water-quality engineering, the business model is shifting slowly away from time-and-materials contracting towards design-build and lump-sum engineering-only projects. Design-build grew more slowly in 2004 than it has in recent years, perhaps as a result of the slowdown in bidding opportunities in late 2002 and early 2003. The growth rate of design-build last year was less than 10 percent. In addition, about 20 percent of the total design-construct value in the water-quality sector is going to alternative delivery.

EXHIBIT 2
U.S. Water Quality Engineering Market ($ Billions)



Net Revenues, Based on *ENR* Top 500 Design Firm Survey for 2004
Source: Farkas Berkowitz & Company



The U.S. water-quality engineering market remains strong, growing at a 13-percent rate.

California and Florida are contributing most to the growth of the alternative-delivery market, and the Pacific Northwest, Colorado, and Georgia are among the other states and regions where alternative delivery is favored. More than 20 states still do not permit it. The five largest firms undertaking projects under the alternative-delivery model – MWH, CH2M HILL, Black & Veatch, CDM, and Earth Tech – remain committed to it. Alternative delivery will grow at a rate of more than 15 percent annually in 2005 and 2006.

The contract operations market, primarily in the form of public-private partnerships, bounced back with an 8-percent growth rate to $1.16 billion last year after an essentially flat 2003. Veolia Water North America alone accounts for 32 percent of this highly concentrated market, while United Water, OMI, and American Water together command another 39 percent.

As the public and private partners come to grips with the nuances of operating under 20-year contracts rather than three-to-five-year contracts, evidence points to this market maturing and becoming more rational. Meanwhile, the players are focusing more on profitability than overall growth, either renegotiating unprofitable contracts or, when this is not possible, settling with their municipal partners.

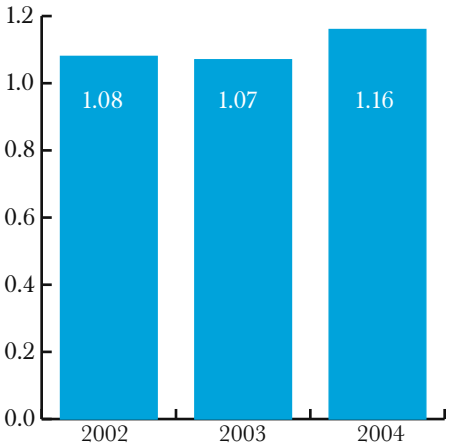
Although growth in contract operations of 8 percent last year was most likely a function of projects that had been in the pipeline for some time rather than increased bidding opportunities, the fundamentals of the public-private partnership model remain strong (*See Exhibit 3*). A recently released survey conducted by the Water Partnership Council provides evidence that the public sector is realizing good value from these relationships and knows it, as reflected in contract renewal rates year over year of better than 90 percent.

The equipment side of the water-quality market is characterized by a "feeding frenzy," as giants like General Electric, Siemens, and ITT Industries aggressively acquire technology firms to build comprehensive product portfolios. The total number of transactions in the equipment sector over approximately the last 15 months totals about $3.5 billion, with the transactions going for multiples of up to 10 to 14 times EBITDA.

With the new players have come new rules, and the first of these rules is that it is a world market. These giant new players have global platforms that can take the technologies and product lines of acquired entities and extend them into that global marketplace far more effectively than has been done in the past.

The second new rule reflects the hard fall of the "total water solutions" company: the myth of market synergy has died. The logic of combining chemicals, equipment, engineering, and contract operations under

EXHIBIT 3
U.S. Government O&M Market ($ Billions)



Based on survey conducted by Public Works Financing
Source: Farkas Berkowitz & Company

one roof suffered from internal contradictions, and the companies that tried to provide total solutions eventually broke the pieces apart again. A new focus on technological synergy has been born, however, as GE, Siemens, and the other giant players attempt to combine in-house technologies with acquired technologies to provide their clients with comprehensive offerings for water and fluids management.

Finally, with the new players, the equipment-services link will grow ever stronger in the years ahead. The model that GE and Siemens have pursued is to take an equipment business and to wrap a service business around it, and this is going to continue. All of these new giants are looking for double-digit growth in their water-related businesses.

Several "mega-projects" exist in the water resources development arena.

INDUSTRIAL AND FEDERAL MARKETS

The U.S. remediation market grew 11 percent to $4.4 billion in 2004 due to significant activity within the industrial sector and at DOE (*See Exhibit 4*). The leaders in this market are URS, Bechtel, CH2M Hill, ERM Holdings, and Tetra Tech, which together account for 37 percent of the worldwide gross revenues derived from remediation.

The industrial portion of the remediation and environmental compliance market grew by an estimated 5 percent in 2004, although there was a significant disparity in the fortunes of the players, as some saw little growth while at least one enjoyed 20-percent growth. The power industry is fueling a market recovery, as proposed coal and LNG facilities prompt permitting activity, and as new rules, such as the most recent round of air emissions standards and the water-intake rule, impose new obligations on existing facilities. In terms of remediation work, the petroleum industry is primarily responsible for the rebound, as high gasoline prices lead to high profitability and stepped up discretionary spending for cleanup projects.

The Sarbanes-Oxley legislation appears to have been less of a stimulus for cleanup work than originally expected, and guaranteed fixed-price remediation now looks more like a market niche than the major trend it appeared to be one year ago. Many Fortune 500 firms are not willing to pay the premium associated with the insurance protection called for under guaranteed fixed-price remediation – insurance protection that those Fortune 500 firms may not fully trust. Furthermore, the shallow pockets of remediation contractors do not give these companies a very high degree of comfort.

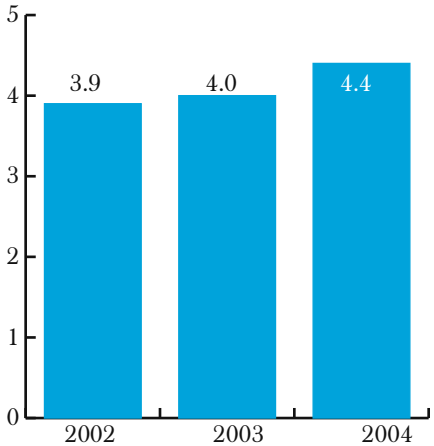
Industrial remediation and environmental compliance should grow at better than 10 percent this year.

By contrast, the DOD cleanup market is quiet. DOD's cleanup budget decreased by 4 percent for the current fiscal year, following an 18-percent decrease in that funding for the previous fiscal year (*See Exhibit 5*). Market players agree that Iraq has slowed or stopped discretionary spending for environmental matters. For example the projected flow of work associated with the cleanup of unexploded ordnance and ranges has yet to materialize, and it does not appear likely to do so over the next couple of years.

Compounding the problems associated with this market sluggishness is the increased favoritism shown to small businesses. The Bush Administration made a very important change in how it counts against the small-business contracting quotas, no longer giving credit for subcontracting. As a result, all of the major players report a loss of market share to small companies, which now command an estimated 25 percent of the total contract value in the DOD remediation market.

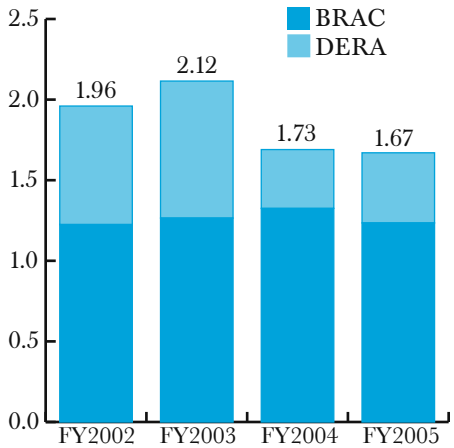
All of the military service branches are relying increasingly on performance-based contracting, with the Army continuing to stress guaranteed fixed-price contracting. The Army has a goal of cleaning up 70-80 percent of all sites through this contracting mechanism, but they will unlikely achieve this goal. For one thing, there is an inadequate amount of insurance capacity available to provide the necessary funding. And there are not a sufficient number of

EXHIBIT 4
U.S. Remediation Consulting Market
($ Billions)



Net Revenues, Based on *ENR* Top 500 Design Firm Survey for 2004
Source: Farkas Berkowitz & Company

EXHIBIT 5
BRAC and DERA Funding
($ Billions)



Source: Farkas Berkowitz & Company

sites that really have the kinds of conditions that make guaranteed fixed-price remediation practical.

New contracting activity is limited within each of the three military branches. In the Army, the Corps of Engineers' dominance of the remediation market is now being questioned in the wake of some dissatisfaction with the way the Corps operates. New agencies, such as the Installation Management Agency, have been created to assume some responsibility over base operations. The Navy has merged the Naval Facilities Engineering Command (NAVFAC) and its Public Works unit, but it continues to rely on traditional contracting vehicles. At the Air Force, the Air Force Center for Environmental Excellence (AFCEE) remains in control of contracting and is expected to let a major engineer-construct contract in the spring of 2006.

The next round of Base Realignment and Closure (BRAC) offers opportunity. Defense Secretary Donald Rumsfeld has recommended the closure of 33 major bases and significant realignment at many more major facilities. Many of these contracts will likely combine cleanup and transfer, making it a very vibrant market over the next six years.

At DOE, the environmental management market is peaking, with an appropriation of $7.8 billion in the current fiscal year and a projected long, gradual decline in funding looking forward. The funding cuts do reflect the fact that progress on cleanups has been substantial, and that less funding is needed.

Of particular note in the DOE market is another potential changing of the guard among the prime operations contractors. Bechtel had been the major winner during the waning days of the Clinton Administration. Today, however, CH2M HILL and a reborn Westinghouse in the form of Washington Group International are posting an impressive number of contract wins.

As is the case at DOD, small businesses are in the ascendance at DOE. One year ago, 86 percent of the pending procurements by number and 35 percent in terms of value were going to be small-business set-asides, and those contracts were indeed let. Approximately half of the indefinite-delivery/indefinite-quantity contracts awarded under DOE's FOCUS initiative went to small businesses, but unfortunately, few task orders have been issued under those contracts. In addition, of the six small-business set-asides last year, four or five have been protested.

The contract operations market bounced back with an 80-percent growth rate.

As for overall contracting opportunity, a relative lull exists now after a torrid pace. A number of the national laboratory operating contracts are in the midst of procurement. The university operators are well entrenched at several of these laboratories, but they have not escaped criticism. Some of them will reach out to the private sector to form teams for managing these facilities.

In Iraq, reconstruction and combat support work provide infrastructure engineering and construction firms with both opportunity and peril. The reconstruction segment is robust, although progress in deploying assets to rebuild the country has been slow. Conflict between DOD and the Department of State, which assumed responsibility for the reconstruction effort in July 2003, has presented just one of the institutional barriers to progress. Congress has scrutinized the contracts issued to date, and instead of seeing a streamlined procurement process, an effort arose to dot all the i's and cross all the t's.

As of this May, only 23 percent of the $18.4 billion originally authorized by Congress for Iraq's reconstruction had been dispersed, while 26 percent of the funding had been diverted to security-related projects. Numerous engineering firms are active in the Iraqi reconstruction segment, including Bechtel, Parsons, Washington Group International, the Shaw Group, Weston Solutions, Earth Tech, Versar, and AMEC. Yet despite the robust market and the launch of some 1,700 projects, the infrastructure in Iraq remains woefully inadequate. As of last November, for example, one in five urban households and three in five rural households lacked access to safe drinking water, according to the Center for Strategic and International Studies.

A ramp-down in the reconstruction market, in terms of the participation of U.S. firms, could come soon. Contracts are already going directly to Iraqi firms. The future of U.S. firms in the reconstruction of Iraq's infrastructure is therefore uncertain.

The combat-support portion of the market is huge and peaking now. This market in 2005 has an estimated value of about $9 billion to $10 billion, and the scope of services is very broad, encompassing the storage and transport of fuel, tanks, and ammunition, and providing guards for U.S. officials, in both Iraq and Afghanistan. As for the major players, Kellogg Brown & Root has posted approximately $7 billion in revenues from its contract, but reports indicate that this contract could be broken up for others to share. The other major players in the combat support market are Dyncorp and IAP Worldwide Services, a combination of IAP Worldwide and Johnson Controls World Services.

Certainly, the civilian deaths associated with doing work in Iraq have sobered all of the market participants. Based on the most recent quarterly Report to Congress of the Special Inspector General for Iraq Reconstruction, there have been claims related to 276 deaths of civilians working on government-funded contracts.

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Farkas Berkowitz & Company is a management consulting firm serving companies that provide design, construction, and operational services for government and industry. Established in 1983, the firm assists clients with strategy, mergers and acquisitions, and operations improvement. Inquires should be addressed to Sarah Chittenden at 202-833-7530 or chittenden@farkasberkowitz.com or visit their website: www.farkasberkowitz.com.

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Tambo, Norihito ..... Japan
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Eugene T. Tonn ..... Jacksonville, FL
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Jose F. Velazquez ..... Denever, CO
Alan H. Vicory ..... Cincinnati, OH
Randall E. Vieser ..... Metuchen, NJ
J. Richard Voorhees ..... Altamonte Springs, FL
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Peter J. Waznys ..... Centerport, NY
Michael R. Weaver ..... Redmond, WA
Steven M. Weaver ..... Anchorage, AK
Calvin E. Weber ..... Shrub Oak, NY
Charles R. Weber ..... Woodbridge, VA
Walter J. Weber ..... Ann Arbor, MI
David A. Weeks ..... Rowlett, TX
George M. Wesner ..... San Clemente, CA
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Nuggehalli C. Vasuki ..... Dover, DE
David A. Weeks ..... Rowlett, TX
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John K. Marr ..... Ann Arbor, MI
James F. Mathis ..... Houston, TX
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Robert C. Moore ..... Naples, FL
C. Eric Mulkey ..... Oak Ridge, TN
Waldemar S. Nelson ..... New Orleans, LA
Nicolaus P. Neumann ..... St. Louis, MO
Parnell O'Brien ..... Lockport, IL
John J. Oransky ..... Lansford, PA
Richard J. Otis ..... Madison, WI
Gerald Palevsky ... Hastings on the Hudson, NY
Frank L. Parker ..... Nashville, TN
Lawrence E. Peirano ..... Lafayette, CA
Serin R. Rao ..... Mapleton, IL
Glenn W. Rehberger ..... Newport News, VA
Debra Reinhart ..... Winter Park, FL
George C. Riek ..... Mulino, OR
Myong Ho Ro ..... City of Industry, CA
Sven Rodenbeck ..... Lawrenceville, GA
August T. Rossano ..... Redmond, WA
Dolph Rotfeld ..... Tarrytown, NY
Theodore M. Schad ..... Arlington, VA
Kenneth Schroeder ..... Houston, TX
William R. Schubert ..... Naperville, IL
Mrs. William P. Simmons ..... Macon, GA
Douglas G. Smith ..... Broomfield, CO
Shinji Soneda ..... Honolulu, HI
Charles A. Sorber ..... Austin, TX
Vernon T. Stack Jr. ..... Coatesville, PA
Leo H. Stander ..... Cary, NC
Robert P. Stearns ..... Long Beach, CA
David G. Stephan ..... Cincinnati, OH
Morton Sterling ..... Farmington Hills, MI
Albert H. Stevenson ..... Towson, MD
John R. Stratford ..... Roseburg, OR
August J. Szabo ..... Lafayette, LA
Michael & Betty Tanner ..... Gulf Shores, AL
Gerald H. Teletzke ..... Scottsdale, AZ
Dennis L. Tucker ..... Phoenix, AZ
John J. Vasconcelos ..... South Pasadena, CA
Nuggehalli C. Vasuki ..... Dover, DE
Jose F. Velazquez ..... Denver, CO
P. Aarne Vesilind ..... Scottsdale, AZ
J. Richard Voorhees ..... Altamonte Springs, FL
C. Herb Ward ..... Houston, TX
Horton Wasserman ..... Wilton, CT
Howard M. Way ..... Alamo, CA
Leo Weaver ..... Greeley, CO
Glenn R. Wentink ..... LaGrange, IL
Robert W. Wheeler ..... Morgantown, WV
Robert L. White ..... San Clemente, CA
Charles A. Willis ..... Charlotte, NC
Terry M. Zaudtke ..... Orlando, FL

Environmental Engineers and Economists —

Strange Bedfellows or Natural Allies?

by Kenneth W. Chilton, Ph.D.

All disappointment is the result of unmet expectations. So, let me set your expectations about my presentation. What I hope to do is to help you understand how economists think — a deep and murky topic, to be sure. Don't be nervous, however, because we won't go beyond Economics 101.

After an introduction to economics, I would like to discuss, "What is pollution?" and "Who pollutes, and why?" Now you are probably saying, "I know a lot about that already." And, I bet you do. But you may not know a great deal about what *economists* have to say about pollution.

Lastly, I will attempt to answer the question raised by the title of the talk, "Are environmental engineers and economists strange bed fellows or natural allies?"

ECONOMICS 101

The basic problem of economics is that *resources are scarce* and, unfortunately, *wants are unlimited*. This leads to the requirement that you and I make choices. Choosing, in turn, leads to the concept of "opportunity cost." Many people think that economists enjoy making up jargon to try to convince others that our craft is based on a peculiar body of knowledge. Setting such cynicism aside, "What is opportunity cost?"

Once a person makes a choice, the cost of that choice is not what she paid for the item or the amount of time lost in pursuing one activity versus another. The true cost is what else she could have done with her money or what else she could have done with her time. The real cost is the "opportunity cost" – the best alternative foregone after the choice has been made.

The Law of Demand

Sticking with the basics, let's next discuss demand curves. The "law of demand" says that demand curves are downward sloping. Labeling quantity on the horizontal axis and price on the vertical axis, a demand curve shows how much of a particular good or service that we want at any given price.

A demand curve for pizza is downward sloping because if I have already had one pizza and you want me to buy another pizza today, you are going to have to sell it to me at a lower price. I am not going to pay the same price for the second pizza as I did for the first pizza within a short period of time. That is generally true of any item or service that you and I purchase over a given period of time. At a lower price, we want more.

This makes sense, but why? Partly because we each face a budget constraint; we don't have unlimited financial resources. If we spend all our money on pizza we are not going to be able to go to a movie. Furthermore, we get sick of pizza. We have to be entreated via a lower price to buy more

This article is an edited transcript of a December 10, 2004, presentation by Dr. Kenneth W. Chilton to graduate students and faculty at the Washington University Environmental Engineering Science Seminar. The purpose of this article (and of the original talk) is to acquaint environmental engineers with the economic principles that apply to their field. It highlights the common objective of engineers and economists to get the "most bang for the buck." The article also explains how the task of environmental engineers to accomplish a prescribed objective is complemented by the economist's emphasis on carefully defining the goal beforehand. "Environmental Engineers and Economists" should serve to remind practicing environmental engineers that economists are their natural allies in protecting the environment in a resource-conserving way.

pizza. In economic speak, we experience diminishing marginal utility. Ask your doctor to measure your utility level at your next physical exam. It is a measure that you can't quantify but it is still conceptually valid.

One of the truisms that I always preach to my microeconomics students is, "We are the demand curve." Sometimes students say that big businesses can charge any price they want for their products. No, not even a monopolist can do that. We are the demand curve; we tell anybody who wants to supply us with a good or service what we are willing to pay for it. If a price is too high, we don't buy it. There are very few items that we cannot live without. Most of the things that we purchase are "wants," not needs. We are demand the curve!

Once we signal how badly we want something through our willingness to pay for it – by our purchases – then businesses get busy. They try to determine how to make that product for the least cost. At different levels of output, what is the combination of inputs and technology that produce the item at least cost. Production managers are always thinking about efficiency.

Engineers, of course, are also efficiency minded. I was an engineer, so I know. We think, "Is this process going to meet the objective and is it going to meet it at the lowest cost?"

That's the way that all business managers think. The reason they think this way is because they want to maximize profits.

The Law of Supply

The "law of supply" is that the supply curve is upward sloping. If you and I will pay a higher price, producers will respond with higher output. Because marginal costs increase as firms increase output in the short run, we will need to pay a higher price for these producers to still realize an acceptable rate of return.

The equilibrium price is where supply and demand curves intersect. At this price and level of output, everybody is happy. In fact, many consumers would have actually been willing to pay more than the equilibrium price. Consumers not willing to pay the market price do not receive the good or service; they are "price rationed." No one tells us we can't buy the product, we do not want it bad enough to pay the market price.

The patron saint of economists is Adam Smith who wrote *The Wealth of Nations* in 1776. Smith described the market exchange process as being directed by an "invisible hand." He wrote:

> "As every individual, therefore, endeavors as much as he can both to employ his capital in the support of domestic industry, and so to direct that industry that its produce may be of the greatest value; every individual necessarily labors to render the annual revenue of the society as great as he can...[H]e intends only his own security; and by directing that industry in such a manner as its produce may be of the greatest value, he intends only his own gain, and he is in this, as in many other cases, led by an invisible hand to promote an end which was no part of his intention."

In other words, because "we are the demand curve," we are part of that "invisible hand" and we tell firms what we want. Producers are trying to make as much profit as they can by producing what we want at the lowest possible cost. When people tell you that businessmen are self-interested, you should say, "Yes, isn't that wonderful!"

Dispersed Knowledge

Another Economics 101 issue is the problem of dispersed information. The bugaboo of centralized decision making in a society is that knowledge is resident in the gray matter of individuals far removed from the bureaucrat in charge.

This problem applies especially to federal agencies like the Environmental Protection Agency. The problem is not that EPA officials are venal. The problem is that even the most well-intentioned person at the EPA cannot determine the best solution to a pollution problem that is peculiar to a particular place and circumstances.

If you are working for the local electric power utility and you are trying to determine the best way to reduce a particular smoke stack emission, you know the solution much better than anybody sitting at the EPA in Washington D.C. You know exactly how that plant works and you know how to optimize the combustion processes to produce a more efficient, less-polluting burn. Unfortunately, our approach to reducing pollution in the United States has largely been a "command and control" method. EPA says, "Thou shalt do this and thou shalt not do that. We will give you a permit if you will follow all of the 'thou shalts' and 'thou shalt nots.'" Economists have spoken out against command and control regulation because we know that the information problem results in higher costs for reaching environmental goals. Economists hate inefficiency – we hate wasting scarce resources.

"IS THIS PROCESS GOING TO MEET THE OBJECTIVE AND IS IT GOING TO MEET IT AT THE LOWEST COST?"

The case of the Amoco Yorktown refinery is a classic example of this type of information problem. The Yorktown refinery took part in a pilot study done in cooperation with U.S. EPA just after the 1990 Clean Air Act Amendments had been signed into law. Dr. Murray Weidenbaum (internationally known economist and professor at Washington University) was on the advisory committee for implementation of the amendments (along with 60 or 70 other people). At the time, I was Dr. Weidenbaum's right hand person at the Center for the Study of American Business and I would sit in for him at committee and subcommittee meetings from time to time. At one such session, an Amoco official reported that they

had gone all around the refinery and had discovered that if they were not told exactly what to do and were allowed to solve the problems themselves, they could reach the air emission targets for one-fourth the cost.

I thought, "Yes! Something good is going to happen here." A representative from the Natural Resources Defense Council had a different reaction. He said, "We must bank the savings for the environment." I asked what he meant by that and he said, "We must require Amoco to reduce its emissions even further." I asked, "How much more?" He said, "Emissions should be reduced to the point where the costs are the same as they would have been before under EPA regulations." I responded that in that instance there would be no "savings" to "bank for the environment," no incentive for Amoco to do anything different than what the original command and control regulations called for. His response was just to give me a knowing smile. This is an example of why is has been so difficult to reduce the costs of environmental protection. Washington-based environmental groups prefer the command and control "cops and robbers" mode over a results and efficiency oriented approach.

WHAT IS POLLUTION, WHO POLLUTES AND WHY?

Pollution is either putting something into the environment that cannot be recycled or it is overwhelming nature's ability to process that agent. Who pollutes? Well, it isn't just businesses that pollute.

There used to be a comic strip called "Pogo" featuring a variety of characters living in a swamp. The feature character was an opossum named Pogo. At the time when Vice President Spiro Agnew coined the phrase "Silent Majority" and was lashing out against "effete intellectual snobs," the Pogo comic strip temporarily introduced a new character with a big nose who looked a lot like the Vice President. This character convinced Pogo and his pals to look for an elusive enemy whose tracks they were following through the swamp. After several days of this search, Pogo finally came to the realization that they were following their own tracks. His classic revelation was, "We has met the enemy and they is us."

Who pollutes? You and I cause pollution because we want products and services that produce wastes that can harm the environment. "*We* is the enemy."

Perhaps a garbage truck is the most recognized symbol of our individual contribution to pollution. The fancy term for our garbage is "municipal solid waste" but I prefer the term "discards." "Waste" sounds as if we are wasting something. We discard left over food and packaging, etc. because they no longer provide a service. Sending a plastic milk jug to a landfill may "waste" fewer resources than attempting to recycle it, by the way, but that is a subject for another time.

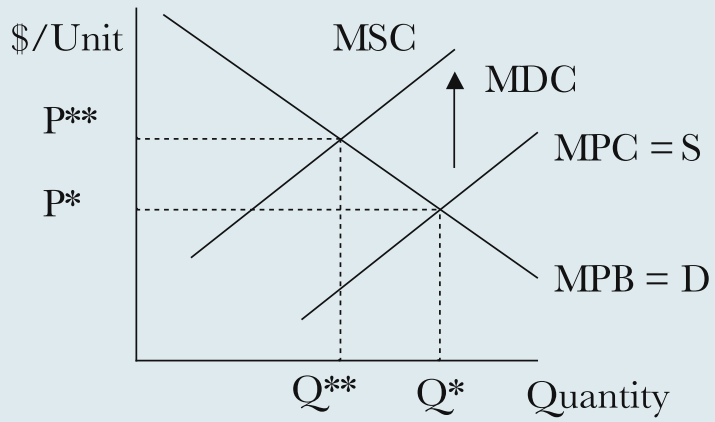
Military and other government agencies have often been some of the worst polluters. Why? Because who was going to tell them that they could not pollute the air, water and land? Some of the worst municipal solid waste dumps were run by cities. Any place there was a hole that they could fill seemed like a great place to dump trash. We now know better. Even during our unenlightened past, private businesses often actually did a better job of protecting the environment because they were more concerned about future liabilities.

Why do we pollute? Generally we pollute because we have something we wish to discard or dispose of, into what appears to be a free dumping ground.

The demand curve (D) for a good also can be thought of as the marginal private benefit (MPB) curve. (*See Figure 1*) It reflects the added benefit that we consumers receive as we increase our purchases. The supply curve (S) reflects the marginal private costs (MPC), those added costs borne by producers as the quantity supplied is increased. Market forces result in a market equilibrium price (P*) and quantity (Q*) that is socially optimal.

MILITARY AND OTHER GOVERNMENT AGENCIES HAVE OFTEN BEEN SOME OF THE WORST POLLUTERS.

FIGURE 1
A Pollution "Externality" Changes the Socially Optimal Level of Output



The market maximizes social welfare as long as *all* costs and benefits are included in the demand and supply curves. However, if firms do not have to consider the environmental and health problems caused by their disposing of wastes in the air, water or on land, the "market fails" to arrive at the socially optimal level of output and price.

Pollution is a classic "externality" – in this case an externality in production. The firms supplying the good or service to us are not paying for the air or water pollution that they cause. Waste disposal appears to be free because polluters are utilizing a common pool resource. In the "bad old days", the cost of eliminating liquid waste was, essentially the cost to lay a pipe down to the river.

We do not necessarily need EPA to handle this problem, however. In fact, it used to be handled through the common law. If somebody down stream was harmed, they would sue. They could even get injunctive relief and shut down the offending facility if the harm was egregious enough.

What should be done about this "externality" problem? Here is a cost – the marginal damage cost (MDC) – that is not paid for by the party creating the cost. Most economists are more interested in getting to the result – reducing the pollution levels – than "punishing" managers who are merely responding to an improper set of incentives. That is the way environmental engineers think, also.

The most efficient way to obtain a desired result is to "get the prices right." If you get the prices right the problem is solved. What we want to do is to have decision makers "internalize" the externalities. We want them to take pollution costs into account.

As Figure 1 shows, if we add the marginal damage cost to the marginal private costs, we get a marginal social cost curve that takes the pollution cost into account. The socially optimal price is then P** (higher than P*) and the efficient level of output is Q** (less than Q*).

General Patton once said, "Never tell a person what to do, tell them what you want done and they will surprise you with their ingenuity." Environmental engineers are well trained to find low cost, reliable ways to mitigate pollution damage. This is what engineers do everyday; they surprise people with their ingenuity.

The difference between engineers and economists can be explained in military terms. If you tell an engineer to "take that hill," he, or she, will figure out the best way to "take that hill." If you tell an economist to "take that hill," the first thing that she will do is try to figure out whether or not we really *want* to "take *that* hill." (You may not want economists in the military because that is the kind of question that they raise.) An economist would say, "I know we want to win the war, but why do we want to take *that* hill?" Or, "Why do we want to assault a hill with infantry. Why not use air attacks?"

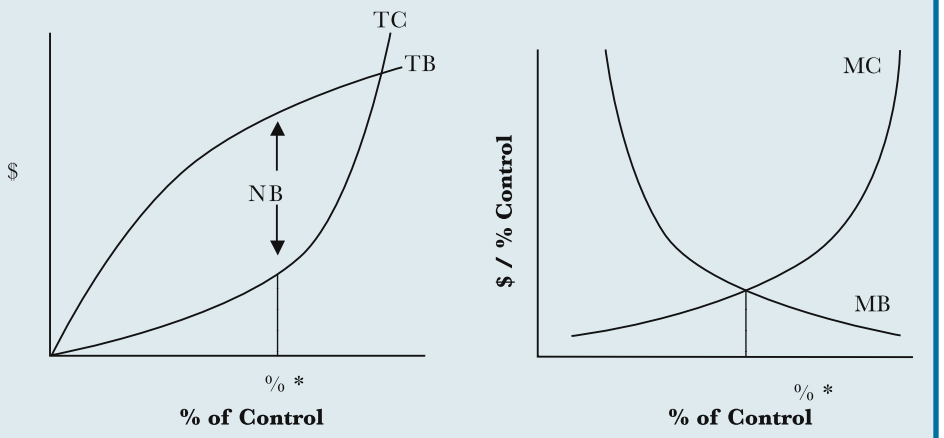
To an economist, the operant question with regard to pollution control is, "How clean is clean enough?" or "How safe is safe enough?" Engineers deal with this same question in many instances. Civil engineers do not try to build bridges and buildings to withstand a 9.0 earthquake if there is very little likelihood of experiencing such a tremendous earthquake. The Corps of Engineers does not build many levies (if any) that can hold back a thousand year flood. Why not? Because it costs much more to build in these extra levels of protection and these scarce financial resources could be better spent elsewhere. Engineers, like economists, understand "opportunity costs."

Returning to the military analogy, economists are asking, "Is taking that hill going to provide more benefits than it costs to take it? If not, why not deploy these soldiers and military equipment somewhere else?"

To an economist it's all about marginal benefits and marginal costs. Indeed, "marginal" (additional) may be an economist's favorite adjective. The goal is to maximize

❖ *Continued on 30* ❖

FIGURE 2
How Clean is Clean Enough? Maximizing Net Benefits



WASTE DISPOSAL APPEARS TO BE FREE BECAUSE POLLUTERS ARE UTILIZING A COMMON POOL RESOURCE.

2004 FINANCIAL STATEMENT

INDEPENDENT AUDITORS' REPORT

We have audited the accompanying statements of financial position of American Academy of Environmental Engineers (a nonprofit organization) as of December 31, 2004 and 2003, and the related statements of activities and cash flows for the years then ended. These financial statements are the responsibility of the Academy's management. Our responsibility is to express an opinion on these financial statements based on our audits.

We conducted our audits in accordance with auditing standards generally accepted in the United States of America. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement. An audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements. An audit also includes assessing the accounting principles used and significant estimates made by management, as well as evaluating the overall financial statement presentation. We believe that our audits provide a reasonable basis for our opinion.

In our opinion, the financial statements referred to above present fairly, in all material respects, the financial position of the American Academy of Environmental Engineers as of December 31, 2004 and 2003, and changes in its net assets and cash flows for the years then ended in conformity with accounting principles generally accepted in the United States of America.

MULLEN, SONDBERG, WIMBISH & STONE, P.A.
Annapolis, Maryland
February 22, 2005

Note: The accompanying notes are an integral part of these financial statements.

STATEMENTS OF FINANCIAL POSITION
December 31, 2004 and 2003

ASSETS

	2004	2003
CURRENT ASSETS		
Cash and cash equivalents	$ 65,935	$ 76,558
Accounts receivable	14,869	37,011
Prepaid expenses	44,172	19,419
Total current assets	124,976	132,988
PROPERTY AND EQUIPMENT		
Net of accumulated depreciation	6,874	8,147
OTHER ASSETS		
Net of accumulated amortization	14,017	12,363
Total assets	$ 145,867	$ 153,498

LIABILITIES AND NET ASSETS

CURRENT LIABILITIES		
Accounts payable and accrued expenses	$ 12,112	$ 2,654
Settlement payable, current portion	18,000	18,000
Note payable, current portion	10,490	9,880
Deferred revenue	210,742	197,925
Total current liabilities	251,344	228,459
LONG-TERM LIABILITIES		
Settlement payable	18,000	36,000
Note payable	16,960	27,449
Total long-term liabilities	34,960	63,449
Total liabilities	286,304	291,908
NET ASSETS		
Unrestricted	(171,674)	(169,647)
Unrestricted – board designated	31,237	31,237
Total net assets	(140,437)	(138,410)
Total liabilities and net assets	$ 145,867	$ 153,498

STATEMENTS OF ACTIVITIES
Years Ended December 31, 2004 and 2003

	2004	2003
REVENUES, GAINS AND OTHER SUPPORT		
Certification fees	$ 326,121	$ 315,884
Publications	70,965	67,982
Meetings	39,763	32,893
Contributions	30,620	31,018
Kappe lecture	12,750	7,818
Environmental engineer	7,482	10,428
Other income	2,246	6,103
Donated equipment	545	1,600
Investment income	35	82
Rental income	---	4,928
Total revenues, gains and other support	490,527	478,736
EXPENSES		
Program service expenses:		
Memberships	35,521	32,026
Environmental engineer	32,206	31,879
Publications	19,964	27,331
Public education	15,268	17,991
Meetings and seminars	13,237	11,177
Certificate/membership	13,151	18,656
Kappe lecture	9,797	8,033
Committee expense	3,507	2,235
Total program service exenses	142,651	149,328
Management and general expenses:		
Staff salaries, fringe benefits and contract employment	225,985	188,239
Office expense	90,341	94,943
Legal, accounting and miscellaneous fees	11,387	15,473
Officer and trustees expenses	8,958	20,538
Depreciation and amortization	7,754	6,352
Insurance	3,231	1,301
Interest	1,971	2,560
Awards	276	626
Total management and general expenses	349,903	330,032
Total expenses	492,554	479,360
Change in net assets	(2,027)	(624)
NET ASSETS AT BEGINNING OF YEAR	(138,410)	(137,786)
NET ASSETS AT END OF YEAR	$(140,437)	$(138,410)

NOTES TO FINANCIAL STATEMENTS
December 31, 2004 and 2003

Note 1 — Summary of Significant Accounting Policies

Nature and Organization
American Academy of Environmental Engineers (AAEE) was founded in 1955 to improve the practice of environmental engineering by certifying properly-qualified environmental engineering specialists, accrediting university environmental engineering curricula and by informing the public and environmental engineers through lectures, publications and other venues regarding proper environmental practices.

Income Taxes
The Academy is exempt under Section 501(c)(6) of the Internal Revenue Code from paying federal income tax on any income except unrelated business income. No provision has been made for income taxes as the Academy has no net unrelated business income.

Basis of Accounting
The accompanying financial statements have been prepared on the accrual basis of accounting in accordance with accounting principles generally accepted in the United States of America.

Revenue Recognition
Certification fees and certain other revenues are recorded as deferred revenue upon receipt and are recognized in the period to which the fees relate.

Contributions received are recorded as unrestricted, temporarily restricted, or permanently restricted support, depending on the existence and/or nature of any donor-imposed restriction. Support that is restricted by the donor is reported as an increase in unrestricted net assets if the restriction expires in the reporting period in which the support is recognized. All other donor-restricted support is reported as an increase in temporar-

2004 FINANCIAL STATEMENT

ily or permanently restricted net assets, depending on the nature of the restriction. When a restriction expires (that is, when a stipulated time restriction ends or a purpose restriction is accomplished), temporarily restricted net assets are reclassified as unrestricted net assets and reported in the statement of activities as net assets released from restrictions. Unexpended grant awards are classified as refundable advances until expended for the purpose of the grants since they are considered conditional promises to give.

Non-Cash Donations

Donated marketable securities and other non-cash donations are recorded as contributions at their estimated market value at the date of contribution.

Use of Estimates

The preparation of financial statements in conformity with accounting principles generally accepted in the United States of America requires management to make estimates and assumptions that affect the reported amounts of assets and liabilities and disclosure of contingencies at the balance sheet date and the reported amounts of revenues and expenses during the reporting period. Actual results could differ from those estimates.

Accounts Receivable

Accounts receivable consists of amounts due for certification fees, royalties and rent at the end of the year. The Academy considers all accounts receivable to be fully collectible. Accordingly, no allowance for doubtful accounts has been established.

Property and Equipment

Property and equipment acquisitions in excess of $500 are capitilized and recorded at cost less accumulated depreciation and amortization. When assets are retired or otherwise disposed of, the cost and related depreciation are removed from the accounts, and any resulting gain or loss is reflected in income for the period. The cost of maintenance and

STATEMENTS OF CASH FLOWS
Years Ended December 31, 2004 and 2003

	2004	2003
CASH FLOWS FROM OPERATING ACTIVITIES:		
Change in net assets	$ (2,027)	$ (624)
Adjustments to reconcile change in net assets to net cash provided by operating activities		
Depreciation and amortization	7,754	6,352
Noncash donations	(545)	---
(Increase) decrease in operating assets:		
Accounts receivable	22,142	5,460
Prepaid expenses	(24,753)	(4,724)
Increase (decrease) in operating liabilities:		
Accounts payable and accrued expenses	9,458	(6,946)
Settlement payable	(18,000)	(18,000)
Deferred revenue	12,817	30,400
Security deposit	--	(2,360)
Net cash provided by operating activities	6,846	9,558
CASH FLOWS FROM INVESTING ACTIVITIES:		
Acquisition of property, equipment and trademarks	(7,589)	(6,970)
CASH FLOWS FROM FINANCING ACTIVITIES:		
Principal payments on notes	(9,880)	(9,307)
Net change in cash	(10,623)	(6,719)
Cash and cash equivalents at beginning of year	76,558	83,277
Cash and cash equivalents at end of the year	$ 65,935	$ 76,558
SUPPLEMENTAL CASH FLOW INFORMATION:		
Cash paid during the year for interest	$ 1,971	2,560
Noncash investing activities:		
Aquisition of property, equipment and trademarks	$ 8,134	$ 6,970
Noncash donations	(545)	---
Cash paid to acquire property and equipment	$ 7,589	$ 6,970

repairs is charged to current income as incurred; where as significant renewals and betterments are capitalized. Depreciation and amortization of property and equipment are provided on a straight-line basis. Leasehold improvements are amortized over their estimated useful lives or the life of the lease, whichever is shorter. Furniture and equipment are depreciated over three to ten years.

Program Service Expense

Program service expense represents the direct cost of performing programs. Direct costs do not include salaries and related expenses. No management and general costs have been allocated to such programs.

Cash and Cash Equivalents

For purposes of the statement of cash flows, cash and cash equivalents represent deposits in checking and savings accounts.

Note 2 — Concentration of Cash Balances

At various times during the year, the Academy maintained cash-in-bank balances in excess of the federally insured limit of $100,000.

Note 3 — Property and Equipment

Property and equipment at December 31, 2004 and 2003 are summarized below:

	2004	2003
Furniture and equipment	$ 206,182	$ 201,178
Leasehold improvements	6,951	6,951
	213,133	208,129
Less accumulated depreciation	(206,259)	(199,982)
Net property and equipment	$ 6,874	$ 8,147

Depreciation expense for the years ended December 31, 2004 and 2003 was $6,277 and $5,280, respectively.

Note 4 — Other Assets

Trademark and organization costs incurred by the Academy are amortized over fifteen years. Amortization expense for the years ended December 31, 2004 and 2003 were $1,477 and $1,072, respectively.

Note 5 — Lease Commitment

The Academy leases office space under a noncancellable operating lease which expires on June 31, 2008.

Future minimum lease payments required under the lease are as follows:

2005	44,741
2006	45,636
2007	46,548
2008	27,467
	$164,392

Rent expense for the years ended December 31, 2004 and 2003 amounted to $47,201 and $55,521, respectively.

Note 6 — Settlement Payable

In October 2001, the Academy entered into a settlement agreement with a former employee in a wrongful termination lawsuit. The Academy has agreed to pay a total sum of $108,000 in consideration for the release of all claims known or unknown by the plaintiff against the Academy. The Academy shall pay the settled amount in a total of six annual installments of $18,000 to the defendant's counsel. The first installment payment was made in October 2001. The remaining 5 installments are due by February 15 of each year.

The future scheduled maturities of long-term debt are as follows:

2005	18,000
2006	18,000
	36,000
Less current maturities	(18,000)
Long-term obligations	$ 18,000

Note 7 — Note Payable

In June 2002, the Academy obtained a note that is payable to a law firm in the amount of $51,084. The note was obtained to pay legal fees incurred in 2001 defending a lawsuit (See Note 6). Monthly installments of $988 at 6% are to be repaid over 60 months.

The future scheduled maturities of long-term debt are as follows:

2005	10,490
2006	11,137
2007	5,823
	27,450
Less current maturities	(10,490)
Long term obligations	$16,960

Note 8 — Unrestricted Net Assets — Board Designated

It is the policy of the Board of Trustees of the Academy to review its plans for future projects from time to time and to designate appropriate sums to assure adequate financing of such projects.

Snow Fund – represents a $10,000 unrestricted contribution for which the Board of Trustees designated for some future use. The Board directed that the $10,000 principal remain intact and that the interest can only be used for purposes designated by the Board. Total designated funds as of December 31, 2004 and 2003 amounted to $14,528. Total accumulated interest as of December 31, 2004 and 2003 amounted to $4,528. The Academy cashed in the Certificate of Deposit for operating purposes during the year ended December 31, 2000 and intends to reestablish the certificate of deposit when funds are available.

Kappe Fund – represents a $10,000 bequest received from the Estate of Stanley E. Kappe during 1985. This unrestricted bequest is used for the purpose of recognizing the contributions of Stanley E. Kappe to the environmental engineering profession. The Board has designated the fund as a Quasi-Endowment. Hence, the principal portion of this fund is to remain intact and the interest can be spent on funding the Kappe Lecture Series. The Board has also designated additional funds and any annual contributions to the Kappe Lecture to be used to fund the Kappe Lecture Series. Total designated funds as of December 31, 2004 and 2003 amounted

❖ *Continued on 34* ❖

Environmental Engineers and Economists, *continued from page 25*

"net" benefits (NB) – total benefits (TB) minus total costs (TC). (*See Figure 2*) Many non-economists say that we want benefits to match costs. That is incorrect; we want *marginal* benefits to match *marginal* costs. If total benefits match total costs, net benefits are zero.

A level of pollution where the marginal benefit (MB) of added pollution reduction equals the marginal abatement cost (MC) maximizes the difference between total benefits and total costs. Refusing to control a particular pollutant beyond this level means we can "bank the savings for the environment" or "bank the savings" for a myriad of other desirable activities – better health care, better education, better products, etc.

To those who respond, "Well, of course," consider the fact that the Clean Air Act is written so that this question ("How safe is safe enough?") cannot even be raised. When the EPA establishes National Ambient Air Quality Standards (NAAQS), they are to consider only one thing: "Is there an adverse health effect?" If there is, then ambient air quality standards should be set at a level that provides "an adequate margin of safety" against that health effect. Trying to implement this goal does not work very well with a non-threshold pollutant such as tropospheric ozone (smog) because health effects can be observed at background levels. Even if there was no anthropogenic component to tropospheric ozone, natural levels of ozone could produce health effects if a person is sensitive to ozone and is heavily exercising.

The Clean Air Act Scientific Advisory Committee told EPA in 1995, "the paradigm of selecting a standard at the lowest observable-effects level and then providing an 'adequate margin of safety' is no longer possible." For a non-threshold pollutant, like ozone, claiming that meeting an arbitrary NAAQS will fulfill the objective of the CAA is a "polite fiction."

BOTH PROFESSIONS ARE EFFICIENCY ORIENTED AND CONCERNED WITH SOLVING PROBLEMS.

CONCLUSION

When we consider how environmental engineers and economists look at environmental problems, I believe we find good support for the proposition that they are "natural allies." Both professions are efficiency oriented and concerned with solving problems. Environmental engineers have the technical competence to actually solve problems but they can benefit from pesky economists who raise more fundamental issues.

Being naturally more rebellious, economists try to determine alternatives to command and control approaches, they are especially fond of solutions that mimic the marketplace and allow those with the most knowledge to devise their own solutions. The idea is to reach an acceptable level of performance, so that other problems, or a myriad of other important activities, can be addressed.

I would like to conclude with a short true story. When I was an undergraduate engineer at Northwestern University, I registered for a microeconomics class. I was a bit worried when I found myself walking past the engineering building to the far end of campus where the "soft sciences" were taught. I was further concerned when I did not see any of my engineer buddies in class.

Soon, the professor came into the classroom and said, "Alright everybody, what I would really like to do in this class is have a one question final. While asking the question, I would hook a lie detector up to you to make sure that you were answering truthfully. Here is the question: 'The parking problem in Evanston is caused by too low a price for parking.' If you answer, 'True' and the lie detector's needle does not jump, you get an 'A.' Otherwise, you fail." I thought, "Oh, I am in the wrong class, I can't wait for this to be over so I can find out where I really belong."

Clearly, I would have no trouble "acing" that class today. Perhaps that final exam might still cause many budding environmental engineers to have misgivings. Just remember economists and environmental engineers are natural allies so you need not fear the economics professor.

ABOUT THE AUTHOR

Kenneth W. Chilton, Ph.D., is Director of the Institute for Study of Economics and the Environment and Associate Professor of Management at Lindenwood University in St. Charles, Missouri. He has been researching and writing about environmental policy issues for two and a half decades. Dr. Chilton has a B.S. and M.S. in Management Science and Industrial Engineering from Northwestern University (1967, 1968) and a MSBA and Ph.D. in Business from Washington University (1992, 1994).

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I would like to thank my graduate assistant, Ms. Heather Shephert, for her invaluable transcription and editing of my talk. Having completed the requirements for her MBA, Ms. Shephert has moved on to bigger and better things. She will sorely be missed.

AAEE DRAWING WINNERS

CHRISTIAN T. HOFFMAN, P.E., DEE, won free membership for 2006

MORTON STERLING, P.E., DEE, won an Academy Golf Shirt

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to $16,709. Total accumulated interest as of December 31, 2004 and 2003 amounted to $3,694. The Academy cashed in the certificate of deposit for operating purposes during the year ended December 31, 2001 and intends to reestablish the certificate of deposit when funds are available.

Note 9 — Employee Benefit Plan

The Academy established a 401(k) Retirement Plan in 1997 for all employees meeting certain eligibility requirements. Employees may contribute up to 15% of their eligible compensation to the plan, subject to the limits of Section 401(k) of the Internal Revenue Code. The Academy does not match the employee contributions.

Note 10 — Related Party Transaction

On January 1, 2001, the Academy entered into a sales agreement with a company owned by the previous Executive Director to sell all of the Academy's inventory and printing equipment. In consideration of the sale, the Company has agreed to pay the Academy a 10% royalty of all monies received after the effective date from the sale of the books included in inventory and future reprints. For the years ended December 31, 2004 and 2003, the Academy received $-0- and $2,623, respectively, in royalties from the Company. At December 31, 2004 and 2003, the total amount recorded as a receivable from the Company was approximately $-0- and $17,000, respectively.

The Academy sub-leased space to a company owned by the previous Executive Director. Rental income for the sub-lease for the years ended December 31, 2004 and 2003 was $-0- and $4,928, respectively. At December 31, 2004 this agreement has been dissolved and currently no related party transactions exist.

Note 11 — Going Concern

These statements are presented on the basis that the Academy is a going concern. Going concern contemplates the realization of assets and the satisfaction of liabilities in the normal course of business over a reasonable length of time. The accompanying financial statements show a current year decrease in unrestricted net assets of $624 and an accumulated deficit in unrestricted net assets of $138,410.

The Academy has developed a plan to reduce expenses and increase revenues. The Academy continues to implement the plan. Management has projected cash flows for one year.

The Academy's continued existence depends on the success of cost reductions and development new sources of revenue.

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have made significant contributions to the environmental engineering profession and are, therefore, deserving of earning a Specialty Certification from the AAEE and should not be denied that opportunity.

The Officers and Board of Trustees of the Academy realize that some of these changes may seem radical. However, these changes were made only after careful study and deliberation. They are the result of initiatives begun in 2003 with the development of a strategic plan and the resulting work of several AAEE Committees and Working Groups charged with looking at the future survival of the organization.

AAEE 50TH ANNIVERSARY CELEBRATION

Come join the festivities celebrating the first 50 years of AAEE. The Anniversary Banquet will take place on Wednesday, November 2nd at the Renaissance Washington Hotel in Washington, DC beginning at 6:00 pm. (This coincides with the last day of WEFTEC '05.)

The Banquet will include dinner, awards presentations, a retrospective of the Academy and much more. The cost is $75 per person.

For questions or to reserve your seats, please visit the 50th Anniversary link on our website or call the Academy at 410-266-3311.

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